# Platte River Basin Plan 2016 Update
# Volume 1
# Executive Summary




*Prepared for:*

## Wyoming Water Development Commission

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**PLATTE RIVER BASIN PLAN 2016 UPDATE**
**VOLUME 1**
**EXECUTIVE SUMMARY**

December 2016

**Explanation of Cover Photos**

Lake Marie in the Snowy Range Mountains. Lake Marie lies south in the shadow of the quartzite massif of 12,847-foot Medicine Bow Peak at an elevation of 11,000-feet. Winter and Spring precipitation in the Snowing Range constitutes an important portion of the water supply in the Platte River Basin.

The bald eagle (*Haliaeetus leucocephalus*, from Greek hali "sea", aiētos "eagle", leuco "white", cephalos "head"). It is a common, frequently observed breeding and winter resident in the North Platte Basin of Wyoming. The bird is strongly associated with large rivers, lakes and reservoirs with an abundant food supply and riparian environments with large trees used for roosting and nesting. The bald eagle is an opportunistic predator which subsists primarily on fish. During the winter, they also feed on dead or injured waterfowl and road or winter killed deer and antelope. The bald eagle is both the national bird and national animal of the United States of America. It is the most familiar success story of the Federal Endangered Species Act. During the latter half of the 20th century it was on the brink of extirpation in the contiguous United States and was one of the first species to receive protections under the precursor to the Endangered Species Act in 1967. Populations have since recovered and the species was removed from the U.S. government's list of endangered species on July 12, 1995 and transferred to the list of threatened species. It was removed from the List of Endangered and Threatened Wildlife in the Lower 48 States on June 28, 2007 but remains protected under the provisions of the Bald and Golden Eagle Protection Act.

Historical photo of flood irrigation. Flood irrigation is an ancient method of irrigating crops and was the first form of irrigation used by humans as they began cultivating crops. In the Platte River Basin, it is still commonly used to irrigate grass hay. In areas of the Platte River Basin where higher value crops are raised such as corn, sugar beets and alfalfa hay, conversion to sprinkler irrigation has the dual benefits of improved crop yields while conserving water.

The Dave Johnston Power Plant is named for W.D. “Dave” Johnston a former PacifiCorp Vice-President. The plant generates power by burning coal that produces steam under high pressure. The steam drives turbines and the turbine blades to engage generator that produce electricity. The plant was commissioned in 1958. There have been four phases of plant expansion to-date and numerous upgrades to comply with changing environmental requirements. The present power generation capacity is 817 megawatts.

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Wyoming Water Development Commission
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**The Platte River Basin Plan 2016 Update is a planning tool developed for the Wyoming Water Development Office. It presents estimated current and estimated future uses of water in Wyoming's Platte River Basin. The Plan is not intended to be used to determine compliance with the administration of state law, federal law, court decrees, interstate compacts, or interstate agreements.**

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# Appendices



**NOTE**: The Platte River Basin Plan Update consists of four main volumes, this Executive Summary, and a brief overview document.

# 1.0 Executive Summary

## 1.1 PREFACE

***"Water is Wyoming's most important natural resource. It is critically important not only to Wyoming but to our country. Wyoming is a headwaters state. The water that begins in our mountains travels down our nation's great rivers. Water that starts here makes its way to the Pacific Northwest, the Gulf of California, and the Gulf of Mexico. From statehood, we have recognized the need to protect and develop our water."***

- Matthew H. Mead, Governor

This document is a planning tool developed for the Wyoming Water Development Office. It presents estimated current and future water uses of Wyoming's Platte River Basin (Platte Basin). This Plan has not been prepared to determine compliance with or administration of state law, federal law, court decrees, interstate compacts, or interstate agreements. In 2006, the Wyoming Water Development Commission (WWDC) published the ***Platte River Basin Plan, Final Report.*** This 2016 document updates, revises and expands upon the information presented in the 2006 Platte Basin Plan.

The Wyoming River Basin Plans (Basin Plans) are prepared by the WWDC with funding provided by the Wyoming Legislature. As broadly described on the WWDC website, the mission of the Basin Plans is to *"develop essential information concerning the current status and future availability of water resources in Wyoming"*. The purpose of the river basin planning efforts is to quantify existing water uses and project future needs in each of the seven major river basins in the State (Bear, Green, Platte, Northeast, Powder/Tongue, Snake/Salt, and Wind/Bighorn). The intent of the river basin planning process is to generate and regularly update the documents to assess current water use in the municipal, agricultural, industrial, and environmental/recreation sectors, document changes in economic conditions affecting water use and to identify and prioritize water development opportunities. The Basin Plans assist Wyoming municipalities, irrigation districts, and other public entities' efforts to plan for the future. Basin Plans often serve as the basis for preparing more focused watershed studies and specific rehabilitation, new development, and dam projects.

As noted in the Table of Contents of this Executive Summary, this update consists of four additional volumes:

Volume 2 – Surface Water Resources Analysis
Volume 3 – Basin Surface Water Use Profile
Volume 4 – Water Demand Projections
Volume 5 – Future Water Use Issues and Water Supply Strategies

The contents of each volume are presented in **Appendix A** of this Executive Summary. In addition, an overview document was prepared for public distribution.

## 1.2 LOCATION

***"I've lived out west some... I've always liked the high plains area - eastern Colorado, eastern Wyoming, western Nebraska."***

- Charles Frazier

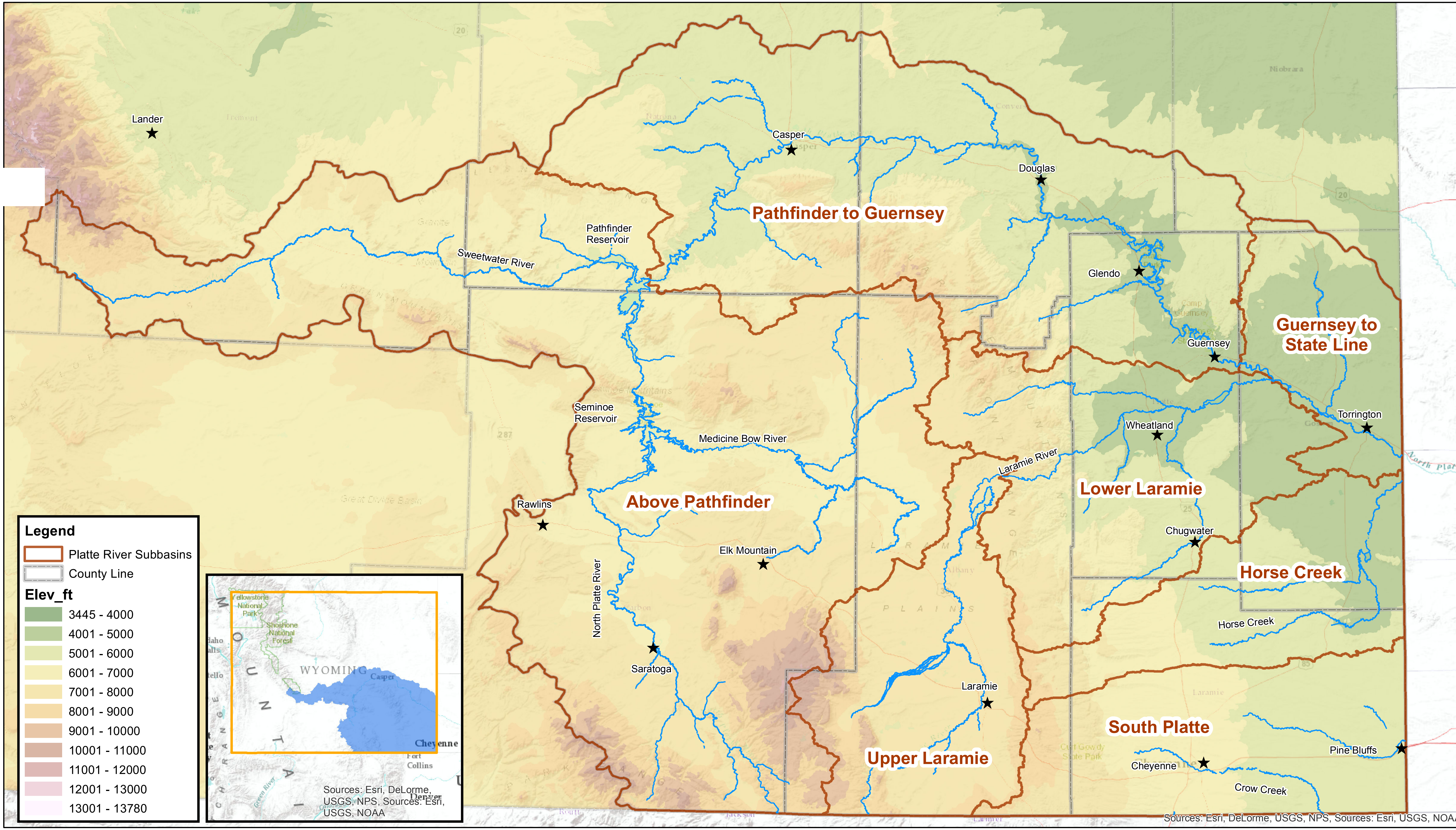
The Platte Basin is located in southeast Wyoming with headwaters in Wyoming and Colorado (**Figure 1.1**). The Platte Basin is comprised or two major subbasins: 1) the North Platte subbasin and 2) the South Platte subbasin. The North Platte River flows north into Wyoming from Colorado and sweeps east and south in a horseshoe bend nearly 350 miles long, draining the entire southeast quarter of the state. The Sweetwater River, one of the North Platte's major tributaries, flows into Pathfinder Reservoir from the west. The South Wind River Mountains are the primary source of water supply for the Sweetwater River. The Wyoming portion of the North Platte subbasin covers 21,907 square miles and, in the far southeast corner of the state, Wyoming's portion of the South Platte subbasin encompasses approximately 2,000 square miles. Within the South Platte subbasin, Crow Creek waters originating in Wyoming flow into northeastern Colorado and Lodgepole Creek flows into the southern portion of the Nebraska panhandle. The North Platte exits Wyoming near Torrington and becomes the Platte River at the confluence with the South Platte near North Platte, Nebraska. The Platte traverses Nebraska before joining the Missouri south of Omaha (**Figure 1.2**). As a headwater stream in the Missouri/Mississippi River system, water originating in Wyoming and Colorado flows through or forms the border of 10 other downstream states.

As shown in **Figure 1.1**, the Platte Basin is divided into the following subbasins:

- Above Pathfinder Dam (comprising the upper North Platte River, Medicine Bow River, and the Sweetwater River drainages)
- Pathfinder Dam to Guernsey Dam
- Guernsey Dam to the State Line
- Upper Laramie (The Laramie River drainage above the Wheatland Tunnel Diversion)
- Lower Laramie (The Laramie River drainage below the Wheatland Tunnel Diversion downstream with the confluence of the Laramie River with the North Platte River)
- Horse Creek
- South Platte

Estimated subbasin water yield from precipitation and water usage by the agriculture, industry and municipal sectors is shown in the table below. **Figure 1.3** graphically presents the annual variance and volume of water usage by the agriculture, industry, and municipal sectors within the Platte Basin. Generally, except for the Lower Laramie subbasin, water supply and water usage are not evenly balanced. The North Platte above Pathfinder and Upper Laramie watersheds provide most of the water used in the other basins. The Crow Creek watershed in the South Platte Basin receives significant water supplies from the upper North Platte watershed and the Colorado River drainage on the west slope of the Sierra Madre Mountains.

| Platte River Subbasin | Estimated Subbasin Yield (ac-ft) | Agriculture Use (ac-ft) | Municipal Use (ac-ft) | Industrial Use (ac-ft) | Total Use (ac-ft) |
|---|---|---|---|---|---|
| Above Pathfinder Dam | 1,577,006 | 122,000 | 3,100 | 18,900 | 144,000 |
| Upper Laramie | 536,092 | 81,600 | 3,600 | 2,800 | 88,000 |
| Pathfinder to Guernsey | 517,948 | 77,800 | 10,700 | 85,200 | 173,700 |
| Lower Laramie | 190,000 | 88,800 | 1,200 | 20,100 | 110,100 |
| Guernsey to State Line | 20,000 | 107,700 | 1,800 | 4,200 | 113,700 |
| Horse Creek | 50,000 | 46,600 | 300 | 7,900 | 54,800 |
| South Platte[1] | 52,314 | 37,200 | 9,500 | 18,200 | 64,900 |
| **Total** | **2,943,360** | **561,700** | **30,200** | **157,300** | **749,200** |
| **Note:** 1. Estimated subbasin yield included 8,314 ac-ft of water imported via L.S. Exchange. | | | | | |

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Miles

**Wyoming Water Development Commission**

**Figure 1.1: Map of the Platte River Basin**

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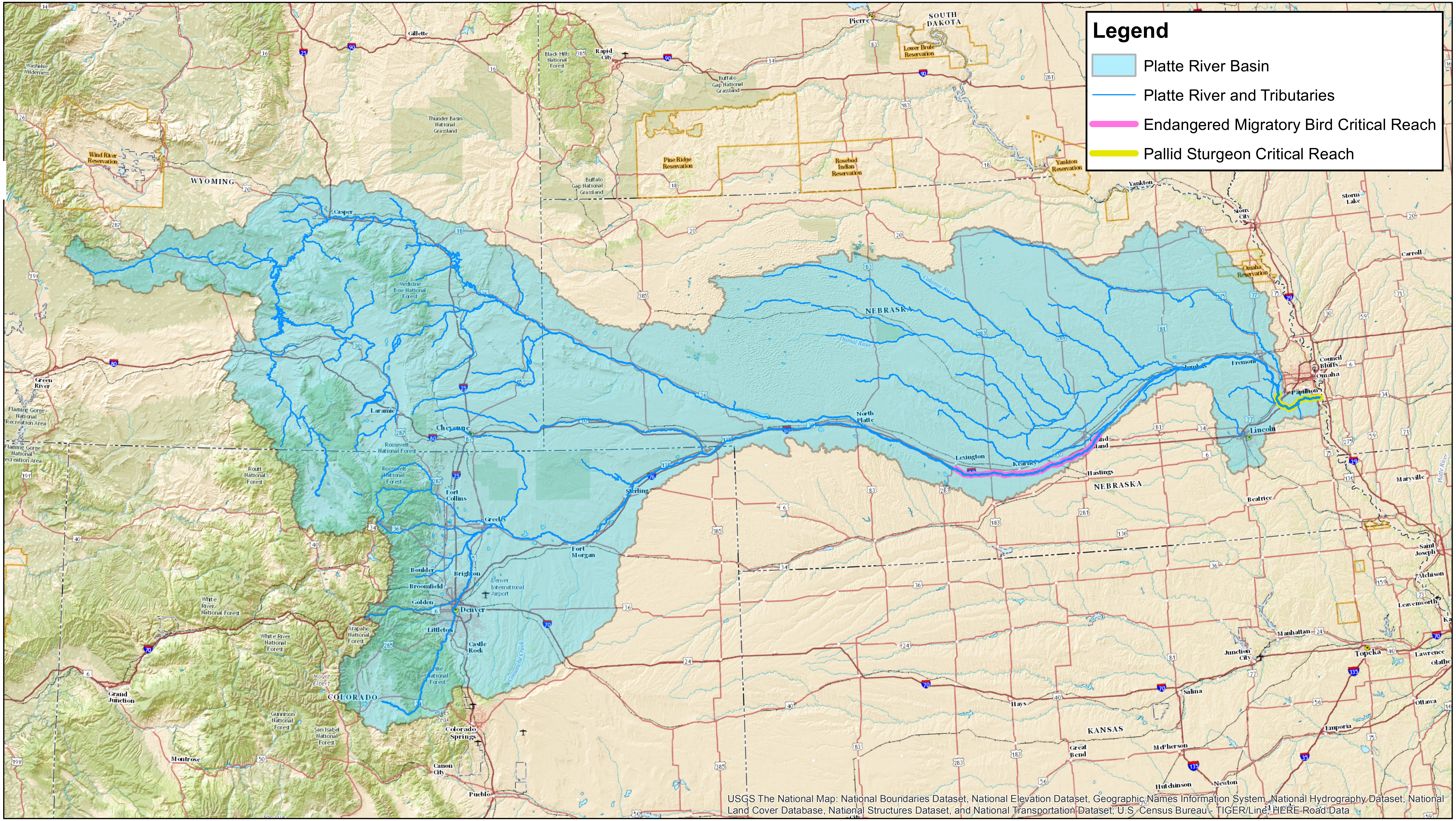


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**Wyoming Water Development Commission**

**Figure 1.2: Platte Watershed in Wyoming, Colorado and Nebraska Showing Critical Endangered Species Habitat Reaches in Nebraska**

Wyoming Water Development Office

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## Figure 1.3
## Overall Water Use Profile within the Platte River Basin

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### Legend

- Watershed
- Subbasins
- Waterbody
- Stream / River
- Major Rivers
- County

Graphs show estimated montly consumptive use in an average year in acre feet.

Pie Charts show total annual consumptive use in acre feet in an average year.

- Agriculutral
- Industrial
- Municipal/Domestic

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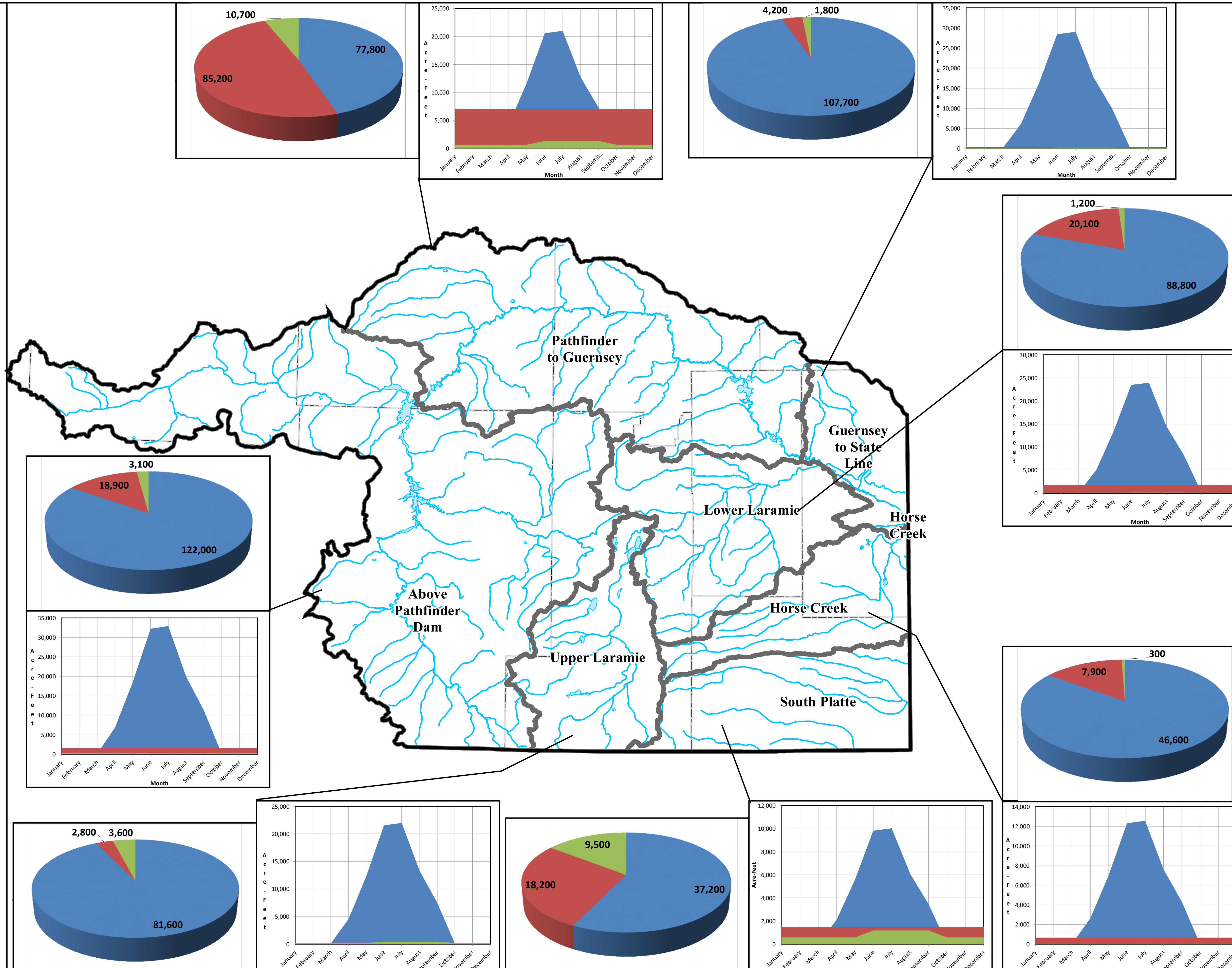


L:\2822\0101\GIS\Feb16Revisions\mxd\Irrigated Areas All Subbasin_Graph2.mxd 10/11/2016

On its' way to the Gulf of Mexico, the waters of the Platte Basin contribute to the economic and ecological life blood of much of the mid-continental United States. In Wyoming, the Platte Basin is the most densely populated major watershed in the state. In fact, Wyoming's three largest population centers (Cheyenne, Casper, and Laramie) are all located in the Platte Basin. The Platte Basin in Wyoming supports a diverse economy based upon agriculture, industry, higher education, recreation, and government services.

The importance of this waterway as a historic thoroughfare by native people and white settlers is well documented. Traversing Nebraska, the waters of the Platte Basin sustain a vibrant agricultural economy. Water usage in the Platte Basin has been contested for over a century. The dependence on this vital resource shared by Wyoming, Colorado and Nebraska has generated disagreements, legally binding agreements, lawsuits, court settlements and court decrees regulating where and how the water can be used. **Figure 1.4** shows the historical progression of legal water apportionment in the Basin. Water usage in the basin apportioned to Wyoming, Colorado and Nebraska is presented in **Figure 1.5**.

The water supplies in the Platte Basin are some of the most regulated in Wyoming. A court decree apportioning the water between Wyoming and Nebraska and contentious legal battles have shaped the use and regulation of Platte Basin water resources in Wyoming.

Wyoming, Colorado, Nebraska, and the U.S. Department of Interior entered into an agreement effective January 1, 2007 to improve and maintain migration habitat for the endangered whooping crane, reproductive habitat for the endangered least tern and reproductive habitat for the threatened piping plover. Additionally, the agreement also reduces the likelihood that other species found in the critical habitat area will be listed under the Endangered Species Act and is testing the assumption that managing water flow in the central Platte River also improves the endangered pallid sturgeon's lower Platte River habitat. The agreement set in motion a recovery plan for these species that has implications for management of water resources within the Platte Basin in Wyoming. The cooperative agreement institutionalized the Platte River Recovery Implementation Program (PRRIP) with the three states and the Department of Interior.

The Endangered Species Act provides the U.S. Fish and Wildlife Service (USFWS) the authority to require the replacement of existing water depletions in Nebraska and the upstream states to achieve a water supply goal for the critical habitat in the Central Platte River in Nebraska. The water supply goal for the PRRIP was 417,000 acre-feet per year. In addition, the USFWS could assess depletion fees to acquire 29,000 acres of habitat in the Central Platte River in Nebraska. **It is very important to note that the PRRIP serves as the reasonable and prudent alternative under the Endangered Species Act for irrigation, municipal, industrial, and other water uses in place on or before July 1, 1997 in each State. Without the PRRIP, the USFWS would use the Endangered Species Act consultations required for future federal actions (permits, including renewals; funding; contracts; easements; and others) to require water users (irrigators, municipalities, industries, and others) to replace existing and proposed new depletions until the water goals were met.**

The Threatened and Endangered (T&E) species targeted in the recovery plan are shown in **Figure 1.6.**

# Figure 1.4 Platte River Significant Water Resources Events

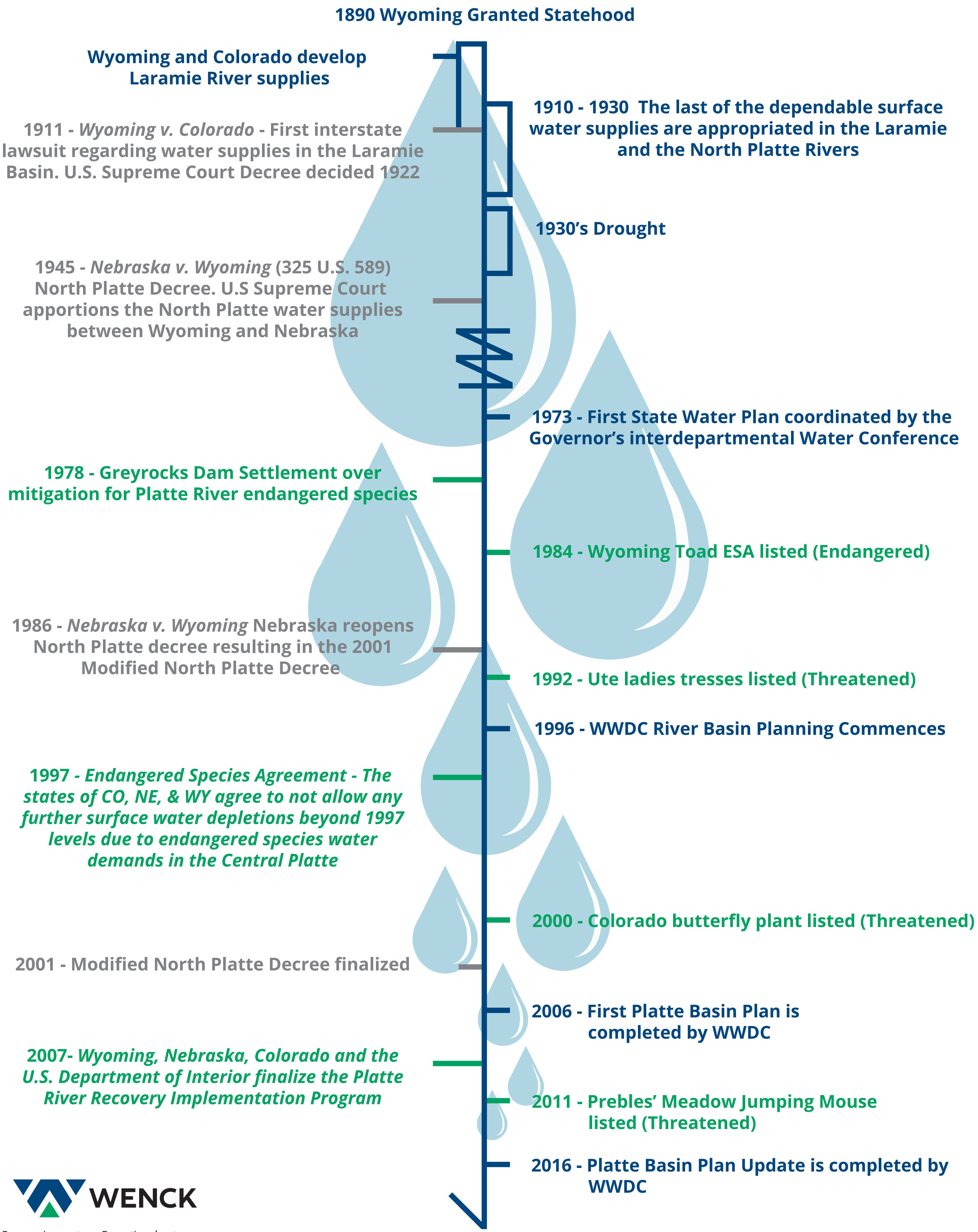


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**Figure 1.5: Overview of Interstate Water Use Allocations & Limitations in the Platte River Basin**

1. Intentionally irrigated acreage limitation for the **Laramie River,** downstream of Wheatland Irrigation District's Tunnel No. 2 and its tributaries including irrigation by hydrologically connected groundwater wells, exclusive of Wheatland Irrigation District lands.

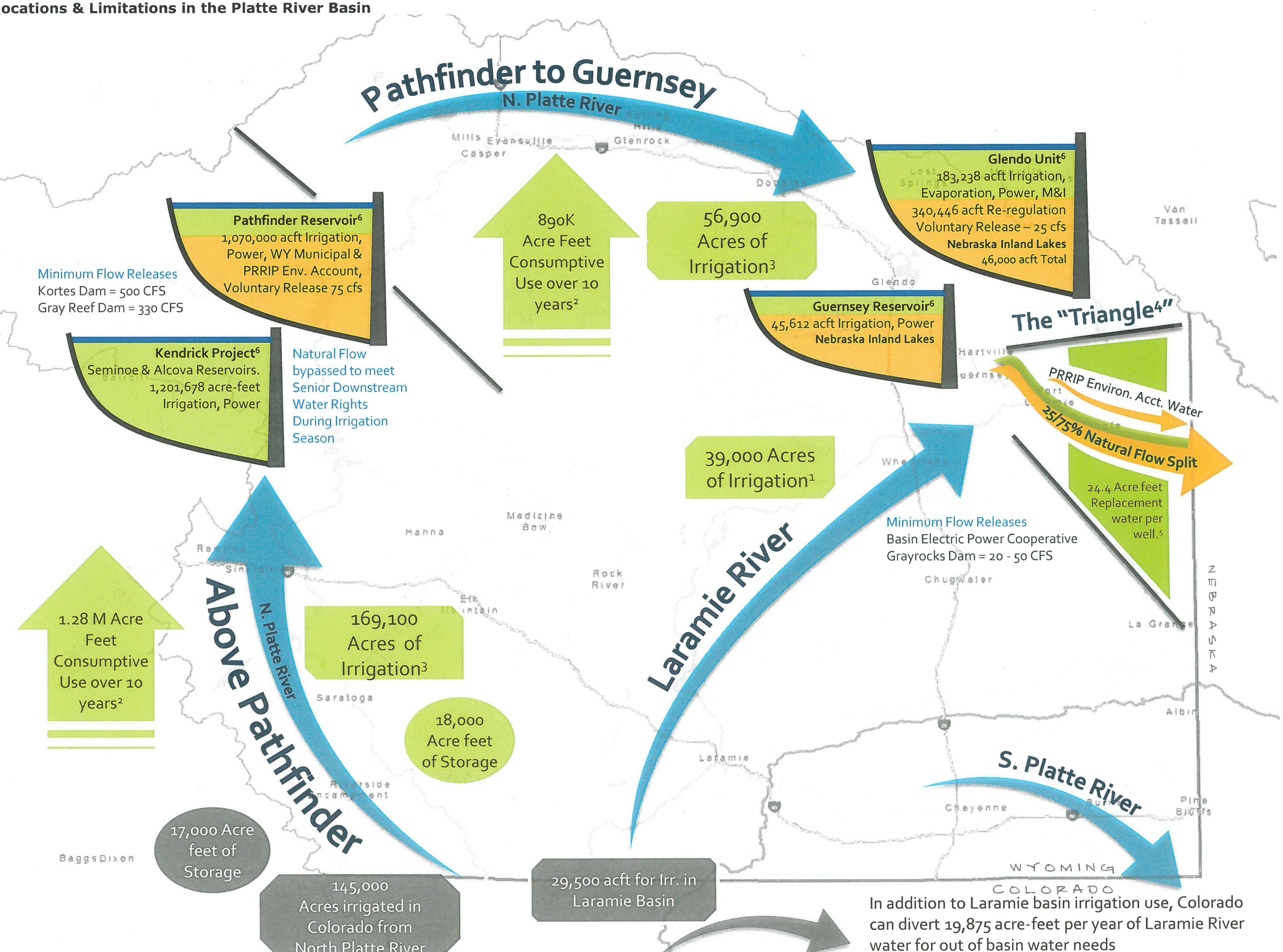
2. For the **North Platte River** and its tributaries above Pathfinder Reservoir and for Pathfinder to Guernsey Reservoir subbasins, including water from hydrologically connected groundwater wells, Wyoming is enjoined from consuming more than quantities of water historically consumed for irrigation from such sources in any consecutive ten-year period according to Decree approved methods.

3. Intentionally irrigated acreage limitations for the **North Platte River** and its tributaries above Pathfinder Reservoir and for Pathfinder to Guernsey Reservoir subbasins, including water from hydrologically connected groundwater wells, in Wyoming during any one irrigation season, exclusive of the Kendrick Project.

4. 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.

5. During a period of natural flow deficiency, Wyoming must provide **replacement water** annually of 24.4 acre feet per well for every active baseline well in the year following the year in which the wells were active. New wells are assessed 80 acre feet per well per year. Wells with priority dates prior to Oct. 1945 (date of the original North Platte Decree) are not affected.

6. The **federal reservoir storage** in the North Platte is segregated among various storage ownership accounts and allocations and physically stored in different reservoirs within the system. The total ownership water right quantities are provided along with the water right uses for each of the reservoirs. The color shading indicates that reservoir storage ownerships are shared between Wyoming and Nebraska appropriators for North Platte Project reservoirs and for Glendo Reservoir. The Environmental Account in Pathfinder Reservoir is operated to benefit endangered species within Central Nebraska under the PRRIP.




**Sources:** Purcell. 2014. *Settlement of the Nebraska v. Wyoming Lawsuit, North Platte River Basin Plan Update.* WY Water Development Commission
Trihydro Corp. 2006. *Summary of the North Platte River and Laramie River Decrees, Chapter 1 Appendix, North Platte River Basin Plan.* WY Water Development Commission

**Figure 1.6: T&E Species Addressed Under the Platte River Recovery Implementation Plan**

Clockwise from upper left: 1) Whooping Crane, 2) Interior Least Tern, 3) Pallid Sturgeon, and 4) Piping Plover.

Although there are no interstate agreements in place for their protection, there are four other water dependent T&E species found in the Platte River Basin in Wyoming:

- The Wyoming toad (*Anaxyrus baxteri*) is a federally listed Endangered Species, found only in Albany County.

Photo Credit: WY Toad SSP - Armstrong

- The Preble's meadow jumping mouse (*Zapus hudsonius preblei*), a federally listed Threatened Species is found in Albany, Converse, Laramie, Goshen and Platte Counties.

Photo Credit: FWS

- Ute Ladies'-tresses (*Spiranthes diluvialis*) is a Threatened Species of orchid that is widely distributed but nonetheless rare throughout its range. The plant is potentially found in every county within the Platte River Basin in Wyoming.

Photo Credit: FWS/Lindstrom

- The Threatened Colorado butterfly plant (*Gaura neomexicana coloradensis*) is a perennial herb endemic to moist soils in wet meadows of flood plain areas. This plant is known to occur in Laramie, Goshen, and Platte Counties. Critical habitat has been designated in Laramie and Platte Counties.

Photo Credit: FWS

## 1.3 GEOMORPHOLOGY AND TOPOGRAPHY

***"Although mountains may guide migrations, the plains are the regions where people dwell in greatest numbers."***
- Elsworth Huntington

Located in the Rocky Mountains, Wyoming Basin and Great Plains physiographic provinces, the Platte River Basin spans a wide variety of landscapes. The headwaters of the Platte River Basin find their sources in the mountains of Wyoming and Colorado. Snowfall in the Park and Front Range Mountains in Colorado, the southern Wind River, Sierra Madre, Snowy, and Laramie Ranges in Wyoming are the primary sources of water supply for the entire drainage. However, smaller mountain ranges are locally important contributors of water supply. The Haystack, Shirley, Ferris, Seminoe, Pedro, Granite, Casper, Rattlesnake, and Laramie mountains are the sources of freshwater springs that provide livestock water and wildlife habitat in some of the arid portions of the Basin. Topography within the Basin varies considerably. Elevations in the Basin range from over 12,000 feet above mean sea level (msl) in the Snowy Range to 4,025 feet msl where the North Platte crosses into Nebraska. Intermountain basins characterize much of the land area in the Upper Laramie subbasin and the Platte drainage above Pathfinder Dam. East of the Laramie Range, the topography is primarily high plains shaped by the erosive forces of wind and water.

The North Platte River Basin in Wyoming looks like a fist with the index finger pointing west. The Sweetwater River drainage, flowing in from the west, forms the "finger". The North Platte River sources in the mountains surrounding Colorado's North Park. The North Platte flows north into Wyoming and sweeps east and south in a horseshoe bend nearly 350 miles long, draining the entire southeast quarter of the state. As the river flows north then east, it gathers significant flow from tributaries draining the mountain ranges listed in the previous paragraph. On its' journey through Wyoming, the North Platte traverses an intermountain valley before reaching Seminoe Reservoir, the first major U.S. Bureau of Reclamation (USBR) impoundment on the mainstem of the North Platte. After flowing Downstream from Seminoe there are six more mainstem USBR reservoirs: Kortes, Pathfinder, Alcova, Grey Reef, Glendo and Guernsey before the river flows into Nebraska.

A major tributary, the Laramie River flows north into Wyoming from the Colorado Front Range Mountains and traverses the Laramie Plains, a broad high elevation deflation basin, in a meandering northeasterly course. As the river drains the Laramie Plains, the elevation changes little from 8,000 feet at Woods Landing to a little less than 7,000 feet at Wheatland Reservoir #2.

## 1.4 CLIMATE

***"The most important thing about global warming is this: Whether humans are responsible for the bulk of climate change is going to be left to the scientists, but it's all of our responsibility to leave this planet in better shape for the future generations than we found it."***
- Mike Huckabee

The overall climate of the Platte Basin in Wyoming is described in a word: Variable. Broadly separated into Highland (Alpine) and Semi-Arid Steppe, the temperature can exceed 100° F during the summer in the lower elevations and sink below -20° F in the winter. In the Snowy and Sierra Madre Mountains, snow has been recorded every month of the year. Temperature swings can come quickly with changes of more than 30° F occurring in a few hours. The saying *"If you don't like the current weather conditions in Wyoming just wait a couple days"* describes the rapidity of some temperature and precipitation changes in the Platte Basin.

Generally, the Basin is characterized by cold, windy winters and warm, relatively dry summers. Summer rains, often in the form of isolated, intense, short duration thunderstorms, often producing hail, are common. These storms can scour small and medium sized tributary channels resulting in flash flooding. Hail storms, especially on the eastern plains are common and frequently damage property and crops (Wyoming Climate Atlas, 2004). In much of the North Platte basin, evaporation significantly exceeds precipitation. The combination of low humidity, breezy conditions and summer heat result in significant pan evaporation and evapotranspiration losses in agricultural areas of eastern Wyoming. A precipitation map of the Platte Basin is presented in **Figure 1.7**.

Comparing the general topography of the Platte River Basin presented in **Figure 1.1** with the precipitation map in **Figure 1.7**, a clear association can be made between elevation and precipitation.

Finally, it is worth noting that in 2016 the Wyoming State Climate Office identified the Cowboy State as the fifth driest state in the country. As such, drought is a constant, and frequent threat. Between 2001 and 2008, more than half of the state experienced moderate to severe drought conditions as shown on **Figure 1.8.** Although this prolonged drought varied from year to year and from county to county and from region to region within the state, this drought was a significant event. Drought conditions returned to most of the state again from 2012 to 2014. The economic impacts of drought are often felt for several years after the precipitation has returned to "normal". Since 1950, droughts have become more frequent and more intense as shown in **Figure 1.9**

## 1.5 SOCIO-ECONOMIC CHARACTERISTICS

***"We are the sum of who we are and what we do"***
- Anonymous

**During an energy boom, between 2000 and 2014, the Platte River Basin's population increased by over 36,000 people, or about 16.3% - an average 1.22% per year.** In comparison, the entire State of Wyoming population grew slightly faster than the Platte River Basin, with total population growth of about 18.3% over that period. Eighty percent of the Platte River Basin's growth occurred in the South Platte and Pathfinder to Guernsey subbasins; other subbasins grew by much smaller amounts. The Above-Pathfinder and Lower Laramie subbasin populations grew insignificantly over the 15-year period and the Guernsey to State Line subbasin experienced growth that averaged less than 1% annually. Overall, the Platte River Basin makes up about 44% of the State's population.

| **Subbasin / City** | **Population** | | **Total Growth** | **Percent Growth** |
|---|---|---|---|---|
| | **2000** | **2014** | **2000-2014** | **2000-2014** |
| Above Pathfinder Dam | 16,381 | 16,909 | 527 | 3.2% |
| Guernsey to State Line | 9,967 | 10,839 | 873 | 8.8% |
| Horse Creek | 2,389 | 2,676 | 287 | 12.0% |
| Lower Laramie | 7,844 | 8,002 | 158 | 2.0% |
| Pathfinder to Guernsey | 73,662 | 87,915 | 14,253 | 19.3% |
| South Platte | 80,349 | 94,909 | 14,560 | 18.1% |
| Upper Laramie | 30,299 | 35,745 | 5,446 | 18.0% |
| **Total** | **220,891** | **256,996** | **36,105** | **16.3%** |
| **State of Wyoming** | **493,782** | **584,153** | **90,371** | **18.3%** |

**Figure 1.7: Average Annual Precipitation in the Platte Basin of Wyoming**

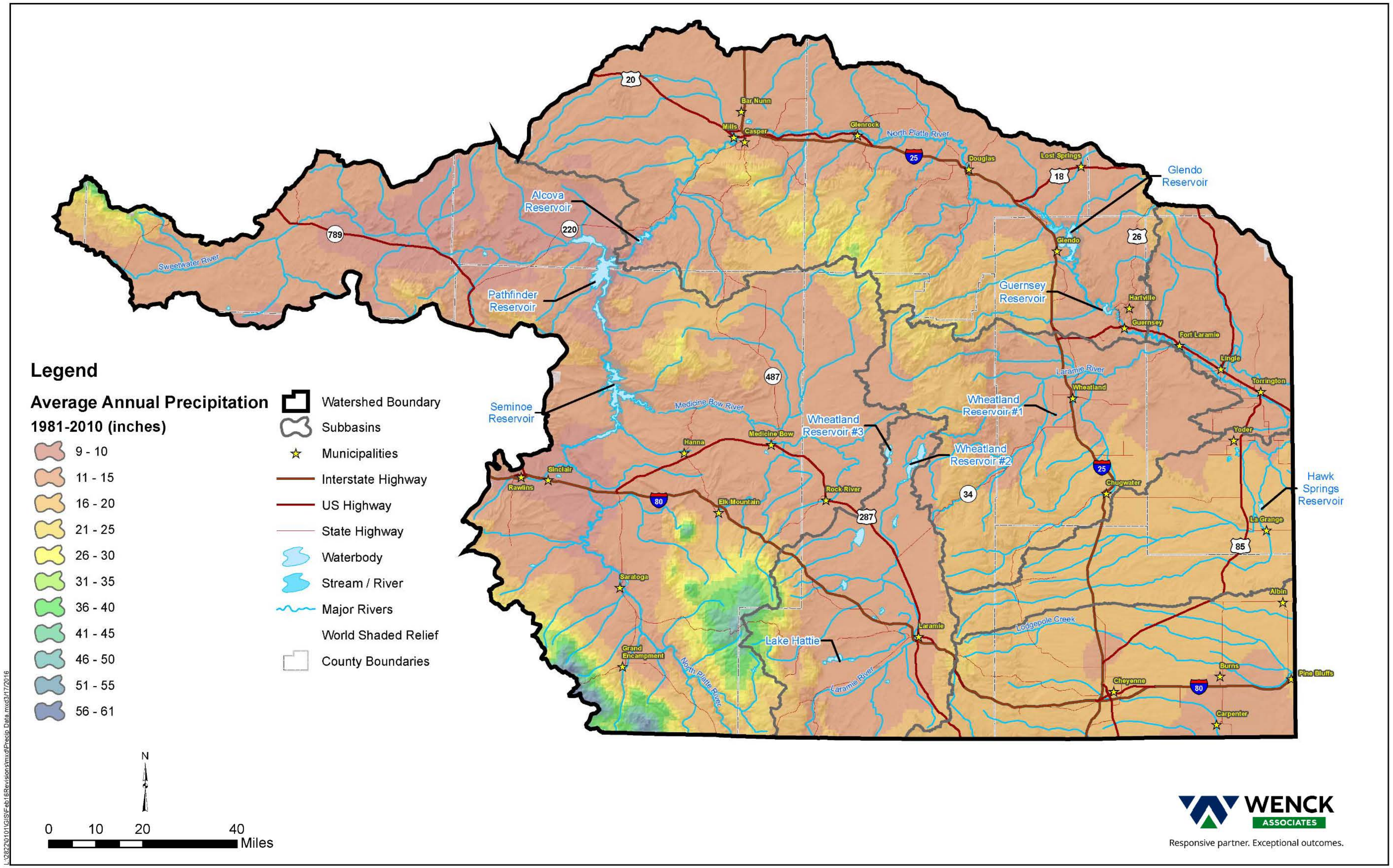


**Figure 1.8: Wyoming Drought Percentage 2000-2014**

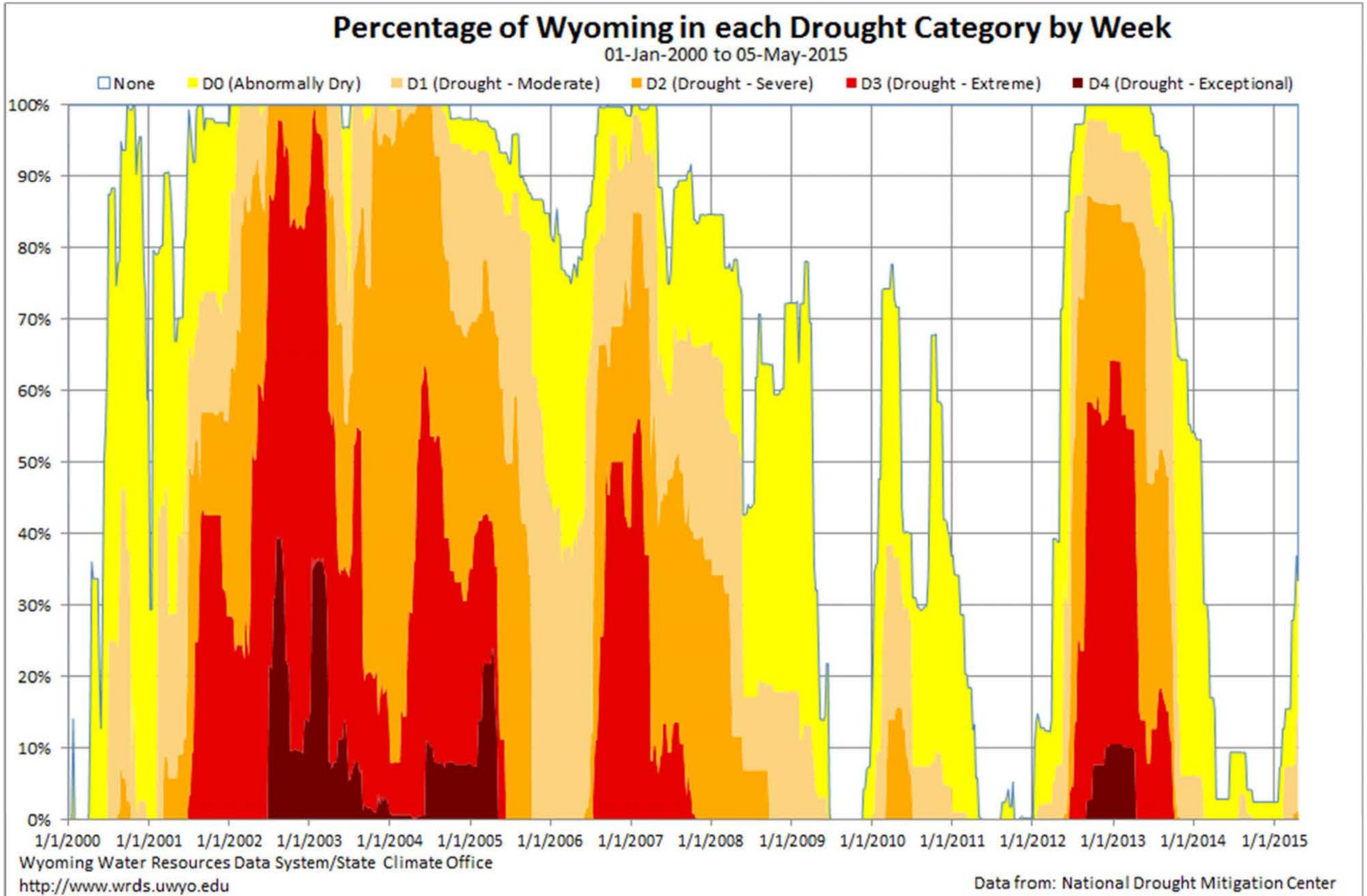
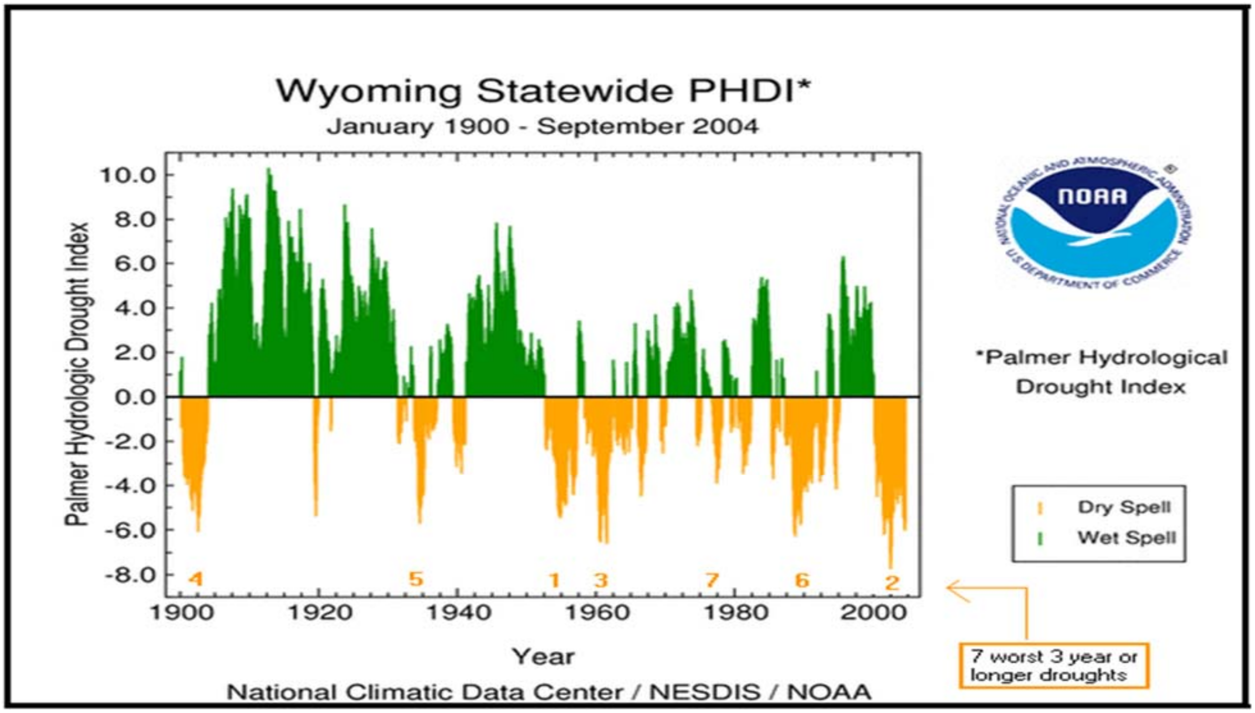


**Figure 1.9: Wyoming Droughts 1900-2008**



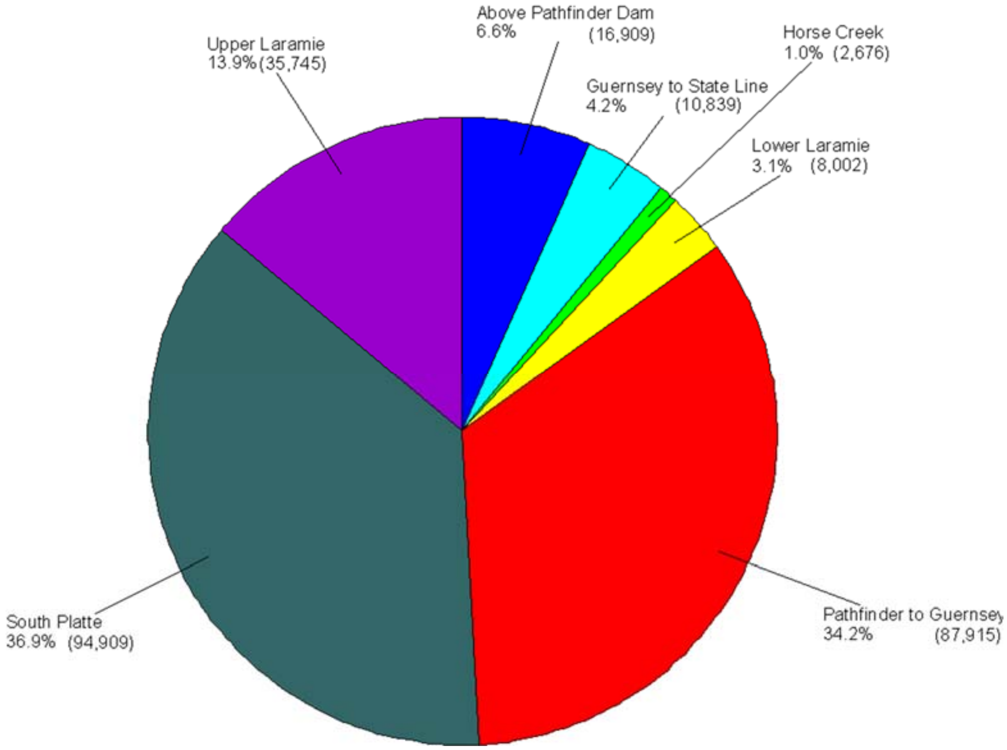

In-migration has been a much more important component of population growth over the last decade, as compared to more historical periods. Between 2000 and 2013, in-migration comprised about half the Basin's population growth. Other demographic changes include an aging population and decreasing household size. The slight decrease in labor force participation rates is also likely the result of the aging population. **Figure 1.10** presents a graphical depiction of the 2014 population distribution by subbasin.

### 1.5.1 Employment

Between 2002 and 2014, the total number of jobs in the Basin increased by about 27,200, from 145,600 full and part-time positions in 2002 to 172,800 total positions in 2014. Over this period, Basin jobs accounted for about 43% of total jobs in Wyoming. Employment growth in individual Basin counties ranged from 0.6% per year up to 2.6% per year over this period; both Basin employment and statewide employment grew at an average rate of about 1.6% annually.

The Basin's largest employment sectors include the government sector, followed by retail trade; healthcare; accommodation and food service; construction and mining. As the largest employment sector by far, the government sector (federal, military, state and local government jobs); included about 37,400 jobs, or about 22% of total Basin jobs, in 2014. Mining accounts for about 5.5% of Basin jobs; the majority of those are located in the Above Pathfinder Dam and the Pathfinder to Guernsey subbasins. Agriculture is a key sector in the Basin in terms of water use; however, employment in that sector is relatively small. Annual earnings within each economic sector vary widely, but averaged about $51,800 in 2014.

**Figure 1.10: Platte Basin Population by Subbasin**




### 1.5.2 Key Economic Sectors

From a water use standpoint, important sectors in the Basin include agriculture, energy, minerals, utilities, and recreation.

#### Agriculture

Agriculture is comprised primarily of cattle ranching and hay production. Irrigated acreage has decreased in recent years (a 14% reduction over about the last decade), likely due to increases in technology and changes in commodity prices, among other factors. Currently, there are about 524,000 irrigated acres in the Basin and about 656,000 head of livestock, compared to about 613,000 irrigated acres and 686,000 head of livestock at the time of the previous 2006 Basin Plan. Basin wide agricultural water use appears to have decreased somewhat in recent years, although fluctuations in water use do occur from year to year. The acreage of irrigated land is strongly correlated with water availability. There are several possible explanations for this change:

- Market forces may affect the amount of acreage planted, hay harvested and livestock raised
- Changes in production costs may also affect amount of acreage planted, hay harvested and livestock raised
- Weather fluctuations (timing of precipitation, availability of water supplies and temperature fluctuations also affect amount of acreage planted, hay harvested and livestock raised
- The method(s) used to assess changes in crop acreage and to a lesser extent, livestock numbers may have changed over the ten-year period from 2006 to 2016. A 15% variance between 2006 and 2016 may simply be a result of sampling error.

### Oil and Gas

A large portion of the State's oil production comes from within the Basin (about 21% produced in Basin counties in 2002 and about 38% by 2014). Oil production from Basin counties has increased annually through 2015, with crude oil production reaching over 34.5 million barrels in that year. There are three oil refineries in the Basin, which use large amounts of water. In 2015, about 16% of the State's natural gas was produced in Basin counties but annual production has generally declined in recent years. However, both 2014 and 2015 saw small increases in natural gas production in the Basin, even as total statewide production continued to decline. Permitted water use in the oil and gas sector increased by more than 50% over the last 10 years in the Basin.

### Minerals

The amount of uranium produced in the Basin has remained relatively constant over the last decade. All coal mines in the Basin have now closed and no coal is currently produced within the Basin.

### Power Generation

In terms of major power generation facilities, USBR operates six hydropower facilities within the Basin, and the Laramie River Station and Dave Johnston Power Plant are also located in the Basin. In 2014, the 132 MW natural-gas fired Cheyenne Prairie Generating Station began operation. Water demands for power generation have increased slightly since the previous Basin Plan.

### Environment and Recreation

Water in the Basin provides for a number of environmental and recreational (E and R) uses, including supporting wetlands and other aquatic habitat; and fishing, boating, swimming, and other recreational activities. E and R water uses exist throughout the Basin, although some subbasins include a greater concentration of E and R amenities than others. The Basin contains a number of major recreational reservoirs, as well as blue, red, and yellow ribbon trout streams. E and R water uses are highly dependent on traditional water uses. The analysis of future demands for this sector is a reflection of the interactions of traditional water uses and non-consumptive uses. Under the High Scenario, recreational water use will be stable or will decline modestly; environmental water use is likely to expand. The Low Scenario will have mostly positive effects on recreational water use, but the outlook for environmental water uses is mixed. E and R uses under the Mid Scenario would largely remain similar to current conditions.

### Other Economic Activity

In addition to the activities described above, the Basin is the seat of Wyoming State Government and home to the University of Wyoming in Laramie, the Wyoming State Penitentiary in Rawlins and several large retailers and distribution facilities located in larger cities. On the downside, the Wyoming Ethanol facility in Torrington closed in 2015 and the Western Sugar Cooperative plans on closing its Torrington plant by 2017.

## 1.6 WATER USAGE

> ***"What you are aware of you are in control of; what you are not aware of is in control of you."***
>
> \- Anthony De Mello

Water resources in the Platte Basin are extensively utilized and legally contested. On a macro scale, water resources in the basin are some of the most regulated in the western United States and have been called "fully appropriated" by some resource managers. The

Wyoming State Engineer's Office works closely with the USBR and the U.S. Army Corps of Engineers (USACE) to manage water in the Basin. The USACE manages the flood storage pool in Glendo Reservoir.

The Platte Basin supports the majority of Wyoming's population. Industry, agriculture, government services, higher education and outdoor recreation are the primary economic drivers in the Basin. Strategically located in the central United States, close proximity to the Colorado front-range communities, served by major railroads and bisected by two major interstate highways, the southeast quarter of Wyoming is an attractive hub for commerce and recreation. The value of the Platte Basin water resources cannot be overstated…They are the vital economic lifeblood of southeast Wyoming.

Wyoming is a premier destination for hunting, fishing, camping and all forms of outdoor recreation and tourism. The quality of these assets depends upon the availability of adequate water supplies and existing land uses that need to be properly protected and enhanced. The existing agricultural water uses provide for a ranching and farming lifestyle that can be very complementary to other water use sectors. The anticipated water use changes by different sectors can occur by relying on adaptive management strategies and agreements to conserve and transfer water supplies to meet a variety of anticipated water needs in the future.

There are significant constraints imposed on the use of water in the Platte River Basin based on allocations and apportionment within the North Platte Modified Decree, the Laramie River Decree and Wyoming's participation within the PRRIP. The limitations affect the management of existing water uses and future water opportunities. A timeline presenting these legal and institutional activities has been presented in **Figure 1.4**. Any new major water developments within the Basin are unlikely without mitigation efforts to offset the proposed new depletions. For the future development of small water uses serving domestic, stock, recreation, fish and wildlife, environmental and other deminimus uses; Wyoming's Depletion Plan addresses new depletions in the North Platte River Basin if the proposed water project does not exceed 20 acre-feet per year in net water depletions. A graphic summary of the water allocated between Wyoming, Colorado and Nebraska is presented in **Figure 1.5**.

Between 2005 and 2015, total estimated consumptive use in the Basin (under normal year conditions) decreased by about 6.5%. That net decrease was made up of changes in individual sectors: 1) a 16% decrease in total agricultural water demand (due to a reduction of about 88,000 irrigated acres and 30,000 fewer head of livestock); 2) about a 4.5% increase in municipal/rural domestic demand (population growth and changes in per capita water usage); and 3) an almost 51% increase in industrial demands (increased water demands for oil and gas production, mining activity, power generation, aggregate production and other miscellaneous industrial demands).

| **Economic Sector** | **Estimated Consumptive Use (AF)** | |
|---|---|---|
| | **2005** | **2015** |
| Irrigated Agriculture | 662,000 | 556,000 |
| Livestock | 6,300 | 5,800 |
| Municipal/ Rural Domestic | 28,910 | 30,200 |
| Industrial | 104,200 | 157,300 |
| **Total Water Usage** | **801,410** | **749,300** |

Current consumptive water demands in the Basin are estimated to be about 749,300 AF per year, with about 75% of that demand coming from the agricultural sector. Current projections for 2045 reflect higher consumptive use under the High Scenario and lower consumptive demands under the Low and Mid Scenarios. Year 2045 water demands, in terms of consumptive use, range from 633,200 AF up to 939,100 AF. The reduction in total consumptive use demands under the Low and Mid Scenarios is largely due to an assumed reduction in irrigated acres over time.

| Economic Sector | Estimated Consumptive Use (AF) 2016 Basin Plan | | | |
|---|---|---|---|---|
| | | Year 2045 | | |
| | 2015 | High Scenario | Low Scenario | Mid Scenario |
| Irrigated Agriculture | 55,000 | 671,000 | 436,000 | 497,000 |
| Livestock | 5,800 | 6,900 | 5,000 | 5,800 |
| Municipal/Rural Domestic | 30,200 | 51,200 | 35,500 | 41,100 |
| Industrial | 157,30 | 210,000 | 156,700 | 174,700 |
| **Total Water Usage** | **749,300** | **939,100** | **633,200** | **718,600** |

## 1.7 WATER SUPPLY STRATEGIES

***"Problems only exist in the human mind."***
- Anthony De Mello

There are many challenges to develop and manage water resources in the Platte River Basin in Wyoming. Conflicting uses including water allocation among three states, water quality, periodic droughts and environmental considerations are just a few. However, working together in trusting, collaborative and open-minded groups can develop solutions that serve the greatest good.

Perhaps Wallace Stegner has stated this sentiment best:

***"One cannot be pessimistic about the West. This is the native home of hope. When it fully learns that cooperation, not rugged individualism, is the quality that most characterizes and preserves it, then it will have achieved itself and outlived its origins. Then it has a chance to create a society to match its scenery."***
*- Wallace Stegner: The Sound of Mountain Water*

The efforts and outcomes of evaluating water strategies in the Platte Basin and seeking input from stakeholders to gather, assess, and recommend strategies are addressed in detail in Volume 5 of this updated Basin Plan. In summary, the high priority categories, individual strategies, and implementations efforts are:

- Operational Enhancements – Existing Storage and Conservation
  - Re-operation of Glendo Reservoir
  - Above Pathfinder - Irrigation Reservoir Storage
  - Municipal and Agricultural Water Use Conservation
  - Weather Modification
- New, Imported, Exchanged, and Transferred Water Supplies
  - Industrial Water Use Changes
  - Transbasin Diversions
  - Watershed Planning and Small Storage Program
- Control and Enhancement of Groundwater Resources
  - Laramie County Regulatory Controls
  - Aquifer Storage and Recovery

- Cooperative agreements between agricultural and recreation and environmental organizations, with the shared goal of conserving irrigation water for the benefit of multiple water users by wisely and effectively meeting agricultural water needs as well as addressing the water needs of fish and wildlife, recreation, and the environment.

Many of the water opportunities and strategies are successfully being implemented in the North Platte River Basin.

- The strategy and implementation of developing and relying upon non-hydrologically connected groundwater sources for existing and new wells serving municipal and other water uses.
- The development and reliance on raw water sources to irrigate municipal green areas. Municipalities and other entities are performing feasibility analysis studying the development of raw irrigation for new or existing golf courses and other green areas.
- Expansions are planned for the City of Cheyenne's successful reuse system.
- Pathfinder Modification Project provides water storage helping to secure water supplies for Wyoming's municipalities affected by water rights administration and provides replacement water for groundwater wells in the "triangle" located below Whalen Diversion Dam and extending downstream on both sides of the North Platte River in Goshen County.
- A cooperative project between Casper-Alcova Irrigation District and the City of Casper is an example of an agricultural conservation project that benefits municipal water needs.

## 1.8 PUBLIC INPUT AND ONGOING INVOLVEMENT IN PLAN DEVELOPMENT AND IMPLEMENTATION

There are many challenges and many opportunities to managing water in the Platte Basin. A cooperative approach is needed to successfully protect and wisely use this resource. Ongoing, consistent implementation of a focused and effective public information and involvement program is essential to building and maintaining support for water management and development projects in the Platte River Basin. Some of the activities that are recommended for implementation include: 1) Periodic newsletters e-mailed to interested organizations and individuals, 2) Booths and displays at meetings of water users, the State Fair and county fairs, 3) WWDC sponsored seminars and activities addressing water supply needs and planning efforts, 4) Annual or bi-annual economic updates in each basin using data compiled by the Wyoming Department of Administration and Information, and, 5) Working with Conservation Districts to encourage development of small storage projects under the Small Water Project Program to benefit agriculture, wildlife and public recreation.

***"Eventually, all things merge into one, and a river runs through it."***
- Norman Maclean

## APPENDIX A

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# Platte River Basin Plan 2016 Update
# Volume 2
# Surface Water Resources Analysis

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**PLATTE RIVER BASIN PLAN 2016 UPDATE**
**VOLUME 2**
**SURFACE WATER RESOURCES ANALYSIS**

December 2016

**Explanation of Cover Photos**

Lake Marie in the Snowy Range Mountains. Lake Marie lies south in the shadow of the quartzite massif of 12,847-foot Medicine Bow Peak at an elevation of 11,000-feet. Winter and Spring precipitation in the Snowing Range constitutes an important portion of the water supply in the Platte River Basin.

The bald eagle (*Haliaeetus leucocephalus*, from Greek hali "sea", aiētos "eagle", leuco "white", cephalos "head"). It is a common, frequently observed breeding and winter resident in the North Platte Basin of Wyoming. The bird is strongly associated with large rivers, lakes and reservoirs with an abundant food supply and riparian environments with large trees used for roosting and nesting. The bald eagle is an opportunistic predator which subsists primarily on fish. During the winter, they also feed on dead or injured waterfowl and road or winter killed deer and antelope. The bald eagle is both the national bird and national animal of the United States of America. It is the most familiar success story of the Federal Endangered Species Act. During the latter half of the 20th century it was on the brink of extirpation in the contiguous United States and was one of the first species to receive protections under the precursor to the Endangered Species Act in 1967. Populations have since recovered and the species was removed from the U.S. government's list of endangered species on July 12, 1995 and transferred to the list of threatened species. It was removed from the List of Endangered and Threatened Wildlife in the Lower 48 States on June 28, 2007 but remains protected under the provisions of the Bald and Golden Eagle Protection Act.

Historical photo of flood irrigation. Flood irrigation is an ancient method of irrigating crops and was the first form of irrigation used by humans as they began cultivating crops. In the Platte River Basin, it is still commonly used to irrigate grass hay. In areas of the Platte River Basin where higher value crops are raised such as corn, sugar beets and alfalfa hay, conversion to sprinkler irrigation has the dual benefits of improved crop yields while conserving water.

The Dave Johnston Power Plant is named for W.D. “Dave” Johnston a former PacifiCorp Vice-President. The plant generates power by burning coal that produces steam under high pressure. The steam drives turbines and the turbine blades to engage generator that produce electricity. The plant was commissioned in 1958. There have been four phases of plant expansion to-date and numerous upgrades to comply with changing environmental requirements. The present power generation capacity is 817 megawatts.

# PLATTE RIVER BASIN PLAN 2016 UPDATE
# VOLUME 2
# SURFACE WATER RESOURCES ANALYSIS

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**The Platte River Basin Plan 2016 Update is a planning tool developed for the Wyoming Water Development Office. It presents estimated current and estimated future uses of water in Wyoming's Platte River Basin. The Plan is not intended to be used to determine compliance with the administration of state law, federal law, court decrees, interstate compacts, or interstate agreements.**

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# 2.0 Surface Water Resources Analysis

## 2.1 INTRODUCTION

***"Plans to protect air and water, wilderness and wildlife are in fact plans to protect man."***
- Stewart Udall

The purpose of this volume is to summarize the surface water data collection and analyses as part of the Platte River Basin Plan Update. The document provides an overview of historic streamflow records, study period determination, indicator gage selection, gage filling and the methodology used to estimate ungaged tributary flow.

The data collection and study period selection from the Platte River Basin Plan in 2006 (TriHydro, 2006) were used as a baseline for this update. The previous Basin Plan determined a study period of 1972 through 2001. Updates to the study period reflect a new study period of 1972 through 2013. The methodology for determining the study period remains the same. Rather than repeating information, the reader can reference TriHydro, 2006.

TriHydro, 2006 developed average, wet and dry year flow averages by using a basin area weighted calculation that incorporated streamflow for a six-month irrigation season from April through September to determine the annual flows for each scenario. Also, the previous Basin Plan did not perform any data filling of records that did not include non-irrigation season streamflow records and did not determine average monthly flows for a 12-month cycle. This update uses a 12-month streamflow period to determine monthly flows and calculates mean monthly streamflow for the three condition scenarios. As a result, much of the 2006 modeling results and data were not used for this analysis.

Further, the Previous Basin Plan did not estimate ungaged tributary flows, whereas this update does estimate streamflow for the ungaged tributaries. Ungaged tributary flow was estimated for the entire basin in this update. The objectives of the update include:

- Collect, update and extend historic streamflow for the study period between 1972 through 2013.
- Select indicator gages to determine the historic dry, average and wet years within the study period.
- Develop monthly streamflow for the dry, average and wet years.
- Perform data filling and extension for missing streamflow data
- Estimate inflow for ungaged tributaries.

## 2.2 HISTORIC STREAMFLOW RECORDS

Historic streamflow data were obtained from the United States Geological Service (USGS), National Water Information System (NWIS) daily streamflow data. This information is available from the internet. The streamflow records were obtained using the USGS's GNWISQ program to obtain the daily streamflow records. This program was developed to obtain daily mean streamflow from the USGS NWIS website. The program downloads two files associated with each gage selected. One file contains the header information for the gage; the second file is the daily mean streamflow file. All USGS gage data collected in this study was acquired using this program. Streamflow data for all gages in each of the seven subbasins with data within the study period was collected. **Tables 2.1 through 2.7** provide summaries of the annual stream flow for these gages. The driest and wettest annual stream flow amounts for the period of record are highlighted in red and yellow, respectively, for each gage.

**Table 2.1: Upper Laramie Annual Stream Flow Summary**

| | 6661000 ^* | 6661585 ^ | 6659580 ^* | 6659500 ^* |
|---|---|---|---|---|
| | Little Laramie River Nr Filmore | Laramie River Nr Bosler | Sand Creek at CO/WY Border | Laramie River and Pioneer Canal Nr Woods Landing |
| 1972 | 81,365 | 96,635 | 4,304 | 113,260 |
| 1973 | 65,129 | 193,871 | 12,576 | 174,919 |
| 1974 | 78,179 | 130,495 | 8,057 | 151,840 |
| 1975 | 82,756 | 105,005 | 5,303 | 121,138 |
| 1976 | 62,294 | 72,852 | 4,140 | 96,349 |
| 1977 | 39,940 | 28,952 | 7,049 | 63,028 |
| 1978 | 98,444 | 115,148 | 5,088 | 146,794 |
| 1979 | 103,514 | 126,908 | 8,687 | 162,036 |
| 1980 | 87,937 | 118,276 | 10,116 | 148,801 |
| 1981 | 38,483 | 35,404 | 4,136 | 67,758 |
| 1982 | 99,942 | 148,138 | 8,204 | 159,839 |
| 1983 | 114,505 | 346,767 | 24,390 | 280,466 |
| 1984 | 102,354 | 296,708 | 12,298 | 210,559 |
| 1985 | 64,349 | 127,843 | 5,657 | 133,678 |
| 1986 | 92,315 | 253,987 | 13,215 | 223,259 |
| 1987 | 37,380 | 52,989 | 3,776 | 69,507 |
| 1988 | 71,634 | 114,388 | 7,843 | 123,633 |
| 1989 | 41,877 | 28,265 | 3,027 | 58,754 |
| 1990 | 55,920 | 59,255 | 4,318 | 96,475 |
| 1991 | 52,784 | 68,247 | 4,183 | 94,339 |
| 1992 | 36,646 | 43,929 | 5,129 | 83,873 |
| 1993 | 63,495 | 104,798 | 7,578 | 137,170 |
| 1994 | 48,490 | 36,078 | 4,376 | 81,241 |
| 1995 | 81,966 | 136,925 | 9,493 | 154,604 |
| 1996 | 76,218 | 116,203 | 6,414 | 163,494 |
| 1997 | 85,204 | 148,421 | 8,758 | 171,919 |
| 1998 | 76,732 | 106,722 | 5,672 | 120,957 |
| 1999 | 85,606 | 120,341 | 6,974 | 134,587 |
| 2000 | 44,602 | 57,377 | 3,175 | 99,798 |
| 2001 | 48,926 | 42,766 | 2,751 | 68,700 |
| 2002 | 23,793 | 12,574 | 1,281 | 28,925 |
| 2003 | 46,672 | 77,395 | 8,637 | 114,145 |
| 2004 | 42,057 | 47,070 | 4,316 | 68,910 |
| 2005 | 53,732 | 111,646 | 6,951 | 134,521 |
| 2006 | 59,673 | 54,999 | 2,875 | 89,181 |
| 2007 | 50,385 | 57,924 | 6,548 | 103,578 |
| 2008 | 58,749 | 91,567 | 6,777 | 139,267 |
| 2009 | 82,447 | 110,980 | 6,050 | 128,628 |
| 2010 | 91,070 | 173,767 | 13,829 | 194,401 |
| 2011 | 144,222 | 285,453 | 10,854 | 268,600 |
| 2012 | 42,461 | 23,962 | 3,758 | 61,557 |
| 2013 | | | | |
| **Average** | **68,640** | **109,293** | **7,038** | **127,914** |

**Notes:**

1) * Denotes an index Gage
2) ^ Denotes gage data was filled
3) Source of raw data – USGS NWIS website. TS Tool was used to manipulate Data.

**Table 2.2: Above Pathfinder Annual Stream Flow Summary**

| | 6630000* | 6635000* | 639000^ | 6620000 | 6622700 | 6622900^ | 6623800 | 6625000 | 6627800^ | 6628900^ | 6632400 | 6634620 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | North Platte Ab Seminoe | Med. Bow River Ab Seminoe | Sweet Water River Nr Alcova | North Platte R Nr Northgate | North Brush Creek Nr Saratoga | S. Brush Creek Nr Saratoga | Encampment R. Ab Hog Park | Encampment at Mouth | Jack Cr. Ab Coyote Draw | Pass Cr. Nr Elk Mountain | Rock Cr. Ab King Canyon | Little Med. Bow R at Boles Spring |
| 1972 | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| 1973 | 1,133,552 | 388,532 | 147,133 | 407,284 | 43,152 | 27,170 | 72,447 | 184,555 | NA | 55,066 | 71,114 | NA |
| 1974 | 1,078,233 | 187,774 | 136,360 | 405,132 | 41,837 | 24,232 | 97,035 | 226,938 | NA | 46,384 | 79,895 | NA |
| 1975 | 907,138 | 145,210 | 117,493 | 301,694 | 30,870 | 19,515 | 92,564 | 214,488 | NA | 25,179 | 57,846 | NA |
| 1976 | 661,999 | 118,831 | 89,106 | 194,264 | 28,417 | 15,408 | 74,090 | 162,379 | NA | 25,716 | 53,877 | NA |
| 1977 | 350,385 | 72,304 | 37,697 | 85,782 | 21,828 | 17,348 | 36,974 | 74,133 | NA | 15,992 | 35,337 | NA |
| 1978 | 1,001,231 | 169,779 | 96,214 | 363,659 | 40,976 | 25,728 | 105,891 | 226,585 | NA | 36,909 | 81,876 | NA |
| 1979 | 979,976 | 132,209 | 90,557 | 408,444 | 30,796 | 19,059 | 106,532 | 225,280 | NA | 26,113 | 68,173 | NA |
| 1980 | 998,946 | 181,647 | 170,886 | 374,104 | 33,553 | 22,457 | 94,311 | 205,124 | NA | 34,795 | 62,016 | NA |
| 1981 | 404,005 | 53,481 | 46,045 | 122,600 | 24,187 | 15,951 | 47,396 | 100,415 | NA | 19,436 | 36,993 | NA |
| 1982 | 1,066,092 | 174,310 | 102,812 | 359,658 | 48,919 | 26,460 | 115,963 | 268,110 | NA | 40,762 | 84,715 | NA |
| 1983 | 1,476,613 | 350,367 | 213,108 | 572,500 | 60,068 | 33,550 | 107,397 | 248,848 | NA | 56,165 | 96,023 | NA |
| 1984 | 1,587,234 | 297,464 | 131,688 | 623,487 | 52,329 | 30,986 | 110,751 | 268,643 | NA | 62,611 | 66,757 | NA |
| 1985 | 944,810 | 93,845 | 64,806 | 384,012 | 32,555 | 23,240 | 86,774 | 183,363 | NA | 25,762 | 48,573 | 19,174 |
| 1986 | 1,381,474 | 191,334 | 172,582 | 599,838 | 45,353 | 24,819 | 109,755 | 254,638 | NA | 42,495 | 76,887 | 48,427 |
| 1987 | 446,524 | 80,518 | 78,313 | 172,370 | 21,093 | 9,921 | 46,081 | 94,573 | NA | 18,829 | 38,868 | 23,622 |
| 1988 | 744,556 | 138,910 | 52,273 | 296,188 | 27,760 | 15,360 | 71,930 | 162,191 | NA | 25,190 | 57,589 | 34,585 |
| 1989 | 424,669 | 44,099 | 39,834 | 142,310 | 19,744 | 11,291 | 52,222 | 106,996 | NA | 15,154 | 36,562 | 11,441 |
| 1990 | 544,691 | 66,261 | 47,595 | 172,418 | 31,379 | 16,687 | 60,759 | 123,630 | NA | 22,168 | 49,198 | 13,946 |
| 1991 | 556,764 | 119,364 | 83,639 | 197,620 | 25,806 | 18,157 | 58,315 | 127,783 | 14,155 | 22,090 | 47,410 | 33,893 |
| 1992 | 399,745 | 55,871 | 34,221 | 136,580 | 26,096 | 13,766 | 42,128 | 85,005 | 11,127 | 20,704 | 38,867 | 8,853 |
| 1993 | 987,712 | 155,038 | 104,006 | 325,711 | 43,605 | 25,274 | 87,004 | 223,392 | 26,780 | 39,719 | 64,842 | 44,133 |
| 1994 | 535,343 | 72,830 | 67,640 | 150,851 | 27,772 | 17,611 | 56,220 | 123,638 | 15,596 | 22,321 | 45,700 | 15,148 |
| 1995 | 1,149,986 | 221,091 | 163,425 | 378,359 | 42,468 | 25,704 | 111,368 | 251,083 | 32,318 | 36,859 | 75,363 | 63,221 |
| 1996 | 1,093,436 | 137,712 | 79,347 | 461,005 | 37,952 | 22,624 | 95,793 | 229,904 | 20,472 | 25,757 | 67,625 | 26,192 |
| 1997 | 1,342,246 | 166,715 | 140,285 | 581,503 | 44,806 | 21,825 | 112,107 | 280,856 | 31,516 | 30.209 | 66,909 | 52,124 |
| 1998 | 906,289 | 112,411 | 100,056 | 304,150 | 38,127 | 22,921 | 92,405 | 211,612 | 22,543 | 31,829 | 59,958 | 16,640 |
| 1999 | 975,650 | 196,759 | 127,581 | 275,258 | 54,882 | 23,803 | 103,102 | 217,394 | 27,599 | 47,957 | 78,528 | 62,957 |
| 2000 | 569,060 | 78,812 | 54,520 | 219,524 | 30,718 | 17,847 | 67,967 | 141,927 | 12,441 | 20,125 | 40,141 | 31,456 |
| 2001 | 451,453 | 74,307 | 37,980 | 150,429 | 23,768 | 12,811 | 58,279 | 125,813 | 13,351 | 18,432 | 43,804 | 28,218 |
| 2002 | 187,582 | 25,691 | 28,355 | 64,013 | 12,625 | 7,934 | 32,706 | 60,201 | 8,226 | 8,138 | 22,142 | 8,840 |
| 2003 | 587,402 | 81,608 | 33,170 | 218,080 | 37,266 | 28,104 | 74,090 | 150,702 | 14,254 | 22,349 | 52,860 | 16,405 |
| 2004 | 464,885 | 38,780 | 62,944 | 163,831 | 20,121 | 13,058 | 63,016 | 132,480 | 14,549 | 13,879 | 35,578 | 11,067 |
| 2005 | 858,046 | 85,928 | 90,341 | 346,355 | 37,598 | 26,692 | 87,016 | 193,816 | 26,104 | 29,052 | 53,426 | 13,446 |
| 2006 | 711,267 | 67,521 | 56,796 | 271,559 | 34,587 | 23,613 | 90,660 | 194,915 | 20,802 | 23,447 | 50,572 | 12,481 |
| 2007 | 622,353 | 65,781 | 56,952 | 216,533 | 26,385 | 16,056 | 72,102 | 147,118 | 17,931 | 20,217 | 43,610 | 20,061 |
| 2008 | 1,046,812 | 123,009 | 80,572 | 396,012 | 43,809 | 25,639 | 111,649 | 238,803 | 42,180 | 35,767 | 59,105 | 37,246 |
| 2009 | 1,071,800 | 162,106 | 81,890 | 307,202 | 51,594 | 33,046 | 117,635 | 250,008 | 43,865 | 43,667 | 68,747 | 30,384 |
| 2010 | 1,248,544 | 232,363 | 127,832 | 325,599 | 59,674 | 42,537 | 105,621 | 263,605 | 39,288 | 70,815 | 80,257 | 45,804 |
| 2011 | 1,994,441 | 284,678 | 135,306 | 731,604 | 88,813 | 54,893 | 159,065 | 379,947 | 46,660 | 67,963 | 106,433 | 75,186 |
| 2012 | 384,462 | 52,756 | 59,352 | 123,465 | 21,905 | 12,420 | 57,525 | 107,030 | 11,793 | 16,984 | 36,201 | 14,531 |
| 2013 | 496,020 | 33,271 | NA | 212,740 | 23,109 | NA | 63,918 | 132,641 | NA | NA | 39,596 | 5,773 |
| **Average** | **848,132** | **134,909** | **91,018** | **305,945** | **36,300** | **22,138** | **83,136** | **185,380** | **23,343** | **31,575** | **58,048** | **28,457** |

**Notes:**

1) * Denotes an index Gage
2) ^ Denotes gage data was filled
3) Source of raw data – USGS NWIS website. TS Tool was used to manipulate Data.

**Table 2.3: Pathfinder to Guernsey Annual Stream Flow Summary**

| | 6646000 | 6647500 * | 6649000 ^ | 6682000 | 6652800 |
|---|---|---|---|---|---|
| | Deer Creek | Box Elder Creek | La Prele Creek | N. Platte at Orin | N. Platte Below Glendo Res. |
| 1972 | NA | 27,602 | 29,823 | 1,276,271 | 1,296,908 |
| 1973 | NA | 48,217 | 63,385 | 2,132,453 | 1,992,697 |
| 1974 | NA | 24,800 | 20,651 | 1,748,800 | 1,841,662 |
| 1975 | NA | 26,353 | 16,531 | 1,248,318 | 1,224,077 |
| 1976 | NA | 26,786 | 19,079 | 1,146,901 | 1,160,203 |
| 1977 | NA | 21,128 | 13,788 | 1,029,815 | 998,842 |
| 1978 | NA | 29,304 | 24,933 | 1,061,301 | 1,090,131 |
| 1979 | NA | 13,841 | 9,887 | 1,091,780 | 1,055,487 |
| 1980 | NA | 23,508 | 24,656 | 1,364,882 | 1,318,311 |
| 1981 | NA | 10,560 | 5.085 | 936,091 | 968,419 |
| 1982 | NA | 22,419 | 14,174 | 914,608 | 915,451 |
| 1983 | NA | 60,191 | 68,918 | 2,063,381 | 1,958,412 |
| 1984 | NA | 33,483 | 34,788 | 2,272,054 | 2,288,373 |
| 1985 | NA | 7,148 | 2,855 | 1,460,320 | 1,406,555 |
| 1986 | 54,343 | 29,798 | 33,537 | 1,688,046 | 1,644,521 |
| 1987 | 37,510 | 13,159 | 8,020 | 955,690 | 984,282 |
| 1988 | 47,332 | 29,726 | 26,773 | 1,099,353 | 1,103,876 |
| 1989 | 9,810 | 5,050 | 1,330 | 890,958 | 931,987 |
| 1990 | 18,310 | 11,426 | 6,142 | 706,414 | 731,103 |
| 1991 | 35,867 | 24,614 | 28,567 | 894,088 | 860,508 |
| 1992 | 16,080 | 8,888 | NA | 735,496 | 743,921 |
| 1993 | 57,685 | 33,473 | NA | 950,446 | 882,865 |
| 1994 | 29,500 | 15,642 | NA | NA | 1,076,084 |
| 1995 | 93,727 | 52,528 | NA | NA | 979,621 |
| 1996 | 57,783 | 29,611 | NA | 1,289,235 | 1,232,916 |
| 1997 | 75,157 | 40,622 | NA | 1,634,517 | 1,513,547 |
| 1998 | 35,315 | 18,927 | NA | 1,308,803 | 1,370,692 |
| 1999 | 57,790 | 41,577 | NA | 1,353,191 | 1,465,469 |
| 2000 | 40,976 | 26,308 | NA | 1,165,390 | 1,208,878 |
| 2001 | 37,351 | 20,058 | NA | 1,059,116 | 1,038,822 |
| 2002 | NA | 6,782 | NA | 621,250 | 678,042 |
| 2003 | NA | 19,915 | NA | 740,940 | 698,652 |
| 2004 | NA | 7,833 | NA | 601,427 | 621,022 |
| 2005 | NA | 13,928 | NA | 772,623 | 758,119 |
| 2006 | NA | 15,853 | NA | NA | 915,582 |
| 2007 | NA | 22,766 | NA | NA | 897,256 |
| 2008 | NA | 36,517 | NA | NA | 879,758 |
| 2009 | NA | 25,252 | NA | 865,510 | 851,610 |
| 2010 | NA | 43,728 | NA | 1,584,699 | 1,440,463 |
| 2011 | NA | 35,777 | NA | 2,538,836 | 2,495,923 |
| 2012 | NA | 11,612 | NA | 1,127,213 | 1,213,194 |
| 2013 | NA | 17,594 | NA | 810,059 | 759,639 |
| **Average** | **44,033** | **24,626** | **22,646** | **1,220,007** | **1,178,426** |

**Notes:**

1) * Denotes an index Gage
2) ^ Denotes gage data was filled
3) Source of raw data – USGS NWIS website. TS Tool was used to manipulate Data.



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## Table 2.4: Guernsey to State Line Annual Stream Flow Summary

| | **6657000 *** | **6674500 *** | **6670500 *** |
|---|---|---|---|
| | N Platte River Below Whalen Divers Dam | N Platte River and Wyoming – Nebraska State Line | Laramie River near Ft. Laramie |
| 1972 | 504,715 | 648,055 | 89,841 |
| 1973 | 1,237,720 | 1,658,984 | 341,271 |
| 1974 | 898,258 | 1,085,502 | 99,753 |
| 1975 | 344,618 | 455,681 | 53,042 |
| 1976 | 285,360 | 417,662 | 63,346 |
| 1977 | 255,579 | 350,163 | 45,972 |
| 1978 | 298,881 | 410,079 | 71,961 |
| 1979 | 277,726 | 374,102 | 54,612 |
| 1980 | 518,065 | 690,191 | 128,667 |
| 1981 | 257,219 | 346,212 | 20,571 |
| 1982 | 244,527 | 345,599 | 24,816 |
| 1983 | 1,339,893 | 1,977,968 | 513,096 |
| 1984 | 1,495,054 | 2,122,075 | 473,297 |
| 1985 | 496,052 | 644,874 | 70,672 |
| 1986 | 924,895 | 1,220,777 | 190,827 |
| 1987 | 283,327 | 426,421 | 46,372 |
| 1988 | 310,221 | 425,812 | 50,064 |
| 1989 | 276,583 | 328,404 | 31,605 |
| 1990 | 219,381 | 288,030 | 32,045 |
| 1991 | 250,234 | 339,883 | 48,028 |
| 1992 | 227,737 | 277,457 | 34,384 |
| 1993 | 237,059 | 349,397 | 50,012 |
| 1994 | 260,319 | 352,829 | 34,727 |
| 1995 | 401,026 | 604,337 | 130,082 |
| 1996 | 438,292 | 551,909 | 63,889 |
| 1997 | 804,853 | 940,871 | 56,159 |
| 1998 | 559,157 | 655,971 | 37,266 |
| 1999 | 755,433 | 930,781 | 92,961 |
| 2000 | 341,586 | 451,956 | 73,282 |
| 2001 | 287,404 | 380,943 | 45,210 |
| 2002 | 209,433 | 243,482 | 33,932 |
| 2003 | 212,321 | 245,263 | 29,467 |
| 2004 | 196,205 | 201,522 | 21,822 |
| 2005 | 224,320 | 249,315 | 22,499 |
| 2006 | 258,494 | 280,731 | 19,754 |
| 2007 | 268,182 | 284,204 | 19,932 |
| 2008 | 292,241 | 329,898 | 22,425 |
| 2009 | 251,011 | 311,810 | 23,564 |
| 2010 | 844,856 | 1,057,614 | 157,242 |
| 2011 | 1,871,765 | 2,191,803 | 298,745 |
| 2012 | 388,260 | 431,558 | 36,820 |
| 2013 | 251,941 | 289,099 | 30,782 |
| **Average** | **483,338** | **623,077** | **90,115** |

**Notes:**

1) * Denotes an index Gage
2) ^ Denotes gage data was filled
3) Source of raw data – USGS NWIS website. TS Tool was used to manipulate Data.

**Table 2.5: Lower Laramie Annual Streamflow Summary**

| | 6664400 ^ Sybille Cr. Ab Mules Cr. | 6675900 ^ Sybille Cr. Ab Canal 3 | 6670500 Laramie R. Nr Ft. Laramie |
|---|---|---|---|
| 1972 | | | 89,841 |
| 1973 | | | 341,271 |
| 1974 | | | 99,753 |
| 1975 | 6,004 | | 53,042 |
| 1976 | 5,627 | | 63,346 |
| 1977 | 4,950 | | 45,972 |
| 1978 | 8,338 | | 71,961 |
| 1979 | 10,245 | | 54,612 |
| 1980 | 30,362 | | 128,667 |
| 1981 | 6,852 | 11,780 | 20,571 |
| 1982 | 6,210 | 18,485 | 24,816 |
| 1983 | 88,950 | 106,256 | 513,096 |
| 1984 | 50,504 | 67,993 | 473,297 |
| 1985 | 6,542 | 27,588 | 70,672 |
| 1986 | 10,214 | 34,988 | 190,827 |
| 1987 | 5,830 | 25,485 | 46,372 |
| 1988 | 13,222 | 30,893 | 50,064 |
| 1989 | 4,518 | 9,792 | 31,605 |
| 1990 | 12,643 | 18,337 | 32,045 |
| 1991 | 16,299 | 20,496 | 48,029 |
| 1992 | 6,535 | 10,788 | 34,384 |
| 1993 | 15,378 | 21,672 | 50,012 |
| 1994 | 7,398 | 15,361 | 34,727 |
| 1995 | 24,650 | 33,067 | 130,082 |
| 1996 | 12,659 | 22,235 | 63,889 |
| 1997 | 7,885 | 19,065 | 56,159 |
| 1998 | 9,187 | 20,100 | 37,266 |
| 1999 | 16,892 | 28,257 | 92,961 |
| 2000 | 7,381 | 16,553 | 73,282 |
| 2001 | 15,287 | 20,280 | 45,210 |
| 2002 | 4,603 | 3,359 | 33,932 |
| 2003 | 12,701 | 15,046 | 29,467 |
| 2004 | 4,739 | 6,456 | 21,823 |
| 2005 | 7,616 | 15,869 | 22,499 |
| 2006 | 6,848 | 10,564 | 19,754 |
| 2007 | 10,226 | 15,755 | 19,932 |
| 2008 | 8,626 | 15,507 | 22,426 |
| 2009 | 10,406 | 18,515 | 23,564 |
| 2010 | 44,387 | 60,301 | 157,242 |
| 2011 | 13,503 | 40,288 | 298,745 |
| 2012 | 5,932 | 14,662 | 36,820 |
| 2013 | | | 30,782 |
| **Average** | **14,214** | **24,869** | **90,115** |

**Notes:**

1) * Denotes an index Gage
2) ^ Denotes gage data was filled
3) Source of raw data – USGS NWIS website. TS Tool was used to manipulate Data.

### Table 2.6: Horse Creek Annual Stream Flow Summary

| | Horse Cr. Nr. Johnson Ranch Nr Lagrange USGS 06675850 | Horse Cr. At WY Cross Ranch Nr Lagrange USGS 06676550 | Bear Cr. Nr Lagrange USGS 06676900 |
|---|---|---|---|
| 1972 | | 6,120.2 | |
| 1973 | | 21,748.5 | |
| 1974 | | | |
| 1975 | | | |
| 1976 | | | |
| 1977 | | | |
| 1978 | | | |
| 1979 | 4,948.4 | | 3,081.9 |
| **Average** | **4,948.4** | **13,934.4** | **3,081.9** |

Notes:
1) * Denotes an index Gage
2) ^ Denotes gage data was filled
3) Source of raw data – USGS NWIS website. TS Tool was used to manipulate Data.

### Table 2.7: South Platte Annual Stream Flow Summary

| | Crow Creek Ab 19th Street USGS Gage 06755960 |
|---|---|
| 1994 | 1,805.2 |
| 1995 | 8,964.6 |
| 1996 | 4,714.2 |
| 1997 | 11,199.8 |
| 1998 | 10,544.5 |
| 1999 | 28,183.4 |
| 2000 | 3,409 |
| 2001 | 3,007.8 |
| 2002 | 1,682.5 |
| 2003 | 1,429.6 |
| 2004 | 1,091.7 |
| 2005 | 1,397.3 |
| 2006 | 1,165.2 |
| 2007 | 1,383.9 |
| 2008 | 2,127.9 |
| 2009 | 3,054.2 |
| 2010 | 14,786.2 |
| 2011 | 5,894.6 |
| 2012 | 1,552.1 |
| 2013 | 9,797.9 |
| **Average** | **5,859.58** |

Notes:
1) * Denotes an index Gage
2) ^ Denotes gage data was filled
3) Source of raw data – USGS NWIS website. TS Tool was used to manipulate Data.

## 2.3 GAGE DATA MANIPULATION AND DATA EXTENSION

The computer program TS Tool was used to manipulate the daily streamflow data to convert data units, study periods, conversion to monthly and annual flows and data extension. TS Tool was developed by Riverside Technology, Inc. funded by the State of Colorado, Water Conservation Board under the Colorado River Decision Support System. TS Tool was selected to perform the data manipulation because it is an integral tool for more advanced modeling techniques such as StateMOD, which is used in many of the Wyoming Water Development Commission's (WWDC) ongoing efforts to model, and analyze stream systems throughout the state. This decision was made so that data collected during this update could easily be incorporated to a more robust model in the future if desired.

The USGS daily streamflow data is input into TS Tool. Using a list of built in commands; this data can be further manipulated. The first adjustment to the data was converting the flow from cubic feet per second (CFS) to acre-feet (ac-ft) per day. The next function was to fill missing data when needed. A gage with complete data (independent gage) with similar drainage area and elevation was chosen to provide a comparison to a gage with missing data (dependent gage). TS Tool utilizes a host of options for data filling. This study used two methods to fill the missing data. The methods used for this study was either by regression equations or the MOVE2 method. Regression equations are developed by using ordinary least square (OLS) regression. Regression relationships are developed using the analysis period for the time series and are applied to the fill period. This methodology is further explained in Appendix 2 of Bulletin 17B, Guidelines for Determining Flood Flow Frequency, USGS

The daily streamflow data for the complete and filled gages was then converted to monthly and annual flows using TS Tool. This data was then used to determine dry, average and wet year water years.

### 2.3.1 Dry, Average and Wet Years Classifications

Index gages were used to determine annual stream flow characteristics for each of the seven subbasins to classify the study period into dry, wet and average years. The index gages used were chosen by gages that contained a significant amount of flow data and were not impacted by reservoirs. The index gages selected for the dry, average and wet year classifications were previously shown in **Tables 2.1 through 2.7**. The resulting dry, average and wet year classifications for each of the subbasins are shown in **Table 2.8**.

## Table 2.8: Dry, Average, Wet Water Year Determination

| Year | Upper Laramie | Lower Laramie | Above Pathfinder | Pathfinder to Guernsey | Guernsey to State Line | Horse Creek | South Platte |
|---|---|---|---|---|---|---|---|
| 1972 | Ave | Ave | Ave | Ave | Ave | | |
| 1973 | Ave | Ave | Wet | Wet | Wet | | |
| 1974 | Ave | Ave | Ave | Ave | Wet | | |
| 1975 | Ave | Ave | Ave | Ave | Ave | | |
| 1976 | Ave | Ave | Ave | Ave | Ave | | |
| 1977 | Dry | Dry | Dry | Ave | Ave | | |
| 1978 | Ave | Ave | Ave | Ave | Ave | | |
| 1979 | Wet | Wet | Ave | Ave | Ave | | |
| 1980 | Ave | Ave | Ave | Ave | Ave | | |
| 1981 | Dry | Dry | Dry | Dry | Ave | | |
| 1982 | Wet | Wet | Ave | Ave | Ave | | |
| 1983 | Wet | Wet | Wet | Wet | Wet | | |
| 1984 | Wet | Wet | Wet | Ave | Wet | | |
| 1985 | Ave | Ave | Ave | Dry | Ave | | |
| 1986 | Wet | Wet | Wet | Ave | Wet | | |
| 1987 | Dry | Dry | Ave | Ave | Ave | | |
| 1988 | Ave | Ave | Ave | Ave | Ave | | |
| 1989 | Dry | Dry | Dry | Dry | Ave | | |
| 1990 | Ave | Ave | Ave | Dry | Dry | | |
| 1991 | Ave | Ave | Ave | Ave | Ave | | |
| 1992 | Ave | Ave | Dry | Dry | Dry | | |
| 1993 | Ave | Ave | Ave | Ave | Ave | | |
| 1994 | Ave | Ave | Ave | Ave | Ave | | Ave |
| 1995 | Ave | Ave | Wet | Wet | Ave | | Ave |
| 1996 | Ave | Ave | Ave | Ave | Ave | | Ave |
| 1997 | Wet | Wet | Wet | Wet | Wet | | Wet |
| 1998 | Ave | Ave | Ave | Ave | Ave | | Wet |
| 1999 | Ave | Ave | Ave | Wet | Ave | | Wet |
| 2000 | Ave | Ave | Ave | Ave | Ave | | Ave |
| 2001 | Dry | Dry | Dry | Ave | Ave | | Ave |
| 2002 | Dry | Dry | Dry | Dry | Dry | | Ave |
| 2003 | Ave | Ave | Ave | Ave | Dry | | Ave |
| 2004 | Dry | Dry | Dry | Dry | Dry | | Dry |
| 2005 | Ave | Ave | Ave | Ave | Dry | | Dry |
| 2006 | Ave | Ave | Ave | Ave | Dry | | Dry |
| 2007 | Ave | Ave | Ave | Ave | Ave | | Dry |
| 2008 | Ave | Ave | Ave | Wet | Ave | | Ave |
| 2009 | Ave | Ave | Ave | Ave | Ave | | Ave |
| 2010 | Wet | Wet | Wet | Wet | Wet | | Wet |
| 2011 | Wet | Wet | Wet | Wet | Wet | | Ave |
| 2012 | Dry | Dry | Dry | Dry | Ave | | Ave |
| 2013 | Ave | Ave | Ave | Ave | Dry | | Ave |

Annual flows were calculated from the daily streamflow data using TS Tool. In subbasins where multiple indicator gages were used, summations of the annual flows were calculated to determine the total flow of the index gages. The summation of the index gages annual flows was used to determine the dry, average and wet years. In the subbasins with a single index gage, the dry, average and wet years were computed from the annual totals for that gage. The wettest and driest 20% of the study period years, on an annual flow basis were identified. The remaining 60% of years were classified as average years.

Using the dry, average and wet year classifications, average monthly flows were calculated for all of the gage records. For each gage used in the study, averages of all monthly flows for the study period were calculated each of the dry, average and wet years. The result is a single flow value for each month of the year for each of the dry, average and wet conditions.

### 2.3.2 Ungaged Tributary Flow Estimation

Many of the tributaries within each of the subbasins do not have gages or lack sufficient gaging station records. To estimate the flow contributions of these tributaries, annual flows were calculated using a regression equation published by H.W. Lowham in USGS Water Resources Investigation Report 88-4045 entitled "Streamflows in Wyoming" (WRIR 88-4045).

The first step of the estimation was to determine the region type as defined in WRIR 88-4045 and the correlating equations for each of the region types. The region type classifications are the Plains Region, High Desert Region and Mountainous Region. Equations to estimate the annual stream flow were provided in the WRIR 88-4045 for each of the region classifications. These equations and a listing of the variables are shown below:

Plains and High Desert Regions

$$Q_a = .0021\ A^{0.88}\ PR^{1.19}$$

Where: $Q_a$ = mean annual flow in CFS
A = contributing drainage area, square miles
PR = average annual precipitation

Mountainous Region

$$Q_a = .0013\ A^{0.93}\ PR^{1.43}$$

Where: $Q_a$ = mean annual flow in CFS
A = contributing drainage area, square miles
PR = average annual precipitation

GIS mapping was used to determine the region type a tributary would be classified within. Mapping of the different regions within the basin were overlaid with HUC watersheds to determine the tributary regional classification. In instances where a tributary was located in multiple region classifications, the areas were calculated pertaining to whichever region was appropriate. Physical data was then obtained from the mapping to collect the necessary variables required of the individual equations. Average annual precipitation was also collected and included in GIS. The average annual monthly precipitation data for the period 1981-2010 was obtained for the entire state from the USDA/NRCS Geospatial Data Center. The source of the data is the Oregon Climate Service at Oregon State University. PRISM (Parameter-elevation Relationships on Independent Slopes Model) is an interpolation method to develop data sets that is the current state of knowledge of spatial climate pattern in the United States.

Variables used to determine annual flow were: 1) area of the reach, 2) "region" as defined in Plate 1 of WRIR 88 4045, and average annual precipitation. The values used for each reach were determined using USGS data and ArcGIS. Monthly averages were assumed to be a fraction of the annual flow based on gage data from the nearest, most hydrologically similar gage. The results of these estimations are presented in **Table 2.9**.

**Table 2.9: Ungaged Flow Calculation**

| | Reach | Mountainous Reach Area (Sq. Miles) | High Desert Reach Area (Sq. Miles) | Mountainous Average Annual Precipitation (in.) | High Desert Average Annual Precipitation (in.) | Mountainous Mean Annual Flow from Precip Regression (Acre-Ft) | High Desert Mean Annual Flow (Acre-Ft) | Total Mean Annual Flow per Reach all precip (Acre-Ft) |
|---|---|---|---|---|---|---|---|---|
| Upper Laramie | 1001 | 173 | 15 | 24 | 15 | 99794 | 407 | 99794 |
| | 1002 | 38 | 0 | 18 | 0 | 16734 | 0 | 16734 |
| | 1004 | 1 | 94 | 13 | 13 | 485 | 1752 | 2237 |
| | 1005 | 1 | 182 | 18 | 16 | 819 | 4113 | 4932 |
| | 1007 | 64 | 37 | 16 | 13 | 24340 | 770 | 25110 |
| | 1008 | 12 | 125 | 16 | 12 | 5278 | 2054 | 7332 |
| | 1009 | 51 | 29 | 17 | 13 | 20410 | 624 | 21033 |
| | 1011 | 37 | 144 | 18 | 12 | 16649 | 2417 | 19066 |
| | 1012 | 173 | 190 | 24 | 12 | 108995 | 3053 | 112048 |
| | 1012A | 161 | 0 | 25 | 0 | 102857 | 0 | 102857 |
| | 1014 | 16 | 61 | 12 | 7 | 4194 | 547 | 4741 |
| | 1015 | 0 | 90 | 0 | 12 | 0 | 1601 | 1601 |
| | 1017 | 23 | 165 | 22 | 14 | 14823 | 3052 | 17875 |
| | 1018 | 0 | 215 | 0 | 13 | 0 | 3654 | 3654 |
| | 1019 | 0 | 94 | 0 | 13 | 0 | 1796 | 1796 |
| Above Pathfinder | 2001 | 243 | 0 | 24 | 0 | 146565 | 0 | 146565 |
| | 2002 | 201 | 0 | 24 | 0 | 122135 | 0 | 122135 |
| | 2003 | 27 | 0 | 27 | 0 | 22585 | 0 | 22585 |
| | 2004 | 62 | 0 | 36 | 0 | 72978 | 0 | 72978 |
| | 2006 | 97 | 9 | 32 | 15 | 95776 | 265 | 96041 |
| | 2006.A | 66 | 0 | 36 | 0 | 52702 | 0 | 52702 |
| | 2006.B | 31 | 9 | 32 | 15 | 32874 | 265 | 33139 |
| | 2008 | 47 | 23 | 27 | 14 | 36409 | 552 | 36962 |
| | 2009 | 35 | 33 | 20 | 14 | 18317 | 735 | 19052 |
| | 2010 | 211 | 51 | 36 | 13 | 227015 | 1016 | 228031 |
| | 2012 | 44 | 22 | 33 | 13 | 46185 | 494 | 46680 |
| | 2013 | 2 | 56 | 18 | 13 | 1195 | 1078 | 2272 |
| | 2014 | 34 | 18 | 25 | 14 | 24477 | 461 | 24938 |
| | 2016 | 75 | 61 | 33 | 13 | 76876 | 1182 | 78058 |
| | 2018 | 24 | 65 | 21 | 11 | 14277 | 1057 | 15334 |
| | 2019 | 0 | 45 | 0 | 10 | 0 | 707 | 707 |
| | 2020 | 73 | 66 | 25 | 14 | 49736 | 1421 | 51157 |
| | 2021 | 0 | 73 | 0 | 11 | 0 | 1152 | 1152 |
| | 2022 | 79 | 172 | 19 | 12 | 38234 | 2765 | 41000 |
| | 2024.A | 114 | 0 | 24 | 0 | 71278 | 0 | 71278 |
| | 2025 | 16 | 686 | 16 | 10 | 6208 | 7586 | 13794 |
| | 2026 | 16 | 301 | 0 | 11 | 0 | 4076 | 4076 |
| | 2027 | 28 | 187 | 21 | 12 | 16356 | 2919 | 19275 |
| | 2028 | 0 | 289 | 0 | 12 | 0 | 4419 | 4419 |
| | 2029 | 8 | 490 | 32 | 13 | 9787 | 7438 | 17226 |
| | 2030 | 157 | 283 | 27 | 13 | 113629 | 4680 | 118309 |
| | 2031 | 162 | 533 | 18 | 12 | 66721 | 7525 | 74247 |
| | 2032 | 8 | 472 | 19 | 10 | 4109 | 5429 | 9538 |
| | 2033 | 243 | 2759 | 21 | 11 | 122697 | 27775 | 150471 |
| | 2034 | 115 | 908 | 22 | 13 | 63614 | 12775 | 76389 |
| Pathfinder to Guernsey | 3001 | 0 | 266 | 0 | 12 | 0 | 3956 | 3956 |
| | 3002 | 161 | 236 | 16 | 15 | 57467 | 4780 | 62247 |
| | 3003 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | 3004 | 0 | 301 | 0 | 12 | 0 | 4515 | 4515 |



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**Table 2.9: Ungaged Flow Calculation**

| | Reach | Mountainous Reach Area (Sq. Miles) | High Desert Reach Area (Sq. Miles) | Mountainous Average Annual Precipitation (in.) | High Desert Average Annual Precipitation (in.) | Mountainous Mean Annual Flow from Precip Regression (Acre-Ft) | High Desert Mean Annual Flow (Acre-Ft) | Total Mean Annual Flow per Reach all precip (Acre-Ft) |
|---|---|---|---|---|---|---|---|---|
| | 3005 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | 3006 | 0 | 657 | 0 | 12 | 0 | 8764 | 8764 |
| | 3007 | 279 | 146 | 19 | 13 | 119244 | 2698 | 121941 |
| | 3008 | 172 | 41 | 20 | 12 | 84081 | 792 | 84873 |
| | 3009 | 0 | 210 | 0 | 12 | 0 | 3284 | 3284 |
| | 3010 | 0 | 81 | 0 | 12 | 0 | 1380 | 1380 |
| | 3011 | 0 | 35 | 0 | 11 | 0 | 596 | 596 |
| | 3012 | 153 | 49 | 21 | 12 | 77798 | 903 | 78701 |
| | 3013 | 0 | 51 | 0 | 12 | 0 | 902 | 902 |
| | 3014 | 0 | 149 | 0 | 12 | 0 | 2336 | 2336 |
| | 3015 | 0 | 31 | 0 | 12 | 0 | 613 | 613 |
| | 3016 | 120 | 56 | 21 | 13 | 61969 | 1139 | 63108 |
| | 3017 | 0 | 201 | 0 | 12 | 0 | 3253 | 3253 |
| | 3018 | 38 | 74 | 20 | 14 | 19773 | 1534 | 21307 |
| | 3019 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | 3020 | 188 | 103 | 20 | 15 | 91794 | 2178 | 93972 |
| | 3021 | 0 | 84 | 0 | 13 | 0 | 1575 | 1575 |
| | 3022 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | 3023 | 0 | 242 | 0 | 13 | 0 | 4101 | 4101 |
| | 3024 | 0 | 66 | 0 | 14 | 0 | 1354 | 1354 |
| | 3025 | 0 | 343 | 0 | 14 | 0 | 5928 | 5928 |
| | 3026 | 0 | 61 | 0 | 15 | 0 | 1441 | 1441 |
| | 3027 | 0 | 223 | 0 | 14 | 0 | 4174 | 4174 |
| | 3028 | 0 | 93 | 0 | 14 | 0 | 1859 | 1859 |
| | 3029 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | 3030 | 100 | 112 | 20 | 16 | 48072 | 2603 | 50676 |
| | 3031 | 0 | 242 | 0 | 14 | 0 | 4437 | 4437 |
| | 3032 | 0 | 330 | 0 | 14 | 0 | 6015 | 6015 |
| | 3033 | 46 | 148 | 17 | 15 | 19383 | 3076 | 22459 |
| | 3034 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Lower Laramie** | 4001 | 175 | 183 | 16 | 15 | 58954 | 3619 | 62573 |
| | 4002 | 42 | 324 | 15 | 15 | 14775 | 6422 | 21197 |
| | 4003 | 3 | 151 | 15 | 15 | 1160 | 3165 | 4325 |
| | 4004 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | 4005 | 251 | 282 | 18 | 14 | 101682 | 4977 | 106659 |
| | 4006 | 0 | 551 | 0 | 14 | 0 | 9193 | 9193 |
| | 4007 | 1 | 638 | 19 | 16 | 867 | 11949 | 12817 |
| | 4008 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | 7002 | 28 | 1043 | 21 | 16 | 16213 | 18432 | 34645 |
| **Horse Creek** | 6001 | 48 | 1125 | 19 | 16 | 23478 | 20028 | 43506 |
| | 6002 | 0 | 424 | 0 | 15 | 0 | 8088 | 8088 |
| **South Platte** | 7001 | 0 | 450 | 0 | 15 | 0 | 8241 | 8241 |
| | 7002 | 28 | 1043 | 21 | 16 | 16213 | 18432 | 34645 |

## 2.4 AGRICULTURAL CONSUMPTIVE USE

Agricultural consumptive use and depletion amounts are described in the Agricultural Use Section of Volume 3 of this study. Agricultural consumptive use, represented by monthly depletion amounts, was developed for each of the seven subbasins based on the amount of irrigated acreage within the basin. Information in the Agricultural Use Section of Volume 3 was used to provide data for agricultural consumptive use for this task. This data was further refined to determine the locations and quantity of consumptive use in relation to the streams and reaches developed in the spreadsheet model. Further refinement included the use of GIS mapping to determine the points of diversions that supplied water for the river systems to the irrigated lands. Point of diversion data provided by the SEO included linking of irrigated lands to a point of diversion on a river or stream. For use in the development of the model, the points of diversions were assigned to a river reach in the model. The amount of irrigated lands being supplied by each point of diversion was then summarized and tied to specific reaches in the model. The result of this analysis determined a total amount of irrigated land that was being supplied water diverted from each of the reaches in the model. Using the consumptive use values provided in the Agricultural Use Section of Volume 3, a total amount of agricultural water use in every reach of the model was developed. It should be noted that the consumptive use values were based on the unit consumptive use rates within the specific subbasin as described within the Wyoming Depletion Plan and the 2006 Platte River Basin Plan and were not calculated based on typical consumptive use calculations. The Wyoming Depletion Plan is the document that the Wyoming State Engineer's Office (SEO) follows in addressing the State of Wyoming's participation in the Platte River Recovery Implementation Program.

To convert the annual irrigation totals to monthly depletion values for the model, a large irrigation diversion in each subbasin was evaluated for each of the three years, 2011, 2012 and 2013. Diversion records for these large diversions were used to determine what percentage of the total irrigation was delivered and consumed during each month of the irrigation season. A percentage of the annual diversion was calculated by dividing the total monthly diversion for each month by the total seasonal diversion. This percentage was then applied to the total annual agricultural depletion quantity assigned to each reach to determine the monthly consumptive use values for each of the reaches in the basin.

## 2.5 IMPORTS AND EXPORTS

The spreadsheet models quantify transbasin diversions and the volumes of water diverted in Wyoming for out-of-state water needs. The transbasin diversions are reported as exports and imports within the water balance summary tables. Water transferred out of a subbasin is quantified in the export column of the spreadsheets. Water transferred into a subbasin is quantified in the import column. The irrigation diversions serving out-of-state agricultural needs, mandated under Federal projects and contracts, are quantified in the "Federal Canal Diversion Out-of-State Delivery" columns.

The City of Cheyenne Board of Public Utilities owns and operates a complicated water supply system that imports water from the Little Snake River Basin to the North Platte River Basin. The water is released to the North Platte River in exchange for diversions from the Douglas Creek drainage within the Above Pathfinder subbasin in the Medicine Bow Mountains. The diversions from the Douglas Creek drainage are captured and stored in Rob Roy Reservoir and Lake Owen and conveyed to the South Platte Basin via a series of pipelines and reservoirs owned by the City of Cheyenne and eventually delivered to the City's water treatment plant when the reservoirs are drawn down to serve municipal water needs.

The Wheatland Irrigation District located in the Lower Laramie subbasin imports water for irrigation through diversions from the Rock Creek drainage within the Above Pathfinder subbasin by capturing and conveying water in a series of reservoirs and ditches. The main conveyance structure is the Canon Ditch that diverts from Rock Creek just above the Town of Arlington.

Within the Guernsey to the State Line reach of the North Platte River, water supplies are diverted and conveyed within Federal Canals for serving agricultural irrigation needs of North Platte Project and Warren Act Contractors within Wyoming and Nebraska. The one North Platte Project contractor in Wyoming is Goshen Irrigation District located south of the North Platte River immediately west of the Nebraska State Line. The three Wyoming Warren Act contractors are Lingle Water Users, Hill Irrigation District, and Rock Ranch Irrigation District. Irrigation water is diverted directly from the North Platte River and applied to the lands of the federal contractors within Wyoming. The agricultural consumptive use of the federal contractors within Wyoming is considered a consumptive use loss within this subbasin reach of the model. The water diverted from the North Platte River within Wyoming and delivered to out-of-state federal contractors in Nebraska is based on historical diversion records.

## 2.6 SPREADSHEET MODELS

Individual spreadsheets were developed for each of the seven major subbasins of the Platte River System. Each subbasin was then divided into river reaches with a starting and ending node. The nodes were developed where a gage was present; a natural flow location was quantified, at a tributary confluence or the location of a major diversion. Water supply and use were imparted onto each reach to determine the amount of water anticipated within each reach during a dry, wet and average hydrologic condition.

Each spreadsheet provides the water balance for each of the subbasins. The water balance estimates the amount of water provided to the entire subbasin by using either gaged flow or estimated flow from regression equations.

### 2.6.1 Spreadsheet Model Data

The spreadsheet contains several tables that contain the input data into the water balance equations for each reach of the river systems. Each of the tables contains data for the dry, wet and average hydrologic year. Tables include:

- Gaged flow – Data includes stream flow gage data for each hydrologic condition by month and total annual flow in acre-feet.
- Flow from Precipitation – Data includes estimated monthly and annual flow derived from regression equations.
- Agricultural Consumptive Use – Data includes monthly and annual consumptive use estimated from irrigated lands and applying the depletion factors to the amount of irrigated acres within each river reach.
- Municipal Diversion – Data includes monthly and annual diversions from each river reach for supply to municipalities. This data was obtained from other technical memoranda developed in separate tasks of this project.
- Industrial Diversions – Data includes diversions monthly and annual diversions from each river reach for supply to industrial uses. This data was obtained from other technical memoranda developed in separate tasks of this project.
- Instream Flows – Data includes monthly and annual requirements to satisfy instream flow permits. Instream flow data was obtained from the SEO website.
- Return Flows – Data includes monthly and annual flows that return to the river from municipal and industrial uses. This data was obtained from other technical memoranda developed in separate tasks of this project.
- Reservoir Release – Data includes flows from a reservoir release into each reach of the river system. Reservoir release data was obtained from the U.S. Bureau of Reclamation's (USBR) website for the federal reservoirs in the system and from the SEO website and hydrographer's reports.
- Reservoir Evaporative Losses – Data includes monthly and annual water losses from evaporation of reservoir storage. Evaporative data was obtained from the previous Basin Plan.

- Reservoir Storage Totals – Data includes end of month storage volumes. Reservoir storage data was obtained from the USBR's website for the federal reservoirs in the system and from the SEO website and hydrographer's reports.
- Import – data includes water imported into a river reach via a transbasin delivery. This data was obtained from the SEO website and hydrographer's reports.
- Export - Data includes water exported from a river reach via a transbasin delivery. This data was obtained from the SEO website and hydrographer's reports.

The data is entered in the "Data" tab of the spreadsheet. Data entered in the table on the "Data" tab are then used in calculations in each individual "Reach" tab of the spreadsheet.

### 2.6.2 Reaches

River reaches were developed to represent mainstem stream or river components and contributing tributary streams. Each river reach is bound by a node. The nodes represent either an ungaged tributary flow, stream gage, confluence of two rivers or a reservoir. **Table 2.10** provides a description of each modeled river reach, reach number and subbasin.

Each river reach within a subbasin has a dedicated worksheet tab in the spreadsheet. Data entered into the "Data" tab sheet is automatically retrieved for inclusion in the Reach tabs. The "Reach" tab then performs calculations to predict and summarize the water supply and uses for each river reach. An overall map generated in GIS is also displayed on each "Reach" tab that highlights the portion of the subbasin being depicted with the river reach. The outflow of each reach is calculated for each river reach using data retrieved from the Data worksheet. The results of the calculations are then presented in graphics. Six graphs are produced to provide a visual summary of the calculations for each reach. The six graphs are; Total Outflows and Losses by Month, total Annual Gains and Losses by Type, Total Annual inflow, Flow from Precipitation, Storage Capacity, Dry Year Gains and Losses by Month and Type, Average Year Gains and Losses by Month and Type, and Wet Year Gains and Losses by Month and Type. Node and river reach mapping is presented in **Figures 2.1 through 2.7**.

**Table 2.10: Summary of River Reaches**

| Reach | Description |
|---|---|
| **Upper Laramie** | |
| 1001 | Laramie River Colorado Border to Fox Creek Confluence |
| 1002 | Fox Creek Headwaters to Laramie River Confluence |
| 1003 | Confluence of Laramie River and Fox Creek To Pioneer Gage |
| 1004 | Pioneer Gage to Confluence of Laramie River and Sand Creek |
| 1005 | Sand Creek Gage to Confluence of Laramie River and Sand Creek |
| 1006 | Laramie River Between Sand Creek and Five Mile Creek |
| 1007 | Five Mile Creek Headwaters to Confluence with Laramie River |
| 1008 | Laramie River Between Five Mile Creek and Harney Creek |
| 1009 | Harney Creek Headwaters to Confluence with Laramie River |
| 1010 | Laramie River Between Harney Creek and Laramie City |
| 1011 | Laramie River Between Laramie City and Little Laramie River |
| 1012 | Little Laramie River Gage to Laramie River |
| 1013 | Laramie River Between Little Laramie River and Four Mile Creek |
| 1014 | Four Mile Creek Headwaters to Laramie River |
| 1015 | Laramie River Between Four Mile Creek and Gage near Bosler |
| 1016 | Laramie River Between Gage near Bosler and Dutton Creek |

**Table 2.10: Summary of River Reaches**

| Reach | Description |
|---|---|
| 1017 | Dutton Creek to Confluence with Laramie River |
| 1018 | Laramie River Between Dutton Creek and Wheatland Res. #2 |
| 1019 | Laramie River Between Wheatland Reservoir #2 and #3 Dutton |
| **Above Pathfinder** | |
| 2001 | N. Platte River - CO Border to Big Creek |
| 2002 | Big Creek |
| 2003 | N. Platte River - Big Creek to French Creek |
| 2004 | French Creek |
| 2005 | N. Platte River - French Creek to Brush Creek |
| 2006 | Brush Creek |
| 2007 | N. Platte River - Brush Creek to Beaver Creek |
| 2008 | Beaver Creek |
| 2009 | N. Platte River - Beaver Creek to Encampment River |
| 2010 | Encampment River |
| 2011 | N. Platte River - Encampment River to Cow Creek |
| 2012 | Cow Creek |
| 2013 | N. Platte River - Cow Creek to Cedar Creek |
| 2014 | Cedar Creek |
| 2015 | N. Platte River - Cedar Creek to Spring Creek |
| 2016 | Spring Creek |
| 2017 | N. Platte River - Spring Creek to Lake Creek |
| 2018 | Lake Creek / Dry Creek |
| 2019 | N. Platte River - Lake Creek to Jack Creek |
| 2020 | Jack Creek |
| 2021 | N. Platte River - Jack Creek to Sage Creek |
| 2022 | Sage Creek |
| 2023 | N. Platte River - Sage Creek to Pass Creek |
| 2024 | Pass Creek |
| 2025 | N. Platte River - Pass Creek to Gage 06630000 |
| 2026 | N. Platte River - Gage 06630000 to Seminoe Reservoir |
| 2027 | Medicine Bow River - Gage 6635000 to Seminoe Reservoir |
| 2028 | Medicine Bow River - Little Medicine Bow River to Gage 6635000 |
| 2029 | Rock Creek |
| 2030 | Medicine Bow River - Medicine Bow River headwaters to Little Medicine Bow River |
| 2031 | N. Platte River - Seminoe Reservoir to Pathfinder Reservoir |
| 2032 | Sweetwater River - Gage 6639000 to Pathfinder Reservoir |
| 2033 | Sweetwater River - Headwaters to Gage 6639000 |
| 2034 | Little Medicine Bow River |
| **Below Pathfinder** | |
| 3001 | N. Platte River - PF Reservoir to Bates Cr. |
| 3002 | Bates Creek |
| 3003 | N. Platte River - Bates Creek to Poison Spider Creek |
| 3004 | Poison Spider Creek |
| 3005 | N. Platt River - Poison Spider Creek to Casper Creek |
| 3006 | Casper Creek |
| 3007 | N. Platte River - Casper Creek to Deer Creek |
| 3008 | Deer Creek |
| 3009 | N. Platte River - Deer Creek to Sand Creek |
| 3010 | Sand Creek |
| 3011 | N. Platte River - Sand Creek to Box Elder Creek |
| 3012 | Box Elder Creek |
| 3013 | N. Platte River - Box Elder Creek to Sage Creek |

**Table 2.10: Summary of River Reaches**

| Reach | Description |
|---|---|
| 3014 | Sage Creek |
| 3015 | N. Platte River - Sage Creek to La Prele Creek |
| 3016 | La Prele Creek |
| 3017 | N. Platte River - La Prele Creek to Wagonhound Creek |
| 3018 | Wagonhound Creek |
| 3019 | N. Platte River - Wagonhound Creek to La Bonte Creek |
| 3020 | La Bonte Creek |
| 3021 | N. Platte River - La Bonte Creek to Gage 6652000 |
| 3022 | N. Platte River - Gage 6652000 to Shawnee Creek |
| 3023 | Shawnee Creek |
| 3024 | N. Platte River - Shawnee Creek to Glendo Reservoir |
| 3025 | Lost Creek |
| 3026 | Elkhorn Creek |
| 3027 | Muddy Creek |
| 3028 | N. Platte - Glendo Reservoir to Gage 6652800 |
| 3029 | N. Platte River -Gage 6652800 to Horseshoe Creek |
| 3030 | Horseshoe Creek |
| 3031 | N. Platte River - Horseshoe Creek to Guernsey Reservoir |
| 3032 | Broom Creek |
| 3033 | Cottonwood Creek |
| 3034 | N. Platte River - Guernsey Reservoir to Basin Boundary |
| **Lower Laramie** | |
| 4001 | Laramie River - Basin Boundary to Sybille Creek |
| 4002 | Sybille Creek - Headwaters to USGS Gage 6664400 |
| 4003 | Sybille Creek - USGS 6664400 to Laramie River |
| 4004 | Laramie River - Sybille Creek to N. Laramie River |
| 4005 | North Laramie River |
| 4006 | Laramie River - North Laramie River to Chugwater Creek |
| 4007 | Chugwater Creek |
| 4008 | Laramie River - Chugwater Creek to USGS 6670500 |
| **Guernsey to State Line** | |
| 5001 | N. Platte River - USGS Gage 6657000 to Rawhide Creek |
| 5002 | N. Platte River -Rawhide Creek to USGS Gage 6674500 |
| **Horse Creek** | |
| 6001 | Horse Creek - Headwaters to Bear Creek |
| 6002 | Horse Creek - Bear Creek to State Line |
| **South Platte** | |
| 7001 | Crow Creek |
| 7002 | Lodgepole Creek |

### 2.6.3 Model Map

The "Model Map" tab show a schematic of the river reaches that represents the subbasin river and its tributaries. The schematic shows the nodes and node types, and lines representing the river reach. The sheet also contains a drawing of the entire subbasin with the reaches and nodes displayed for reference. The lines representing the river reaches in the schematic vary in line thickness. The variable weight indicates the amount of outflow from each reach. For example, the line thickness for each reach is representative of the average year annual outflow for that reach with a ratio of 1 pt. line thickness = 60,000 acre feet (Ac.Ft.); i.e., Reach 1004 has a line weight of 1.5.

### 2.6.4 Summary Tab

The “Summary” tab combines the cumulative input data and calculation results on a single graph. This graph displays all of the data and results for each of the three hydrologic conditions.

**Figure 2.1: Upper Laramie Reach and Node Map**

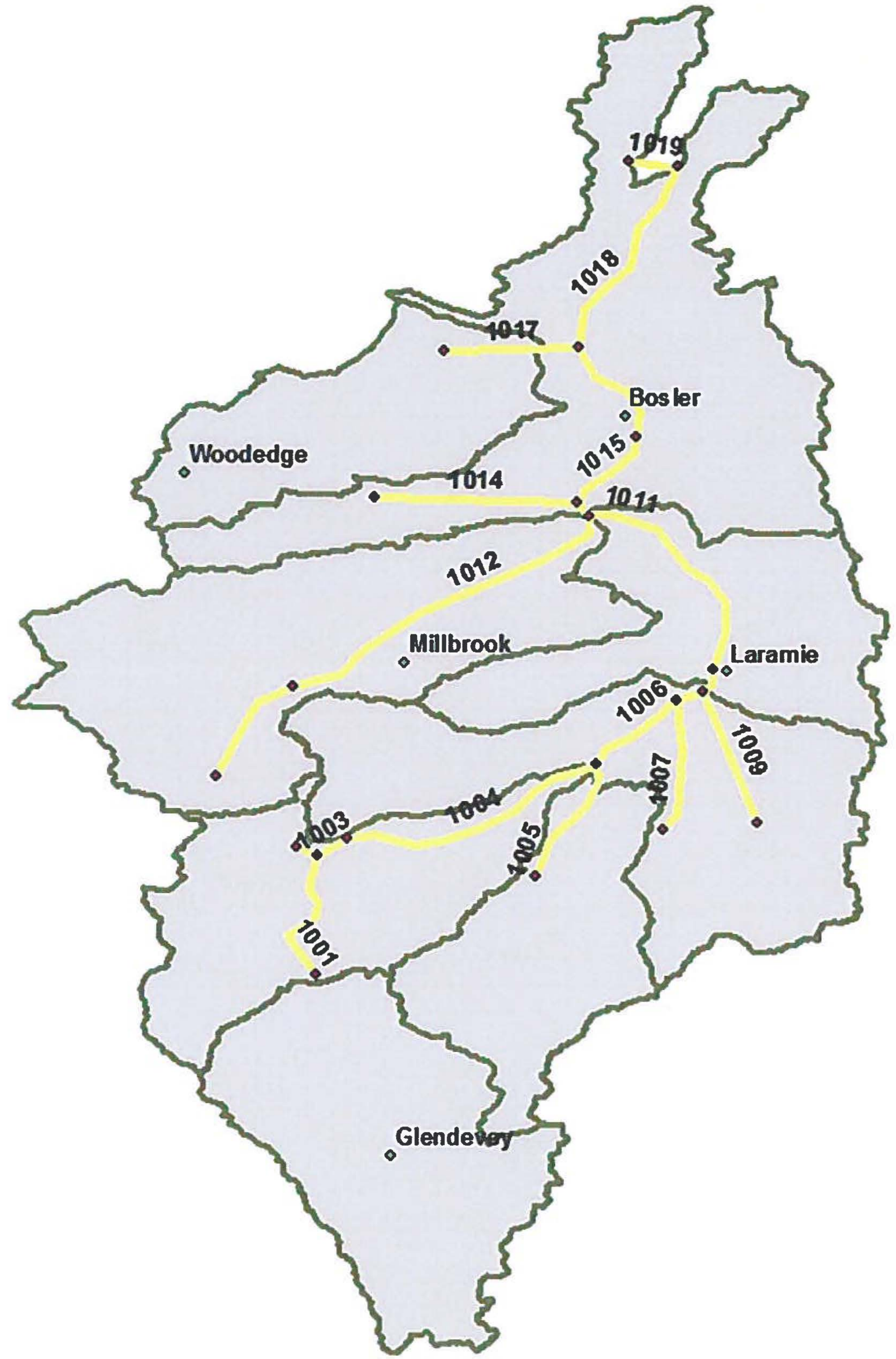

**Figure 2.2: Above Pathfinder Reach and Node Map**

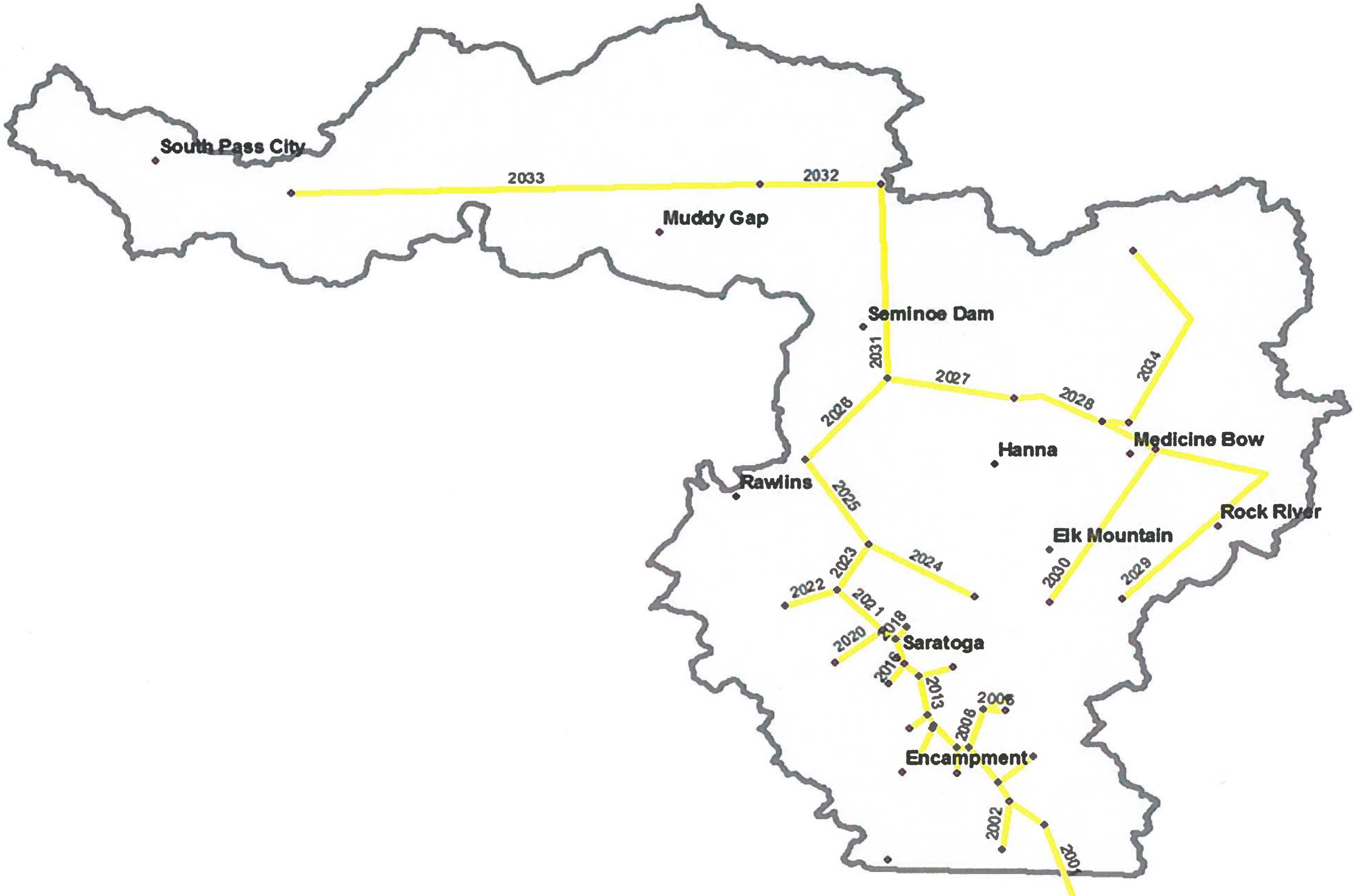

**Figure 2.3: Pathfinder to Guernsey Reach and Node Map**

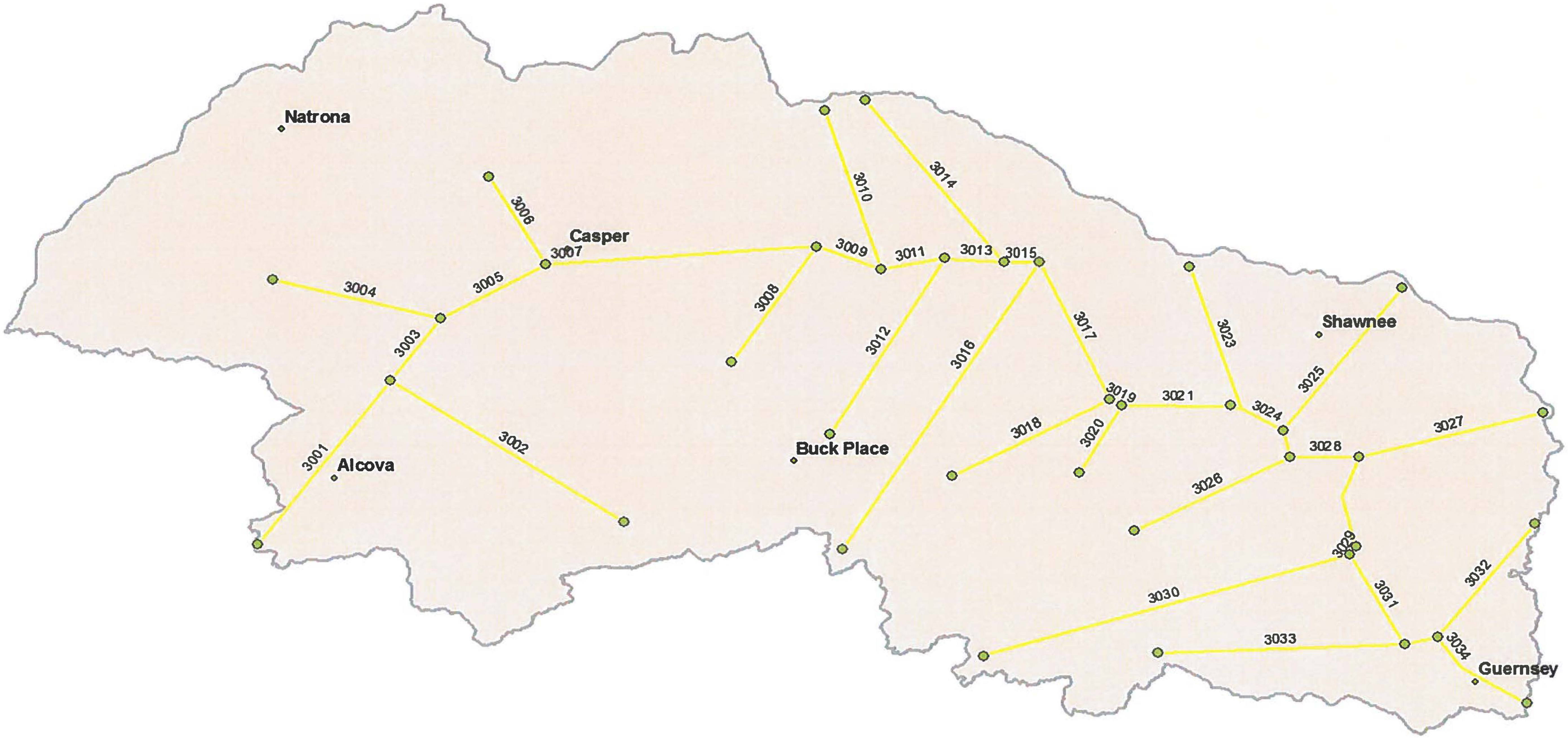




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Figure 2.4: Guernsey to State Line Reach and Node Map

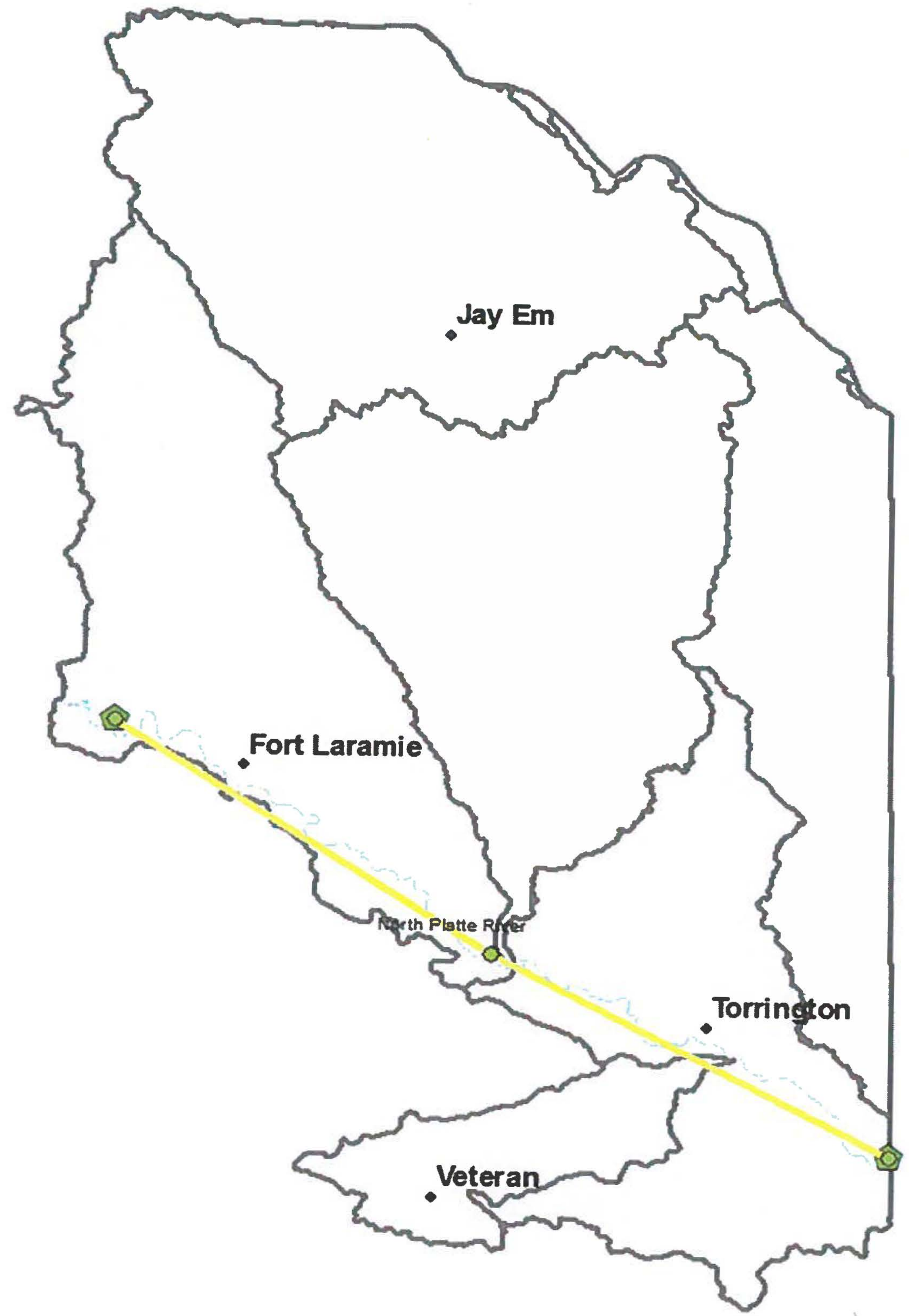
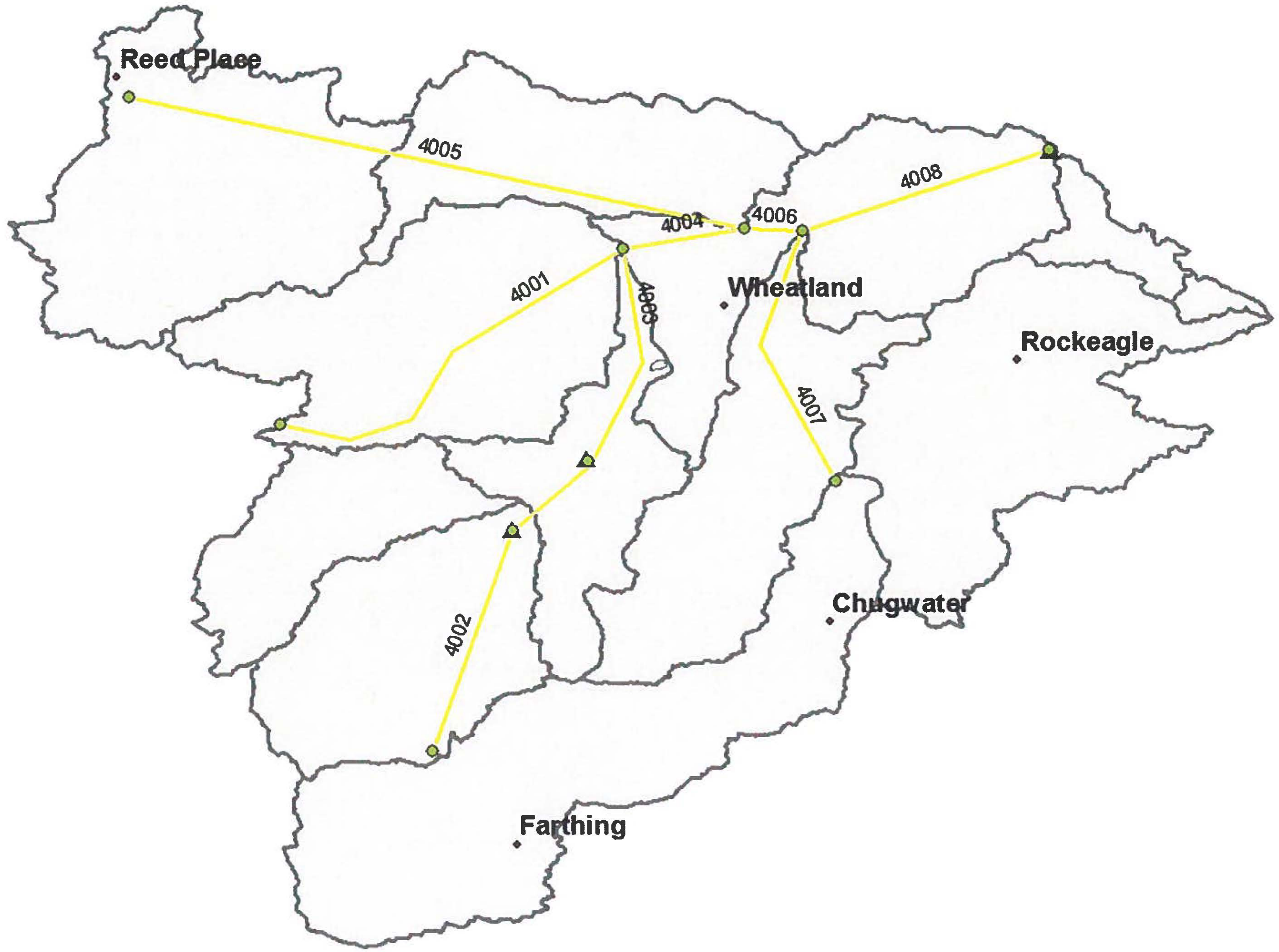


**Figure 2.5: Lower Laramie Reach and Node Map**






WENCK ASSOCIATES
Responsive partner. Exceptional outcomes.

**Figure 2.6: Horse Creek Reach and Node Map**

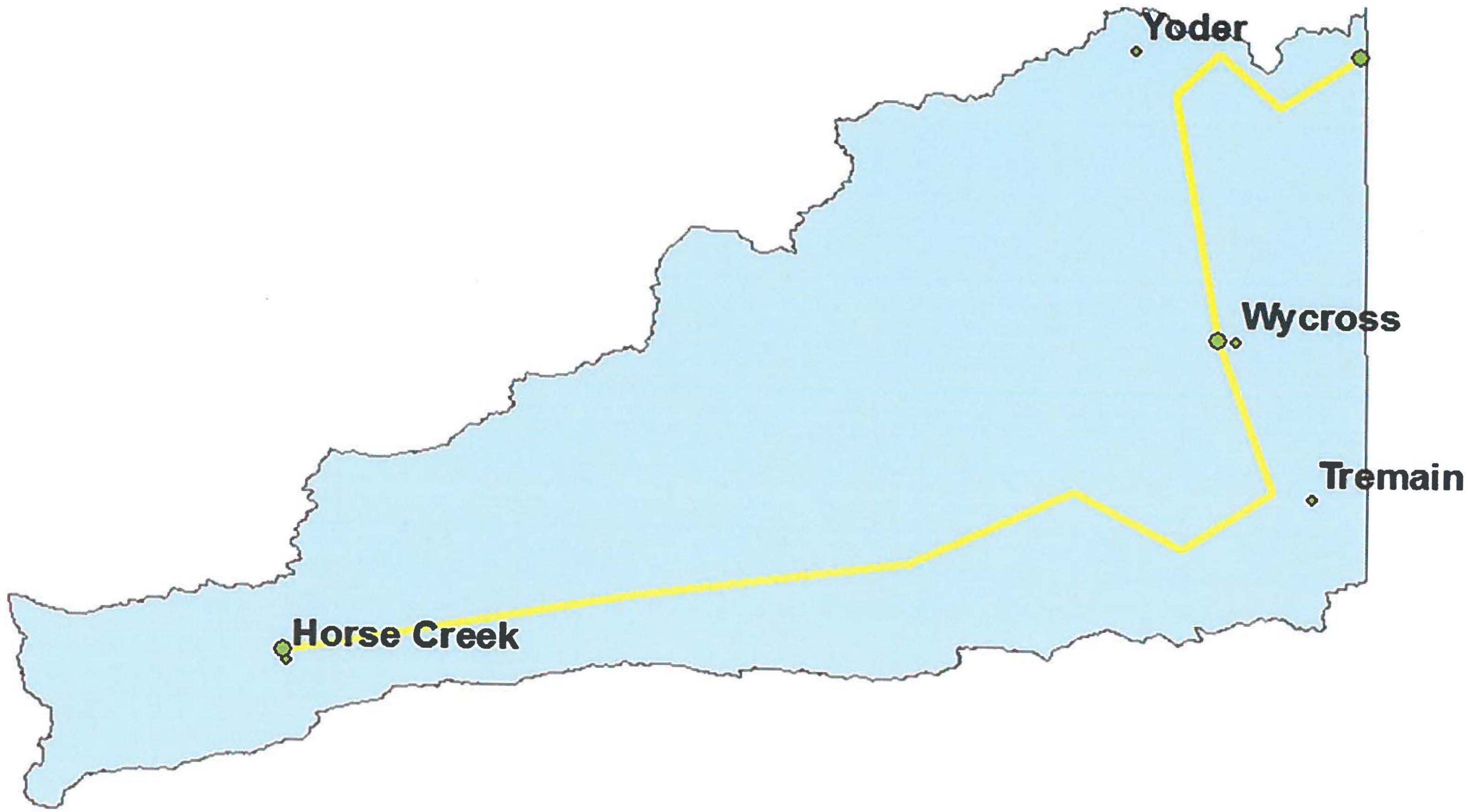
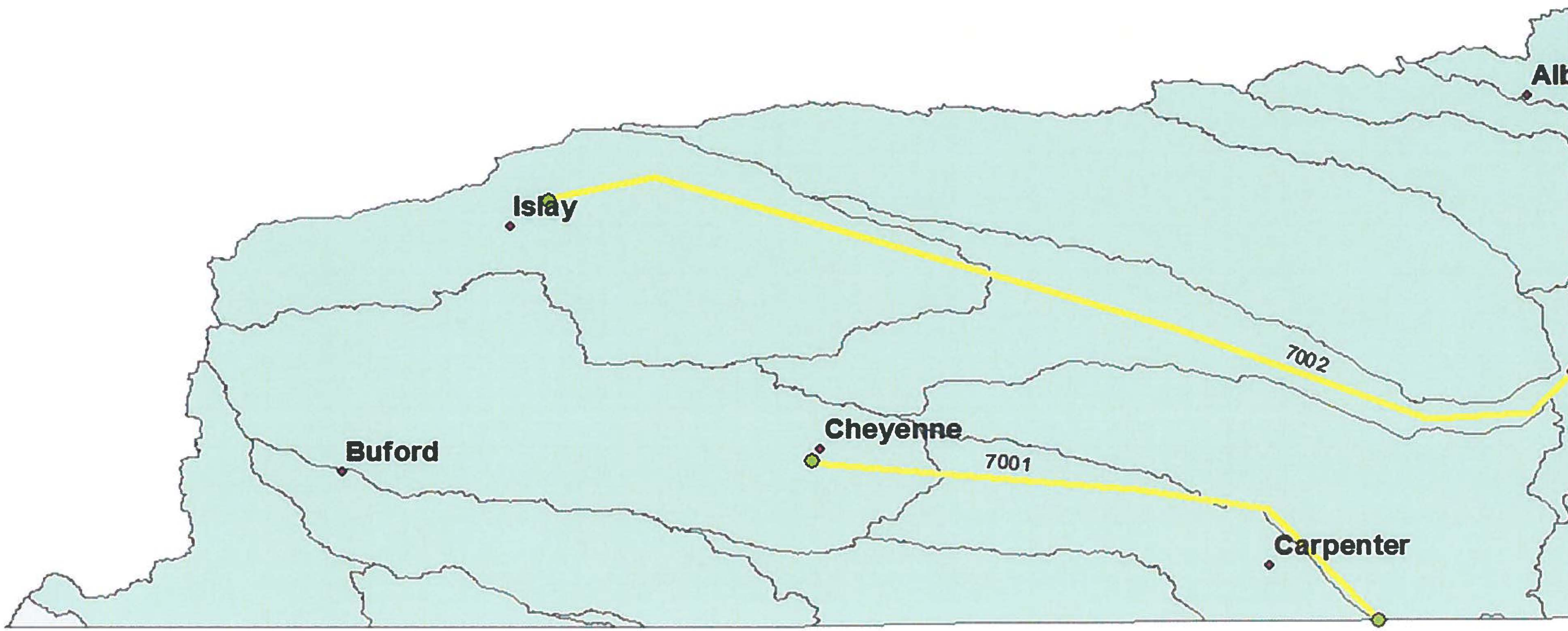


**Figure 2.7: South Platte Reach and Node Map**



## 2.7 RESULTS

The purpose of the model development for this Platte Basin Plan Update was to develop water balance within each of the seven subbasins to help determine how much flow each of the subbasins contributes to the North and South Platte River basins. Seven spreadsheet models were developed, one for each of the seven subbasins. A summary was developed within each of the spreadsheet models to illustrate the results of the water balance. The summaries contain information for a dry, average and wet year scenario.

The summaries show the amount of contributing water supply as "Gains" and consumptive water use in each subbasin or "Losses" for each dry, average and wet year scenarios. The summaries also show the average amount of reservoir storage and total subbasin outflow for each of the scenarios as well.

Gains, or water supply, in each basin consists of the following:

- Flow from Regression – calculated ungaged streamflow contributing to the subbasin.
- Return Flows – The amount of flow returned to the stream from municipal and industrial diversions.
- Import – the amount of water imported through a transbasin diversion between different subbasins or transbasin diversions imported into the Platte River Basin.

Losses, or consumptive uses, in the sub basin consist of the following:

- Agricultural Consumptive Use – the amount of depleted water for irrigation and other agricultural uses.
- Municipal Diversions – Total surface water diverted for municipal uses. (Note: the consumptive use component of the municipal diversions is accounted for as the difference between diversions and return flows discussed above.)
- Industrial uses – Total amount of surface water for industrial diversions. (Note: the consumptive use component of the industrial diversions is accounted for as the difference between diversions and return flows discussed above.)
- Instream Flows – Instream flows reduce the amount of water available for consumptive use. The flows are protected through the designated river reach and no losses or depletions occur in the model.
- Reservoir Evaporative Losses – water lost (consumptive use) due to evaporation of reservoir storage water.
- Export – amount of water exported as a transbasin diversion between subbasins or to basins outside the Platte River Basin.
- Federal Canal Diversion Out-of-State Delivery – amount of water diverted within Wyoming from the Platte River and delivered to Federal Contractors in Nebraska. (This water is delivered to Nebraska via canal, and is in addition to water in the Platte River passing the Stateline.)

The modeled outflow for each of the subbasins is the result of the model analyses tracked and reported at the most downstream node in each of the subbasin nodes. A summary of these results for dry, average and wet years is presented in **Table 2.11**. The results are summarized for the entire Platte River Basin within **Table 2.12** with a breakout of North Platte and South Platte subbasins.

Hydrographs were developed within the spreadsheet models to compare the depleted flow to undepleted flow. Undepleted flows represent the amount of water that could be expected in the tributary if water was not diverted from the stream. Depleted flows reflect actual water flow within the stream. The graphs plot the total monthly volume of water in the stream for the average year water condition. The major tributaries, subbasin and reach number tab where the hydrographs are presented are listed below:

| Tributary Name | Subbasin Model | Reach Number |
|---|---|---|
| Little Laramie River | Upper Laramie | 1012 |
| Brush Creek | Above Pathfinder | 2006 |
| Encampment River | Above Pathfinder | 2010 |
| Spring Creek | Above Pathfinder | 2016 |
| Medicine Bow River | Above Pathfinder | 2027 |
| Sweetwater River | Above Pathfinder | 2032 |
| Bates Creek | Pathfinder to Guernsey | 3002 |
| Deer Creek | Pathfinder to Guernsey | 3008 |
| Box Elder Creek | Pathfinder to Guernsey | 3012 |
| LaPrele Creek | Pathfinder to Guernsey | 3016 |
| La Bonte Creek | Pathfinder to Guernsey | 3020 |
| Laramie River | Lower Laramie | 4008 |
| Horseshoe Creek | Horse Creek | 6002 |
| **Note:** Graph is located in Tab – Depl vs Undepl Laramie Total | | |

**Table 2.11: Subbasin Water Balance Results Summary**

| | | Gains | | | | | | Losses | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Gaged Upstream Inflows[1] | Gaged Tributary Inflow | Ungaged Tributary Inflows | Total Subbasin Inflow | Return Flows (Municipal, Industrial) | Import | Agricultural Consumptive Use | Municipal Diversions | Industrial Diversions | Reservoir Evaporative Losses | Export | Total Gains | Total Losses | Average Reservoir Storage | Federal Canal Diversion Out-of-State Delivery | Modelled Outflow |
| Dry | Upper Laramie | 68,303 | 43,126 | 60,000 | 103,126 | 3,400 | 355 | 81,432 | 3,091 | 0 | 34,521 | | 180,000 | 119,044 | 150,646 | | 33,848 |
| | Above Pathfinder | 129,740 | 239,252 | 390,000 | 629,252 | 617 | 9,142 | 98,592 | 2,872 | 3,113 | 99,992 | 8,669 | 770,000 | 213,239 | 1,091,785 | | 681,214 |
| | Pathfinder to Guernsey | 927,878 | 27,261 | 220,000 | 247,261 | 64,568 | 0 | 70,503 | 4,517 | 64,587 | 51,120 | | 1,240,000 | 190,727 | 481,295 | | 920,801 |
| | Lower Laramie | 64,087 | 13,116 | 70,000 | 83,116 | 57 | 0 | 93,895 | 0 | 0 | 10,698 | | 150,000 | 104,593 | 79,616 | | 33,985 |
| | Guernsey to State Line | 1,017,619 | 28,086 | 13,000 | 41,086 | 231 | 0 | 109,823 | 0 | 509 | 1,391 | | 1,060,000 | 841,723 | 5,043 | 730,000 | 125,205 |
| | Horse Creek | 0 | | 16,000 | 16,000 | 0 | 0 | 47,090 | 0 | 0 | 3,077 | | 20,000 | 50,167 | 11,910 | | 0 |
| | South Platte | 1,260 | | 13,000 | 13,000 | 7,789 | 8,314 | 40,807 | 9,755 | 0 | 611 | | 30,000 | 41,418 | 25,508 | | 0 |
| Average | Upper Laramie | 119,203 | 72,299 | 110,000 | 182,299 | 3,479 | 812 | 70,113 | 3,163 | 0 | 34,521 | | 310,000 | 107,797 | 140,237 | | 91,953 |
| | Above Pathfinder | 291,425 | 499,137 | 770,000 | 1,269,137 | 664 | 10,089 | 100,130 | 2,678 | 2,852 | 111,342 | 9,126 | 1,570,000 | 226,128 | 1,237,419 | | 924,669 |
| | Pathfinder to Guernsey | 1,030,587 | 87,948 | 430,000 | 517,948 | 61,499 | 0 | 71,602 | 4,157 | 62,183 | 52,553 | | 1,610,000 | 190,495 | 530,217 | | 1,162,013 |
| | Lower Laramie | 77,203 | 19,811 | 130,000 | 149,811 | 57 | 0 | 97,743 | 0 | 0 | 10,698 | | 230,000 | 108,441 | 68,881 | | 44,750 |
| | Guernsey to State Line | 1,151,709 | 105,345 | 20,000 | 125,345 | 231 | 0 | 107,069 | 0 | 519 | 1,391 | | 1,280,000 | 768,979 | 5,043 | 660,000 | 270,037 |
| | Horse Creek | 0 | | 50,000 | 50,000 | 0 | 0 | 43,379 | 0 | 0 | 3,077 | | 50,000 | 46,456 | 11,329 | | 2,093 |
| | South Platte | 4,149 | | 40,000 | 40,000 | 9,344 | 8,314 | 37,592 | 9,755 | 0 | 611 | | 60,000 | 38,203 | 21,744 | | 16,735 |
| Wet | Upper Laramie | 198,893 | 116,670 | 230,000 | 346,670 | 3,136 | 3,633 | 96,089 | 2,850 | 0 | 34,521 | | 550,000 | 133,460 | 156,092 | | 210,658 |
| | Above Pathfinder | 527,522 | 977,144 | 1,280,000 | 2,257,144 | 577 | 9,895 | 118,735 | 2,816 | 2,595 | 117,118 | 11,947 | 2,800,000 | 253,211 | 1,476,844 | | 1,653,532 |
| | Pathfinder to Guernsey | 1,320,225 | 186,604 | 780,000 | 966,604 | 60,283 | 0 | 84,904 | 3,758 | 60,566 | 53,436 | | 2,350,000 | 202,664 | 563,990 | | 1,647,692 |
| | Lower Laramie | 146,667 | 49,625 | 350,000 | 399,625 | 57 | 0 | 114,917 | 0 | 0 | 10,698 | | 550,000 | 125,615 | 88,813 | | 160,202 |
| | Guernsey to State Line | 1,656,453 | 266,299 | 70,000 | 366,299 | 231 | 0 | 109,622 | 0 | 407 | 1,391 | | 1,990,000 | 721,420 | 5,043 | 610,000 | 1,148,027 |
| | Horse Creek | 0 | | 200,000 | 200,000 | 0 | 0 | 47,004 | 0 | 0 | 3,077 | | 200,000 | 50,081 | 19,289 | | 148,080 |
| | South Platte | 16,178 | | 170,000 | 170,000 | 10,469 | 8,314 | 40,733 | 9,755 | 0 | 611 | | 200,000 | 41,344 | 37,305 | | 151,109 |

**Notes:**

1. Upper Laramie gaged upstream inflows based on Laramie River and Pioneer Canal gaged flows – Fox Creek ungagged inflows + mainstem reach consumptive uses losses from Colorado State Line to Pioneer Canal.

**Table 2.12: Basin Water Balance Results Summary**

| | | Gains | | | | | | Losses | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Gaged Upstream Flows | Gaged Tributary Inflow | Ungaged Tributary Inflows | Total Subbasin Inflow | Return Flows (Municipal, Industrial) | Import[1] | Agricultural Consumptive Use | Municipal Diversions | Industrial Diversions | Reservoir Evaporative Losses | Federal Canal Diversion Out-of-State Delivery[2] | Export | Total Gains | Total Losses | Average Reservoir Storage | Depleted Flows Leaving Wyoming[3] |
| North Platte | Dry | 198,000 | 350,000 | 770,000 | 1,120,000 | 68,873 | 9,142 | 501,335 | 10,480 | 68,209 | 201,000 | 730,000 | 0 | 1,400,000 | 1,511,024 | 1,820,000 | 260,000 |
| | Average | 411,000 | 780,000 | 1,510,000 | 2,290,000 | 65,930 | 10,089 | 490,036 | 9,998 | 65,554 | 214,000 | 660,000 | 0 | 2,780,000 | 1,439,588 | 1,993,000 | 420,000 |
| | Wet | 726,000 | 1,600,000 | 2,910,000 | 4,510,000 | 64,284 | 9,895 | 571,271 | 9,425 | 63,567 | 220,000 | 610,000 | 0 | 5,310,000 | 1,474,263 | 2,310,000 | 1,530,000 |
| South Platte | Average | 4,000 | | 40,000 | 40,000 | 9,344 | 8,314 | 37,592 | 9,755 | 0 | 611 | | 0 | 60,000 | 38,203 | 22,000 | 16,000 |
| Platte River Basin | Average | 420,000 | 780,000 | 1,550,000 | 2,330,000 | 75,000 | 10,089 | 530,000 | 20,000 | 66,000 | 215,000 | 660,000 | 0 | 2,840,000 | 1,480,000 | 2,020,000 | 440,000 |

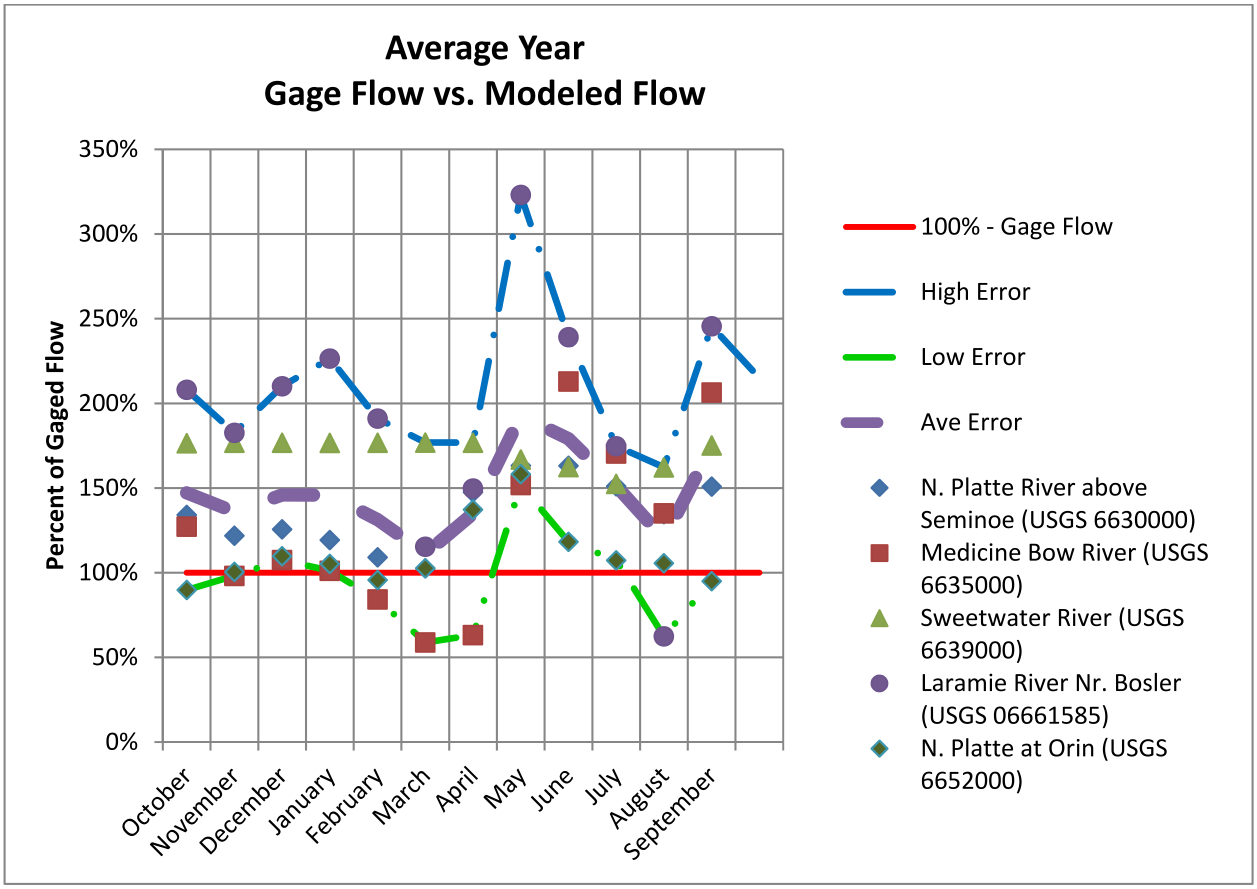
**Notes:**

1. For North Platte, quantity is water imports by City of Cheyenne from Little Snake River Basin. For South Platte, quantity is water imported to South Platte from North Platte Basin. For Platte River Basin, quantity is the Little Snake River Basin import.
2. Water diverted from the North Platte Basin and delivered to Nebraska for use by out-of-state Federal contractors.
3. North Platte outflows based on 1973-2013 period of record at USGS State Line Gage.

### 2.7.1 Comparison of Modeled Flow to Gage Data

A comparison was developed to graphical compare stream flow calculated within the model to the actual flow realized at several gages. Modeled flow was calculated in the spreadsheet models. At locations in the model where a node represented an actual gage with sufficient data for the period of record selected for the study, the modeled flow was compared to the gaged flow. The modeled flow was calculated as a percentage of the gaged flow at each of the representative gaged nodes for each month of an average year condition. For example, a modeled flow of 150% means that the modeled flow at a gaged node is 50% higher than the gage flow at that node. Each modeled flow percentage was plotted to the corresponding month, so that each month had five modeled flow percentages plotted. The 100% line on the chart represents the gage flow. The "High Error" line in the chart plots a line between the highest flow percentages of all the data points. The "Low Error" line plots the lowest percentage of compared flow. The "Ave Error" line plots the average of all the data points within the chart.

**Figure 2.8 Average Year Gage Flow vs. Modeled Flow comparison.**




The largest differences between modeled flow and gaged records are major ungaged tributaries dominated by plains and high deserts regions; i.e., Sweetwater, Medicine Bow, South Platte, Horse Creek and Laramie River drainages. The overall trend throughout is that modelled flows primarily exceed the gaged flows with exceedance over 300% measured in the Laramie River drainage. On an average error basis, the errors are approximately 150% of gaged flow and the error excursions vary on a monthly basis with the smallest errors occurring in March and the largest exceedances in May, June, and September which correlate to the higher monthly flow periods.

Two USGS reports performing flood frequency analysis in Wyoming according to regression methods concluded a number of causes of errors within the statistical analysis of the data. The overriding concern was the lack of available gage records within the plains and high desert regions. The most recent peak-flow analysis study in Wyoming completed in 2003 (WRIR 03-4107), cited that flows within these regions are impacted by intense localized convective rainstorms. The intense rainstorms that occur in the eastern portion of the state receive moisture from summer monsoonal flow from the Gulf of Mexico or from east-moving storms. The distribution and occurrence of the events vary considerably from year-to-year having a significant and variable impact on actual flows measured at gaging stations. Particularly when the period of record is short, the large runoff events have a substantial affect on the statistical regression analysis of the available flow records. The large dispersions of the flow record data are reflected in the magnitude of standard errors associated with the regression analysis. The standard error is a measure of how much the existing flow data varied from the predicted flow calculated from the derived regression equation. Another significant problem is that the few gages that are available within these regions are typically operated on a seasonal basis.

The standard errors and predictive estimate intervals reported within the USGS studies portray the high uncertainty of the derived regression equations. The average standard error cited within the USGS Lowham report (WRIR 88-4045) for the plains and high desert regression equation was 96% for mean annual flow estimates. A lower average standard error of 57% was reported for the mountainous region regression equation. In specific instances, the standard errors in the more recent 2003 USGS report increased in comparison to the 1988 report. The standard error for the flow regression equation derived for peak flows with a 1.5 year return period was 122% for the eastern basins and plains region which encompasses much of the major tributary drainages within the Platte River Basin. This high standard error quantity indicates that actual peak flow records can have high errors that exceed flows by 2.2 times as calculated with the regression equation based on the significant dispersions of the analyzed regression data. Conversely, when the standard errors exceed 100% the actual records can drop to zero so no flows are generated within the subbasin based on the significant low error dispersions of analyzed regression data. The error analysis of modeled flow versus gaged flow demonstrates that the regression derived flows typically over predict actual flows so actual data is associated with low errors. The level of low errors indicate that much of the plains and high desert subbasins may not yield any actual flows that reach a defined drainage that would be measurable with a gage. Both reports relied on the more extensive network of gaging stations existing in many of the mountainous areas of the State but there were large data gaps in much of the State because of the lack of gages within plains and high desert basin regions throughout Wyoming.

## 2.8 SUMMARY

As described in the previous section, for the results of the spreadsheet model and individual reaches within, it was difficult to correlate modeled results with available gage data. When comparing modeled flow in many of the reaches to gage flow, the modeled flow often differed from the gage data considerably. Throughout the entire basin, complete records of gage data were very scarce, particularly within the plains and high desert regions. The compilation of all gage data developed in the previous master plan produced a large number of gages. However, many of the gages identified did not contain significant amounts of data, if any, pertaining to the study years. To further compound this problem, gage data that did coincide with the study period years was largely in the form of seasonal data, not representing an entire year of record. This likely produced inaccuracies with data filling and estimations of data during non-irrigation seasons for many of the gages. **Of the gages representing an entire period of record, very few were located on tributaries where needed to determine the amount of stream flow contributing to the basin. Most of the gages with complete records were located downstream of reservoirs, making is difficult to estimate virgin flows entering the system.**

With the lack of gage data, much of the basin inflow was calculated using regression flood frequency prediction equations. As described previously the regression method relied upon for ungaged flow estimates had a 57% average standard error in the mountainous regions and as much as a 96% average standard error in the high plains regions (WRIR 88-4045). For comparison between gaged data and modeled data in the previous section of the report, the flow estimates in arid ungaged regions exceeded gaged flows by approximately 150% percent on average with excursions up to 300%. Given the large amount of data that were generated with these equations, it is possible that flow estimations could produce large errors in data for the model.

Another likely problem with the data is the manner in which consumptive use for agriculture was determined. The consumptive use data for irrigated lands was provided for each of the subbasins to reflect the Wyoming's Depletion Plan. It is unsure that the depletion numbers used to calculate the consumptive use reflect actual consumptive use values within the basin and the timing of return flows from irrigation was not considered.

In addition, much of the precipitation falling on specific watersheds may be evaporated or transpired, or being lost to infiltration, and may never show as surface water flow. These undetermined losses likely result in modeled overestimates of runoff from most of the ungaged watersheds.

Because of these issues, the accuracy of the models developed for this update was very questionable.

The following research and monitoring studies may address some of the deficiencies in the data and modeling discussed above:

1) Collect precipitation, weather and streamflow data on specific watersheds within the subbasins where the modeling results did not correlate well with the gage data.
2) Expand the gage network in subbasins where the modeling results did not correlate well with the gage data.
3) Collect temporary gage data in watersheds where the modeling results did not correlate well with the gage data. This may be necessary if impoundments (large or small) or wetland enhancements are being contemplated.

4) Utilize actual consumptive use values for agricultural depletions and address the timing of return flows.

**“Clean water and access to food are some of the simplest things that we take for granted each and every day.”**
- Marcus Samuelsson

## 2.9 REFERENCES

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# Platte River Basin Plan 2016 Update
# Volume 3
# Basin Surface Water Use Profile

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Wyoming Water Development Commission

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*In Association With:*
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Harvey Economics
HDR Engineering

**PLATTE RIVER BASIN PLAN 2016 UPDATE**
**VOLUME 3**
**BASIN SURFACE WATER USE PROFILE**

December 2016

**Explanation of Cover Photos**

Lake Marie in the Snowy Range Mountains. Lake Marie lies south in the shadow of the quartzite massif of 12,847-foot Medicine Bow Peak at an elevation of 11,000-feet. Winter and Spring precipitation in the Snowing Range constitutes an important portion of the water supply in the Platte River Basin.

The bald eagle (*Haliaeetus leucocephalus*, from Greek hali "sea", aiētos "eagle", leuco "white", cephalos "head"). It is a common, frequently observed breeding and winter resident in the North Platte Basin of Wyoming. The bird is strongly associated with large rivers, lakes and reservoirs with an abundant food supply and riparian environments with large trees used for roosting and nesting. The bald eagle is an opportunistic predator which subsists primarily on fish. During the winter, they also feed on dead or injured waterfowl and road or winter killed deer and antelope. The bald eagle is both the national bird and national animal of the United States of America. It is the most familiar success story of the Federal Endangered Species Act. During the latter half of the 20th century it was on the brink of extirpation in the contiguous United States and was one of the first species to receive protections under the precursor to the Endangered Species Act in 1967. Populations have since recovered and the species was removed from the U.S. government's list of endangered species on July 12, 1995 and transferred to the list of threatened species. It was removed from the List of Endangered and Threatened Wildlife in the Lower 48 States on June 28, 2007 but remains protected under the provisions of the Bald and Golden Eagle Protection Act.

Historical photo of flood irrigation. Flood irrigation is an ancient method of irrigating crops and was the first form of irrigation used by humans as they began cultivating crops. In the Platte River Basin, it is still commonly used to irrigate grass hay. In areas of the Platte River Basin where higher value crops are raised such as corn, sugar beets and alfalfa hay, conversion to sprinkler irrigation has the dual benefits of improved crop yields while conserving water.

The Dave Johnston Power Plant is named for W.D. “Dave” Johnston a former PacifiCorp Vice-President. The plant generates power by burning coal that produces steam under high pressure. The steam drives turbines and the turbine blades to engage generator that produce electricity. The plant was commissioned in 1958. There have been four phases of plant expansion to-date and numerous upgrades to comply with changing environmental requirements. The present power generation capacity is 817 megawatts.

# PLATTE RIVER BASIN PLAN 2016 UPDATE
# VOLUME 3
# BASIN SURFACE WATER USE PROFILE

December 2016

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**The Platte River Basin Plan 2016 Update is a planning tool developed for the Wyoming Water Development Office. It presents estimated current and estimated future uses of water in Wyoming's Platte River Basin. The Plan is not intended to be used to determine compliance with the administration of state law, federal law, court decrees, interstate compacts, or interstate agreements.**

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# Appendices

# 3.0 Basin Surface Water Use Profile

## 3.1 SUMMARY

***"Our lifestyle, our wildlife, our land and our water remain critical to our definition of Wyoming and to our economic future."***
- Dave Freudenthal, Former Governor of Wyoming

The water supplies in the Platte Basin significantly contribute to the economy of the entire State of Wyoming. The Platte region is home to 44% of the State's population and supports a diversified economic base of agricultural, industrial, government, education, and recreation resources. The water uses that were evaluated in this study are the industrial, municipal, agricultural, recreational and environmental sectors.

### 3.1.1 Industrial Use

Since 2004, the types of industrial water use have not changed appreciably in the Platte River Basin. The principal industrial users continue to include oil and gas, coal and uranium as well as power generation, aggregate mining, cement production, chemical processing and ethanol production. Overall, annual industrial water use is estimated to be approximately 147,950 acre-feet. Increases in industrial water use were limited to a few areas. The Pathfinder to Guernsey Subbasin experienced the most robust increase in industrial water use with additional groundwater production to serve the oil and gas industry near Douglas and uranium mining near Glenrock. Industrial activity increased the subbasin's percentage of total water use in the Platte River Basin from 36.4 to 38.0%. The South Platte Subbasin also witnessed an increase in industrial water use with the addition of a new power plant, dairy, and oil and gas development. This industrial activity raised the subbasin's percentage of total water use from 6.1% to 7.2%

### 3.1.2 Municipal and Domestic Use

There are 54 community public water systems located within the seven subbasins of the Platte River Basin. Since the completion of the 2006 Basin Plan, additional water usage data have been developed and compiled through master planning projects sponsored by the Wyoming Water Development Commission (WWDC), the Wyoming State Engineer's Office (SEO) annual municipal water use surveys and the WWDC's public water system surveys.

Groundwater remains a significant water supply for municipal and domestic users. Since January 1, 2004, 32 new wells or enlargements have been filed with the SEO for municipal use. Between January 1, 2004 and January 26, 2015, 5,043 domestic well permits were obtained and presumably completed within the subbasins of the Platte River Basin. An assumed per capita usage rate of 150 to 300 gpd was used to calculate rural domestic water usage for each of the subbasins. With a total rural population of approximately 20,000, the South Platte subbasin has the highest estimated usage at approximately 3.0 to 6.0 million gpd. The Pathfinder to Guernsey subbasin had the second highest usage estimated at 1.8 to 3.6 million gpd. With the lowest rural population, the Horse Creek subbasin had the lowest estimated usage at 0.2 to 0.4 million gpd. Municipal use accounts for 6.1% to 7.2% percent of the South Platte subbasin's total groundwater use.

### 3.1.3 Irrigation Use

Surface water and groundwater are both used for irrigation purposes in the Platte River Basin. Trihydro (2006) and The Wyoming Geological Survey tabulated the quantities of permitted irrigation groundwater rights. Total annual average groundwater withdrawals f or irrigation were estimated to be 206,745 acre-feet (Taucher and others, 2013). Assuming surface water is applied at a rate of 1 cubic foot per second (cfs) per 70 acres, total surface water use during the irrigation season based on the number of irrigated acres in 2012 would be approximately 2.4 million acre-feet.

### 3.1.4 Recreation and Environmental Use

There are numerous and excellent water-based recreational opportunities in most of the Platte subbasins, primarily flat water boating, swimming, river rafting and stream fishing. There are also extensive environmental water uses, including wetland areas, crucial habitat areas and in-stream flows. Overall, almost all of the environmental and recreational uses (E&R) uses in the Basin have been determined to be protected or complementary. Of those that are competing, most are likely already unavailable in many years due to over-appropriation of Basin water resources.

### 3.1.5 Water Use from Storage

The reservoirs above Pathfinder have permitted and actual active storage capacities that exceed 18,000 ace-feet so the potential exists for Wyoming to exceed the cap in any one year. The records reviewed for the largest reservoirs instrumented with new measuring devices confirmed that most reservoirs filled nearly every year except when affected by severe drought conditions or when reservoir or conveyance deficiencies prevented their physical ability to store water.

During drought periods, the reservoir owners are intentionally saving water to conserve water supplies for the following year so the storage space available for accruals the following year is physically limited. Some reservoir owners are also increasing reservoir carry-over amounts to serve other beneficial uses such as fishery or recreational purposes. HDR’s structural and non-structural recommendations are based on the water storage analysis performed on the reservoirs storing for irrigation purposes above Pathfinder Reservoir exclusive of Seminoe Reservoir. The implementation of one or more of the stated alternatives could assist Wyoming in maximizing the annual accrual quantities.

Constructing new reservoirs or enlarging existing irrigation reservoirs are challenging projects to implement. The siting of new reservoirs would require the need to evaluate suitable reservoir sites and consider the environmental effects of each site to address the environmental permitting requirements. Water supply alternative analysis evaluations would also be a National Environmental Policy Act (NEPA) requirement for a reservoir enlargement project. The permitting process will require NEPA compliance for the issuance of federal permits or required right-of-way agreements on federal lands. Wyoming’s compliance with the Platte River Recovery Implementation Program (PRRIP) and Wyoming’s Depletions Plan will need to be considered for either alternative. A new irrigation reservoir would require the need for a local sponsor that could provide a share of the overall capital costs.

A potential non-structural recommendation is to facilitate the coordination of storage accruals amongst the reservoir owners. Coordination with reservoir owners on an annual basis could occur that would allow maximizing storage accruals occurring in Wyoming in any one year. This approach requires cooperation between the SEO and the entities responsible for coordinating the individual reservoir owners. The reservoir owners of the largest reservoirs with measuring device equipment may be the most amenable to this coordination approach based on their previous coordination with the State of Wyoming. The largest reservoirs represent the most efficient entities to accomplish this cooperation alternative due to their size and the practicality of coordinating with fewer reservoir owners.

Another potential non-structural alternative is to consider the reservoir storage water right and its function of serving irrigation purposes. A portion of the active reservoir storage in the larger reservoirs could be better defined and modified within a Wyoming Board of Control change of use petition process to eliminate the requirement and the need to track the storage under the Modified Decree requirements. For example, the portion of storage that is for the purposes of meeting fishery or recreation beneficial uses could be formally designated for that purpose within the reservoir storage water right. The portion of the storage water right for in-place environmental or recreation uses should not be included in the SEO reporting or storage water dedicated to meeting irrigation purposes.

Graphic summaries of water usage in the Platte River Basin are presented in **Figures 3.1.1 – 3.1.8**.

> **"It is life, I think, to watch the water. A man can learn so many things."**
> - Nicholas Sparks

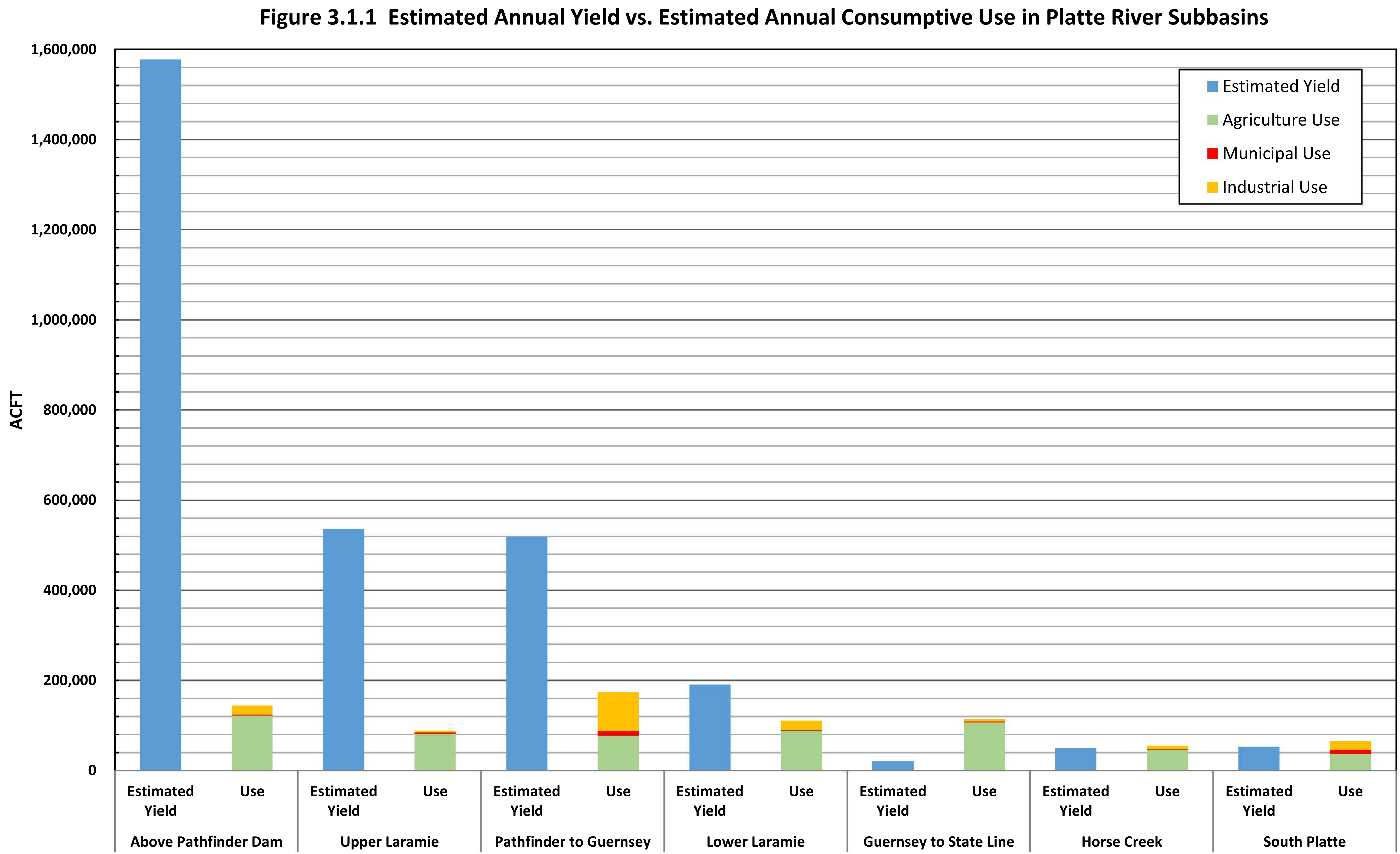
Figure 3.1.1 Estimated Annual Yield vs. Estimated Annual Consumptive Use in Platte River Subbasins
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1,600,000
1,400,000
1,200,000
1,000,000
800,000
600,000
400,000
200,000
0
Estimated Yield
Agriculture Use
Municipal Use
Industrial Use
Estimated Yield
Use
Above Pathfinder Dam
Upper Laramie
Pathfinder to Guernsey
Lower Laramie
Guernsey to State Line
Horse Creek
South Platte

# Figure 3.1.2
# Overall Water Use Profile within the Above Pathfinder Subbasin

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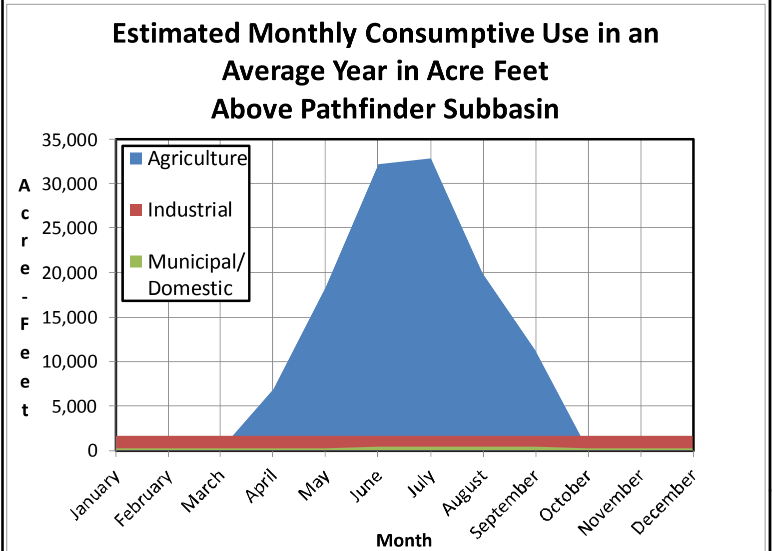


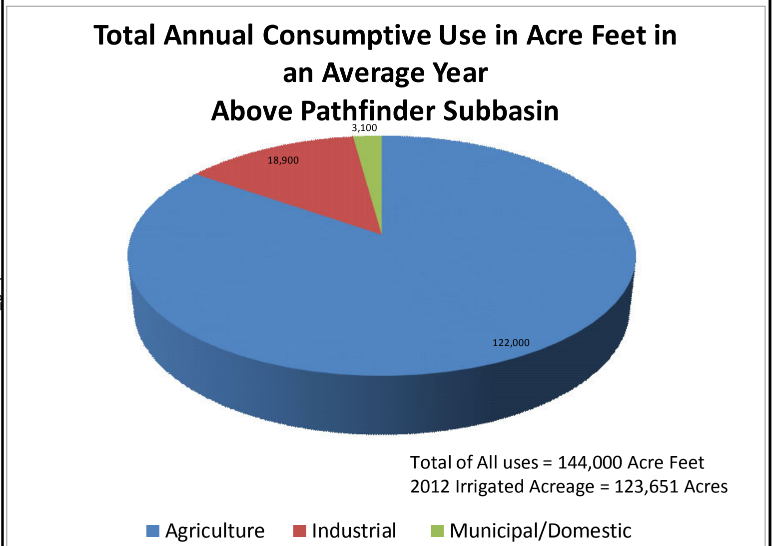


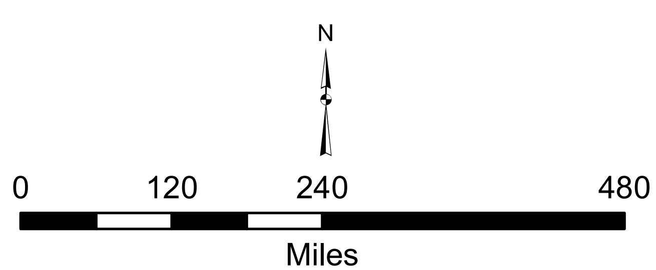


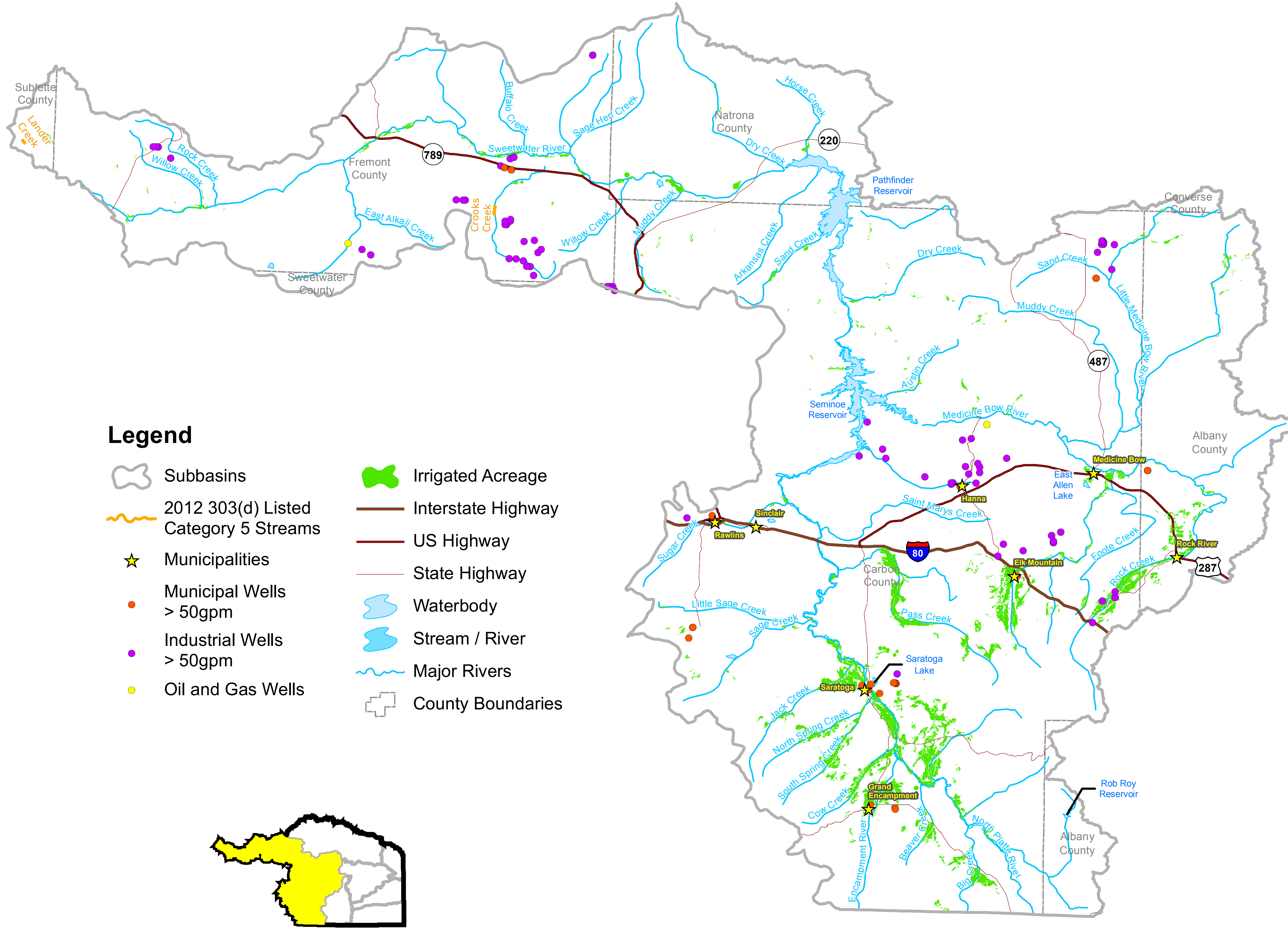


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# Figure 3.1.3
# Overall Water Use Profile within the Pathfinder to Guernsey Subbasin

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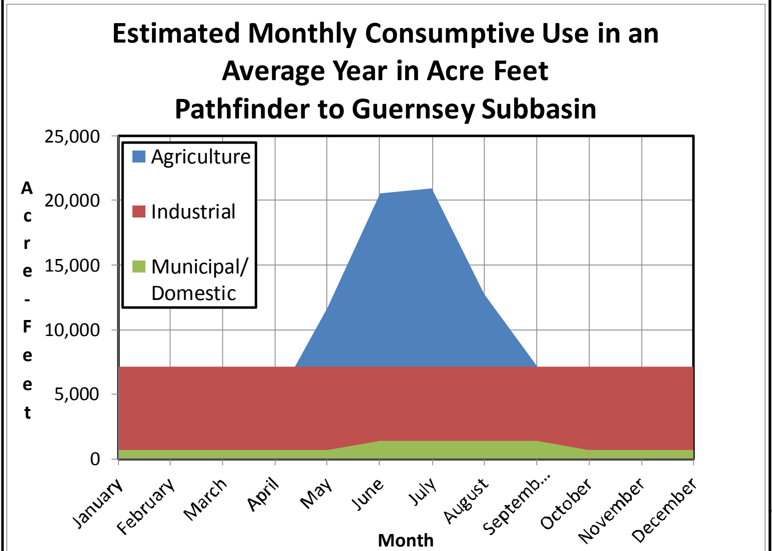


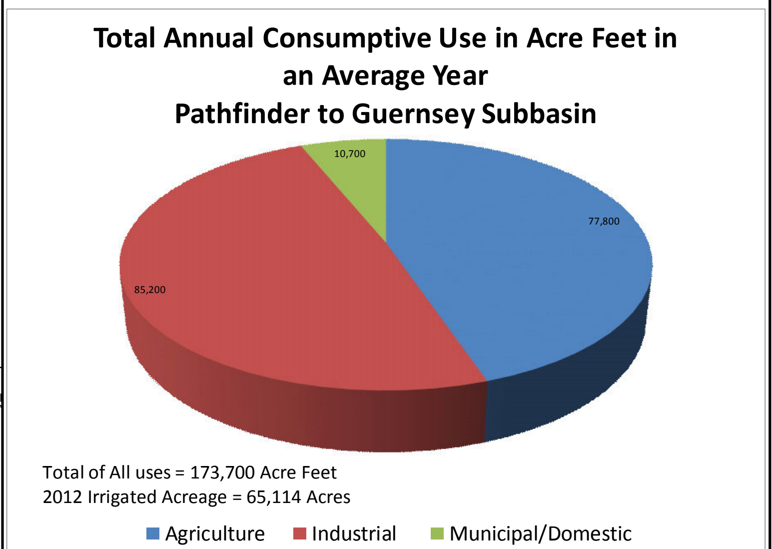


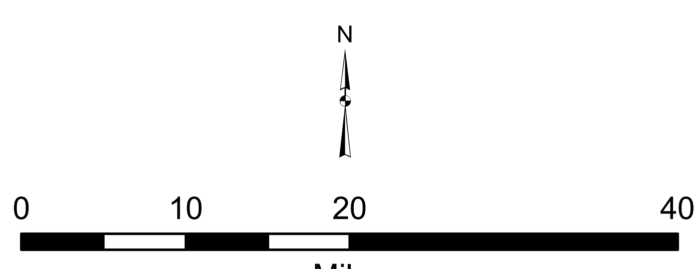


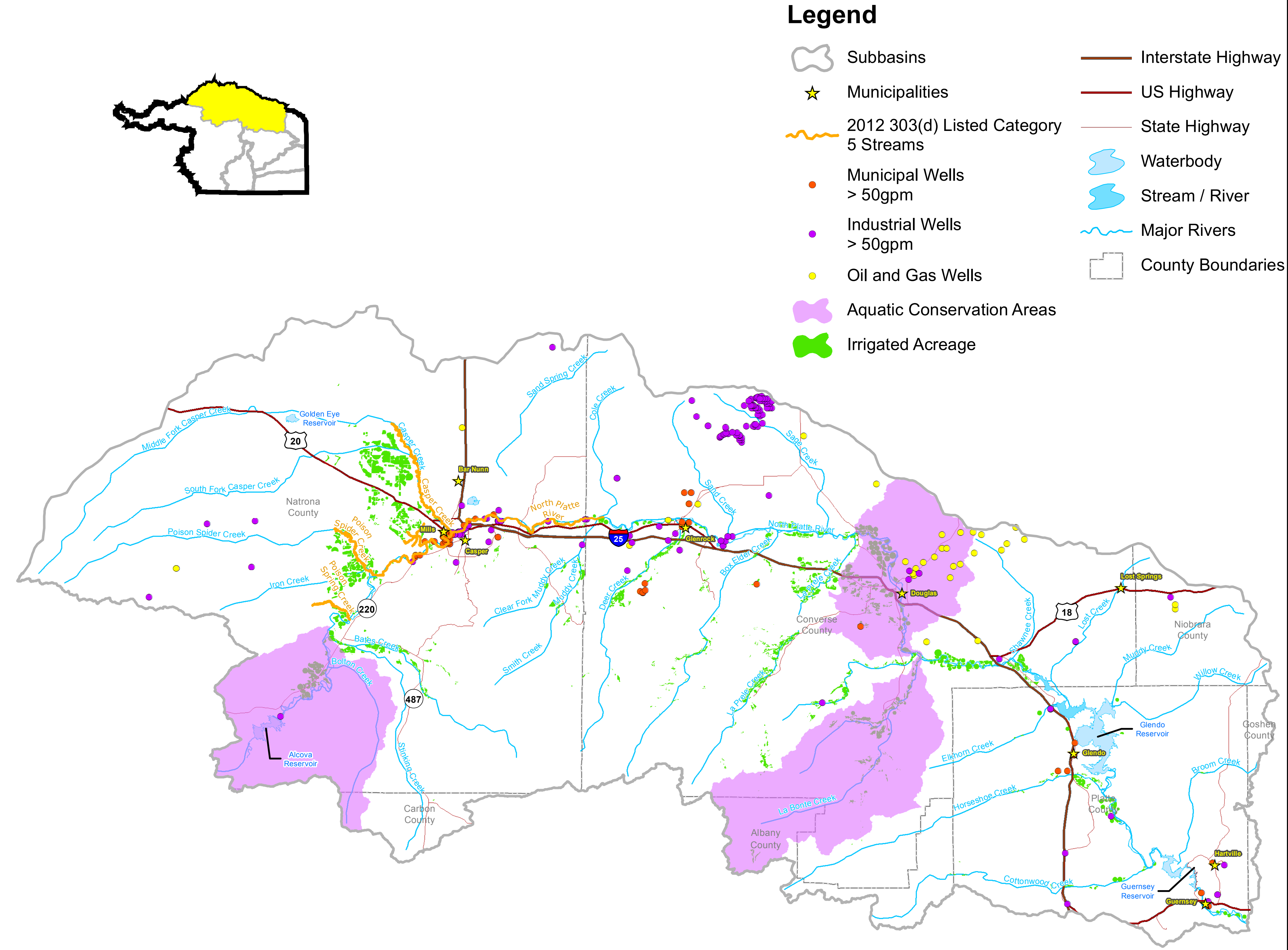


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# Figure 3.1.4
# Overall Water Use Profile in the Guernsey to State Line Subbasin

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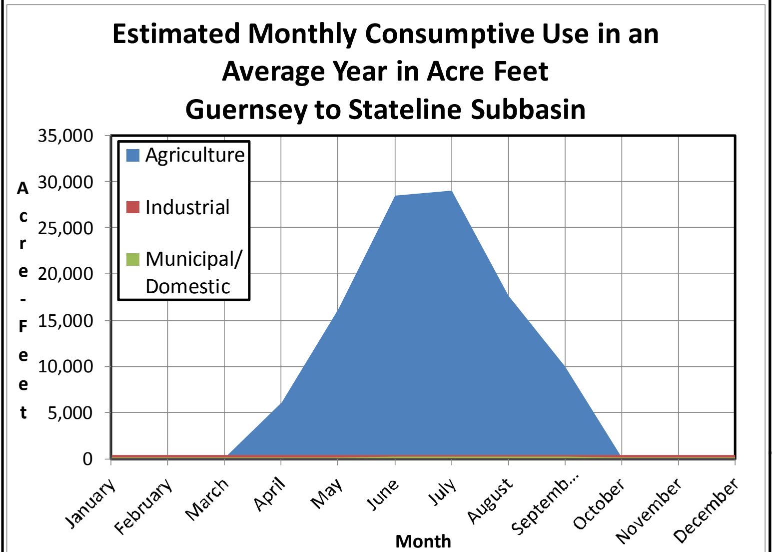


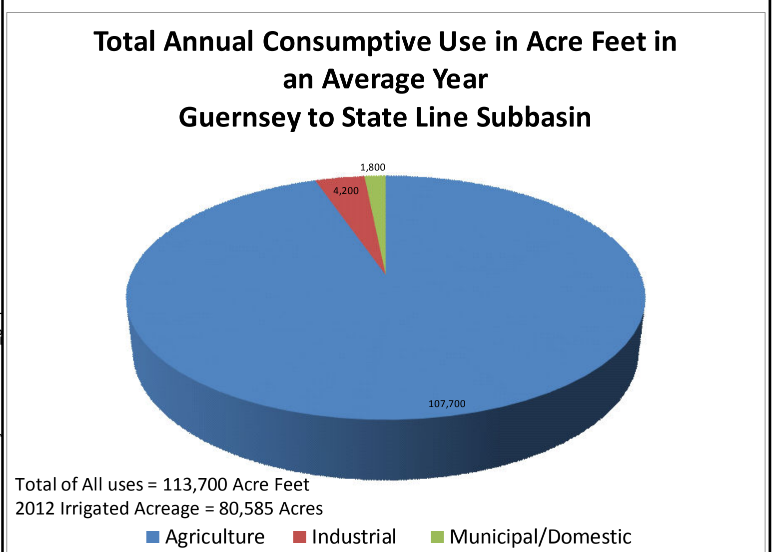


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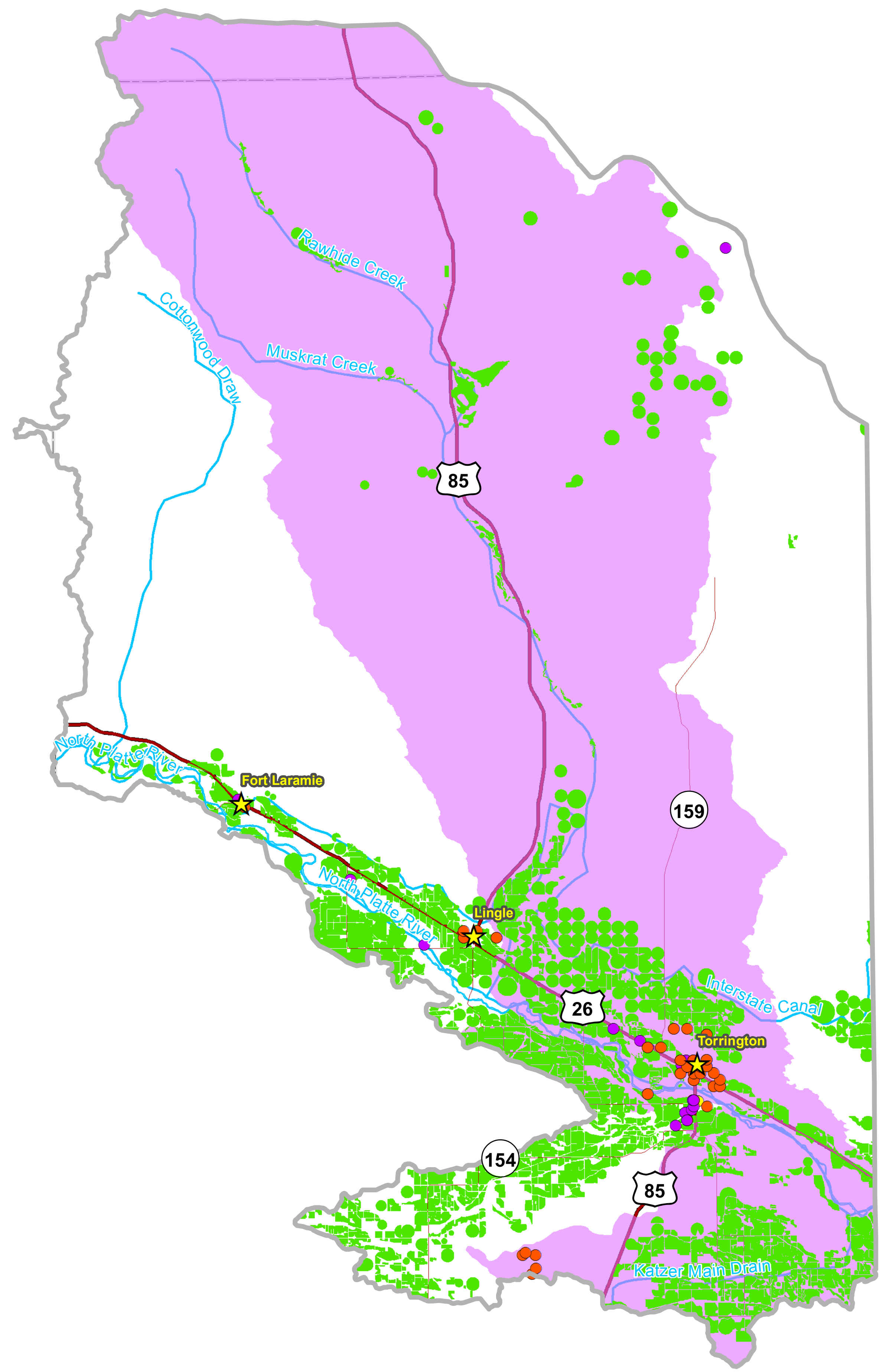


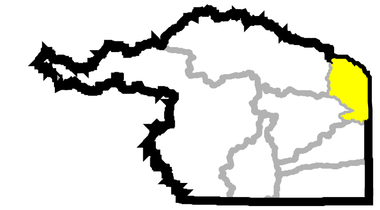

## Legend

- Subbasins
- Municipalities
- 2012 303(d) Listed Category 5 Streams
- Municipal Wells > 50gpm
- Industrial Wells > 50gpm
- Oil and Gas Wells
- Irrigated Acreage
- Aquatic Conservation Areas
- Interstate Highway
- US Highway
- State Highway
- Waterbody
- Stream / River
- Major Rivers
- County Boundaries

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# Figure 3.1.5
## Overall Water Use in the Upper Laramie Subbasin

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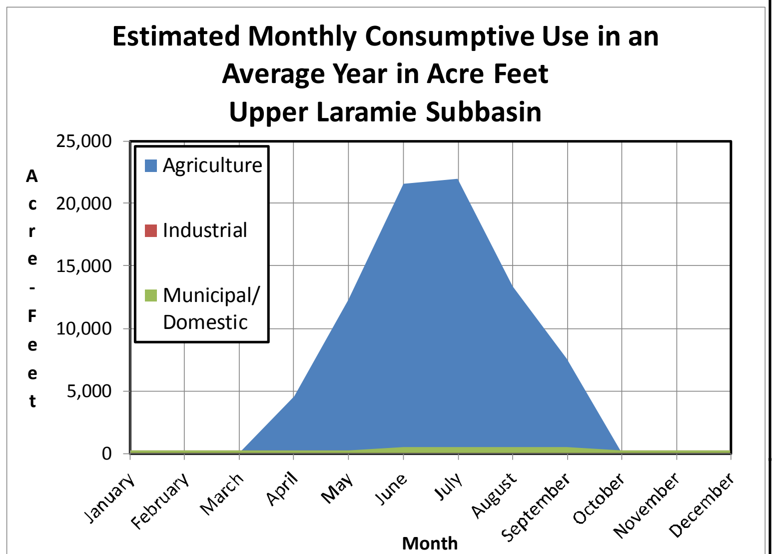


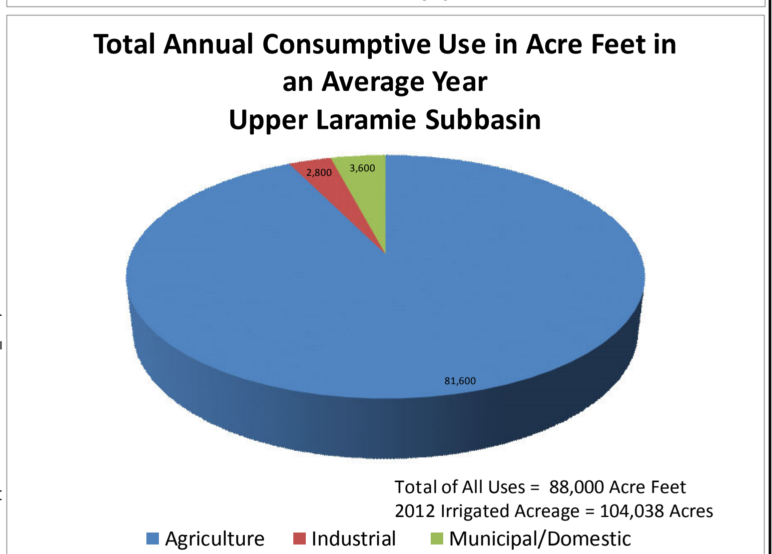


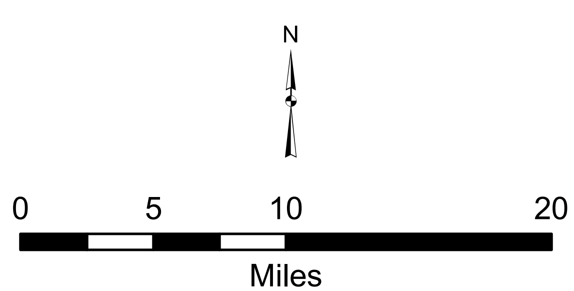


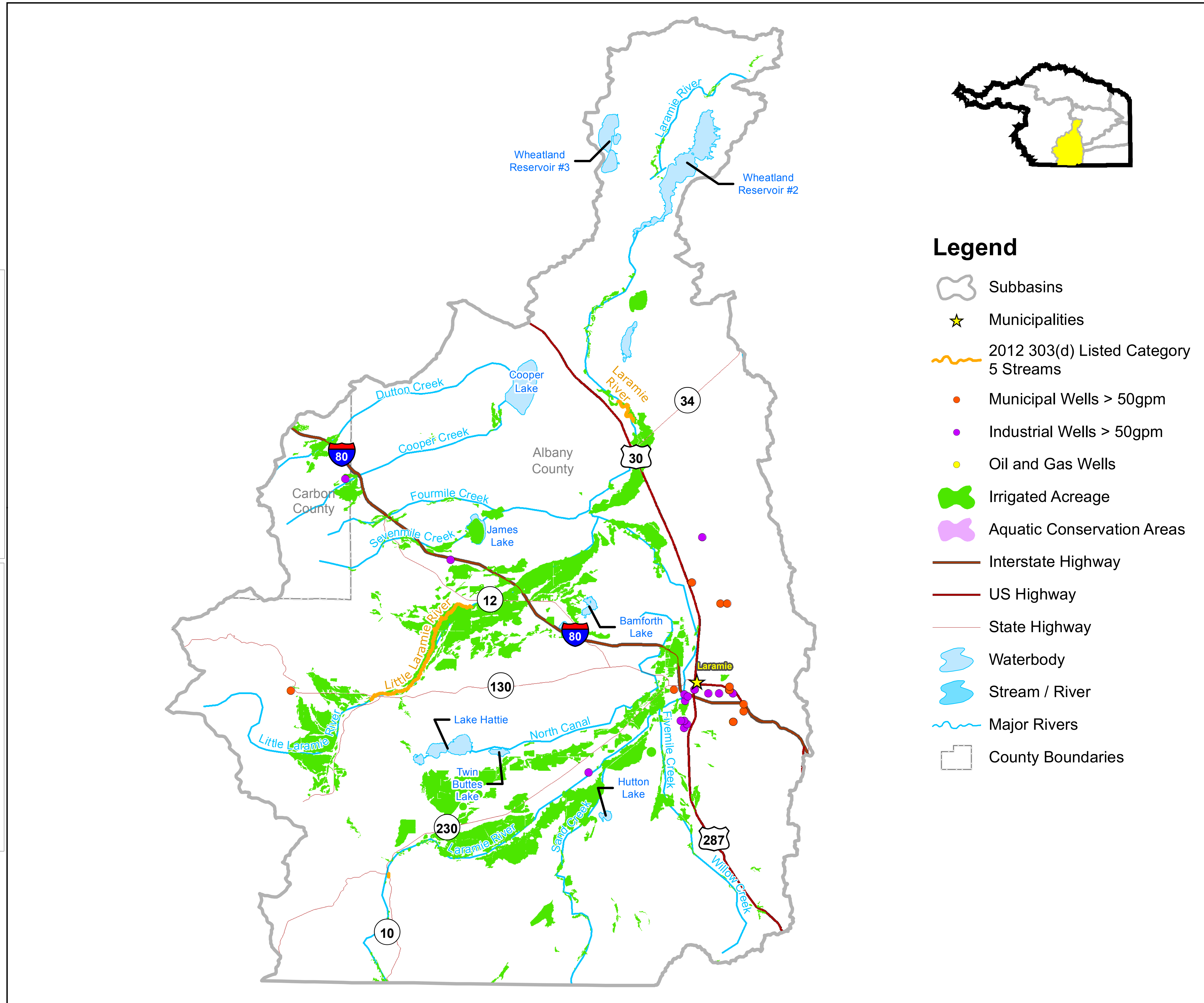


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# Figure 3.1.6
# Overall Water Use Profile within the Lower Laramie Subbasin

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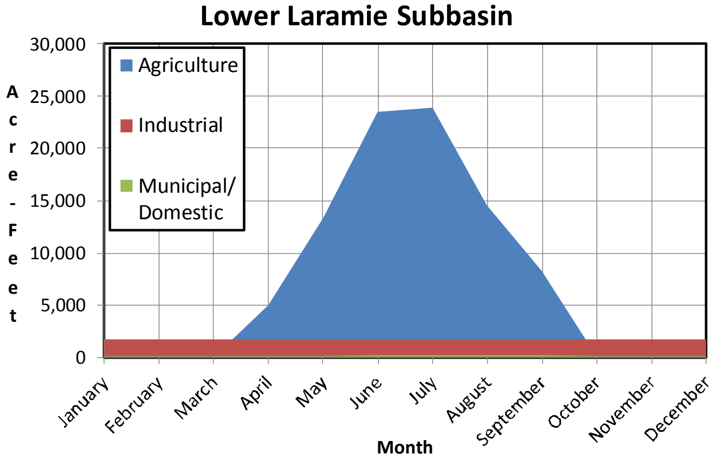
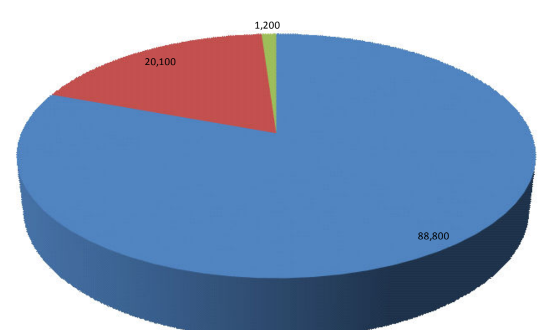
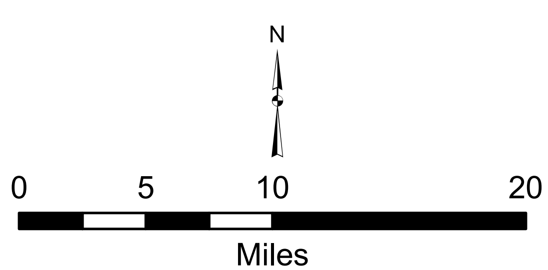
**Estimated Monthly Consumptive Use in an Average Year in Acre Feet Lower Laramie Subbasin**

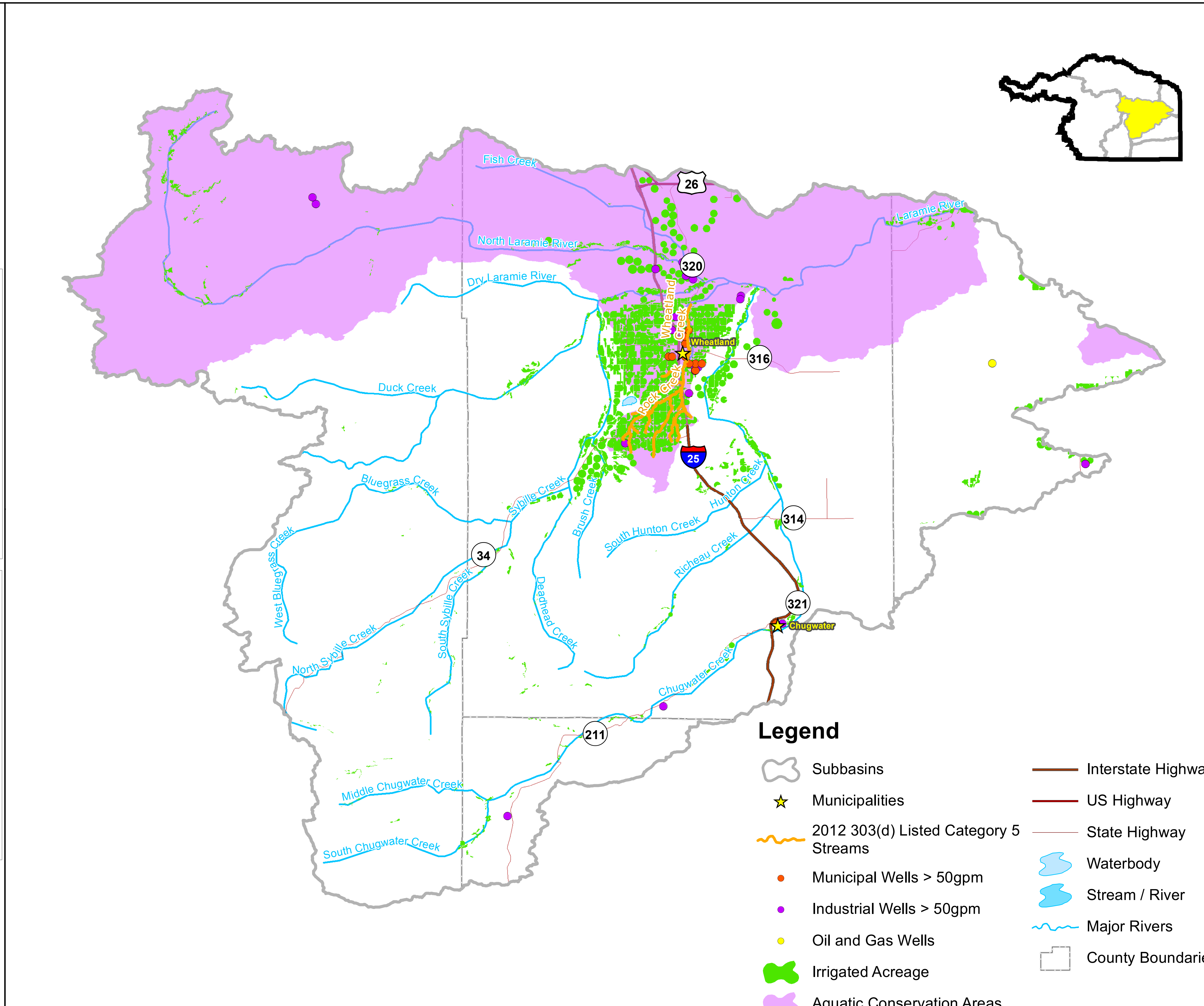



**Total Annual Consumptive Use in Acre Feet in an Average Year Lower Laramie Subbasin**




Total of All uses = 110,100 Acre Feet
2012 Irrigated Acreage = 66,437 Acres
Agriculture Industrial Municipal/Domestic



# Figure 3.1.7
# Overall Water Use Profile within the Horse Creek Subbasin

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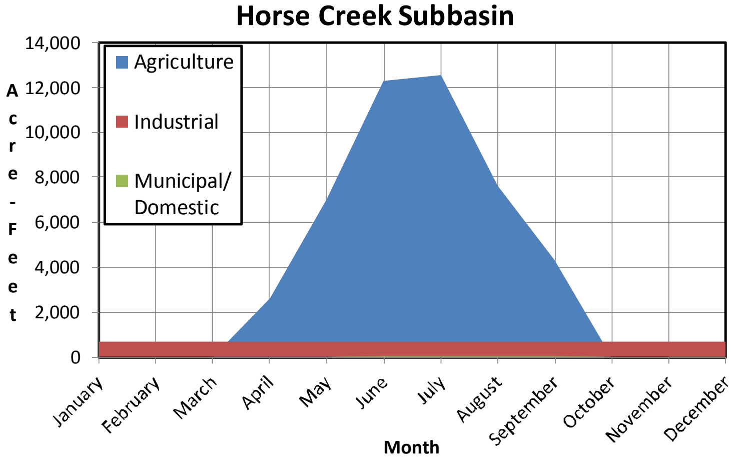
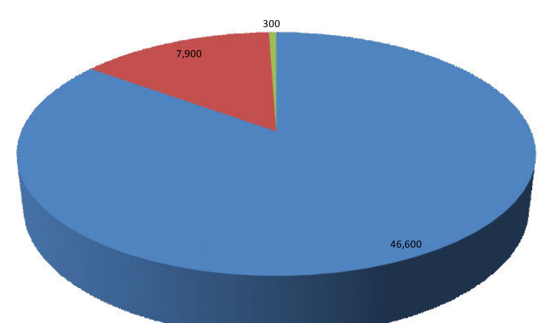
**Estimated Monthly Consumptive Use in an Average Year in Acre Feet Horse Creek Subbasin**



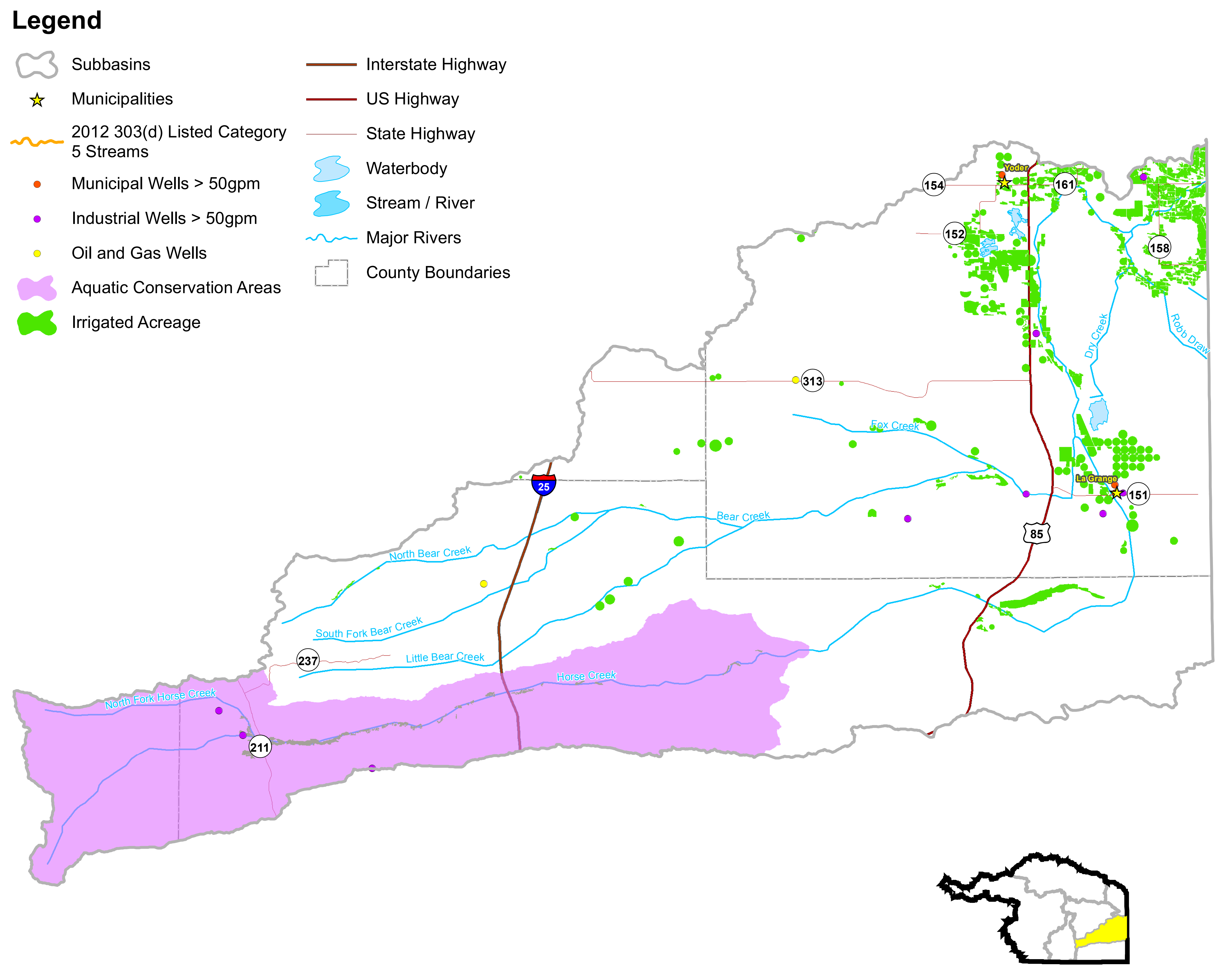

**Total Annual Consumptive Use in Acre Feet in an Average Year Horse Creek Subbasin**

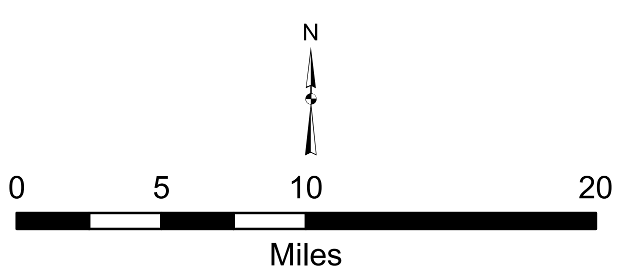



Total of All uses = 54,800 Acre Feet

2012 Irrigated Acreage = 40,595 Acres

Agriculture Industrial Municipal/Domestic



# Figure 3.1.8
# Overall Water Use Profile within the South Platte Subbasin

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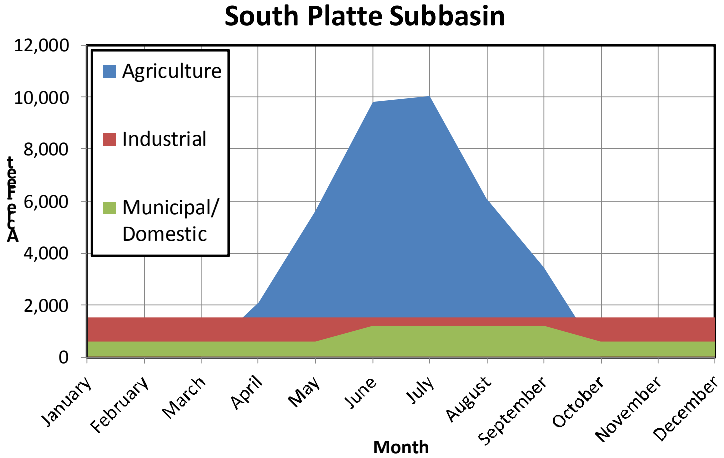
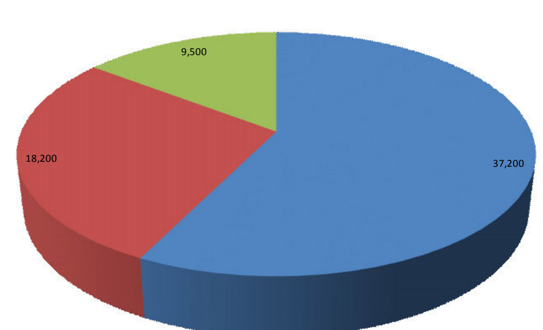
**Estimated Monthly Consumptive Use in an Average Year in Acre Feet South Platte Subbasin**

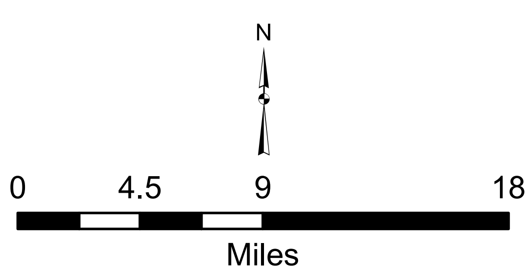


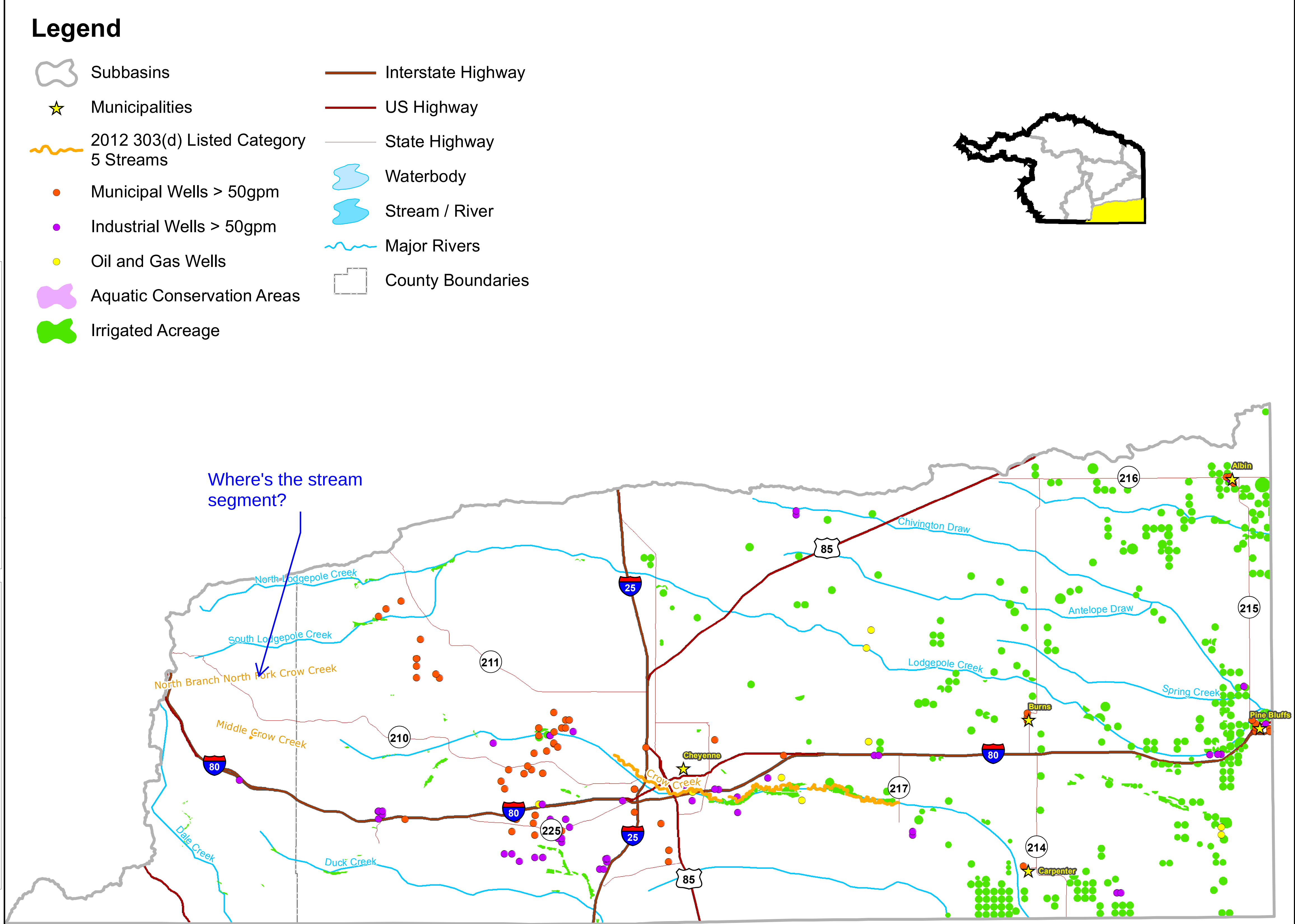

**Total Annual Consumptive Use in Acre Feet in an Average Year South Platte Subbasin**




Total of All uses = 64,900 Acre Feet
2012 Irrigated Acreage = 43,223

Agriculture | Industrial | Municipal/Domestic



## 3.2 AGRICULTURE USE

### 3.2.1 Introduction

Section 3.2 presents an update on the agricultural use within the Platte River Basin of Wyoming. The principal focus of this update to the Platte River Basin Plan (Trihydro, 2006) has been a revision to the irrigated lands mapping and the consumptive use estimates associated with irrigated agriculture in the basin. This update relied heavily on information developed and maintained by the SEO for the Wyoming Depletions Plan.

### 3.2.2 Irrigation Systems

Trihydro (2006) provided a comprehensive overview of the irrigation systems established within each subbasin of the Platte River Basin in Technical Memorandum 2.1.3. The locations of the irrigation districts within the Platte River Basin are shown on **Figure 3.2.1**. Since the completion of that report, master plan studies have been completed through the WWDC for both the Goshen Irrigation District (Anderson Consulting Engineers, 2008) and Wheatland Irrigation District (Anderson Consulting Engineers, 2011). Briefly, these reports noted that significant infrastructure improvements were needed to various structures and conveyances to improve overall irrigation system efficiency.

In addition to the aforementioned reports, the WWDC's Irrigation System Survey Report (2012) was reviewed for the purpose of identifying irrigation systems in need of repairs. **Appendix 3-A,** Table 1 lists the irrigation systems within each subbasin, and presents a comparison of the issues that were noted during the original basin plan and now.

### 3.2.3 Platte River Basin Irrigated Acreage Update

Trihydro (2006) completed an irrigated lands map of the Platte River Basin that was based on several data sources spanning 1995-2001. Since 2006, the SEO has been completing annual inventories of the irrigated lands with the portions of the Platte River Basin that are subject to the Modified North Platte Decree of 2001. The SEO has not specifically delineated irrigated acreages with the following areas: South Platte Subbasin, Horse Creek Subbasin, the Casper Alcova Irrigation District, any closed surface water basins not tributary to the North Platte River, and any Glendo contract water (Hoobler, 2014). The irrigated lands within these areas were delineated and added to those identified by the SEO for 2012, the date of the most recent aerial photography dataset that could be used. Irrigated acreages from the previous Basin Plan (TriHydro, 2006) formed the basis of comparison for this study.

The current irrigated lands mapping for 2012 was composited from data acquired from several sources. These data sources included the following:

1. GIS mapped irrigated acreages for decree areas from 2011-2013 from the SEO (Hoobler, 2014).
2. GIS mapped agricultural acreages (irrigated and dryland) for Laramie County supplied by the Laramie County Assessor (Pavlica, 2014).
3. GIS mapped irrigated acreage from the Casper Alcova Irrigation District (Anderson Consulting, 2014).
4. Lidstone & Associates, a Wenck Company (LA), delineated acreages in the Horse Creek, Pathfinder to Guernsey, and South Platte subbasins using ArcGIS and US Department of Agriculture aerial photos (USDA, 2014).

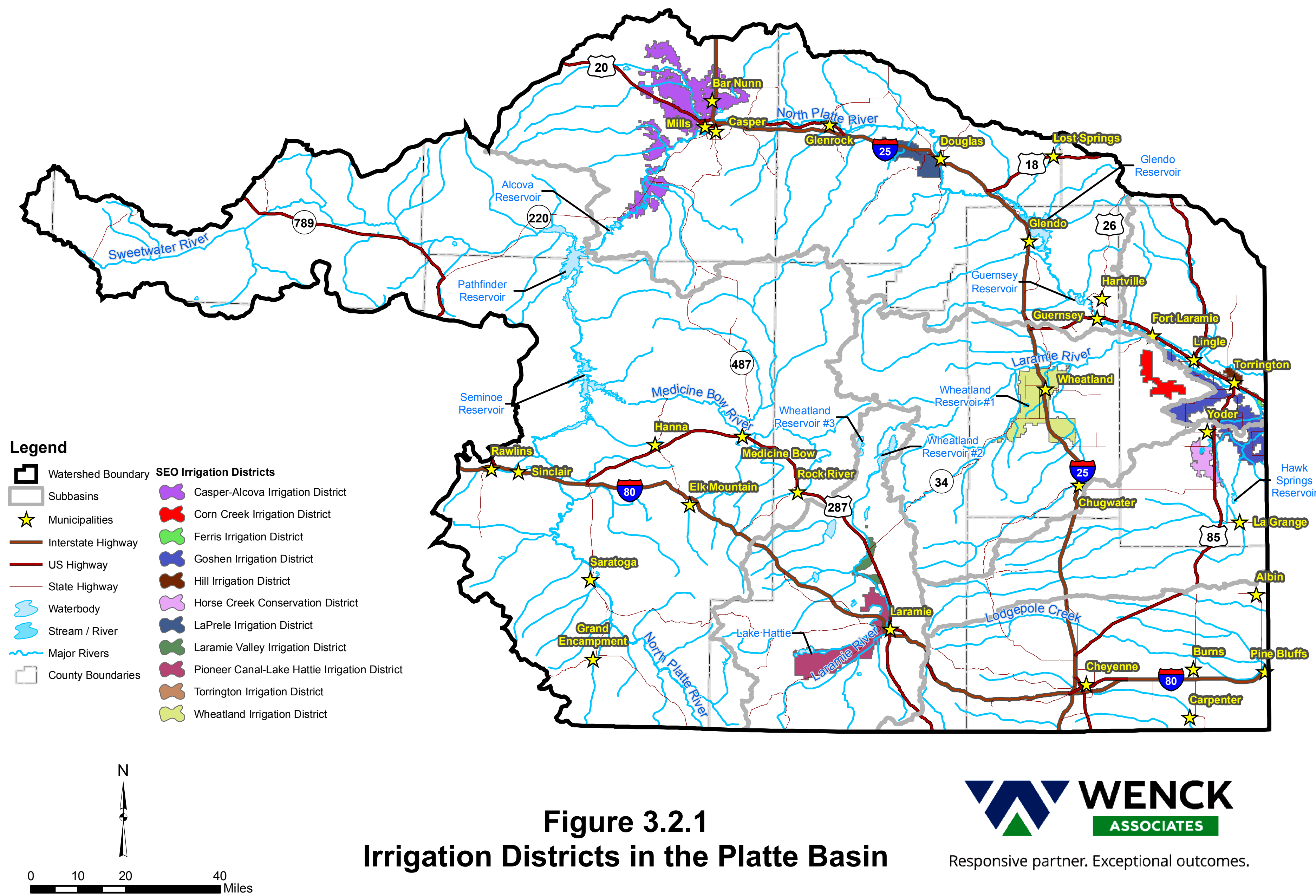



Figure 3.2.1
Irrigation Districts in the Platte Basin

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### 3.2.4 GIS Mapped Irrigated Acreages, 2012

LA delineated irrigated agricultural lands in areas that the SEO had not based on whether they were being actively irrigated in 2012 from aerial imagery (USDA, 2014). The LA specific GIS delineations included the entire South Platte subbasin, the Horse Creek subbasin outside of the Goshen Irrigation District, the Dutton Creek closed basin, and the Casper Alcova Irrigation District in the Pathfinder to Guernsey subbasin. Hoobler (2014) noted that the acreages related to Glendo contract water are small and therefore LA did not delineate those minor areas. Results of the irrigated land delineation are summarized by subbasin and county, and are presented in **Table 3.2.1**. The locations of the irrigated lands identified in 2012 are presented by subbasin on **Figures 3.2.2 through 3.2.8**.

**Table 3.2.1: GIS-derived Platte River Basin Irrigated Agricultural Land Organized by Subbasin for 2012**

| Platte River Subbasin | County | Area (acres) | Percent of Total Per Subbasin |
|---|---|---|---|
| Above Pathfinder | Albany | 8,586 | 6.9 |
| | Carbon | 106,692 | 86.3 |
| | Converse | 52 | 0.0 |
| | Freemont | 4,918 | 4.0 |
| | Natrona | 3,102 | 2.5 |
| | Sublette | 303 | 0.2 |
| | **Total** | **123,651** | **100** |
| Pathfinder to Guernsey | Albany | 209 | 0.3 |
| | Converse | 32,423 | 49.8 |
| | Natrona | 28,565 | 43.9 |
| | Platte | 3,917 | 6.0 |
| | **Total** | **651,14** | **100** |
| Guernsey to State Line | Goshen | 80,585 | 100 |
| | **Total** | **80,585** | **100** |
| Upper Laramie | Albany | 101,537 | 97.6 |
| | Carbon | 2,501 | 2.4 |
| | **Total** | **104,038** | **100** |
| Lower Laramie | Albany | 2,627 | 4.0 |
| | Goshen | 4,316 | 6.5 |
| | Laramie | 695 | 1.0 |
| | Platte | 58,799 | 88.5 |
| | **Total** | **66,437** | **100** |
| Horse Creek | Goshen | 34,505 | 85 |
| | Laramie | 5,420 | 13.3 |
| | Platte | 670 | 1.7 |
| | **Total** | **40,595** | **100** |
| South Platte | Albany | 195 | 0.5 |
| | Laramie | 43,028 | 99.5 |
| | **Total** | **43,223** | **100** |
| **Note:** All data has been projected in the NAD1983 datum. | | | |

**Figure 3.2.9** presents a direct comparison of the irrigated acreage among the different subbasins of the Platte River Basin. The Above Pathfinder, Upper Laramie, and Guernsey to Stateline subbasins account for 59% of the irrigated acreage in the riverbasin while the remaining 41% is split between the other four subbasins.

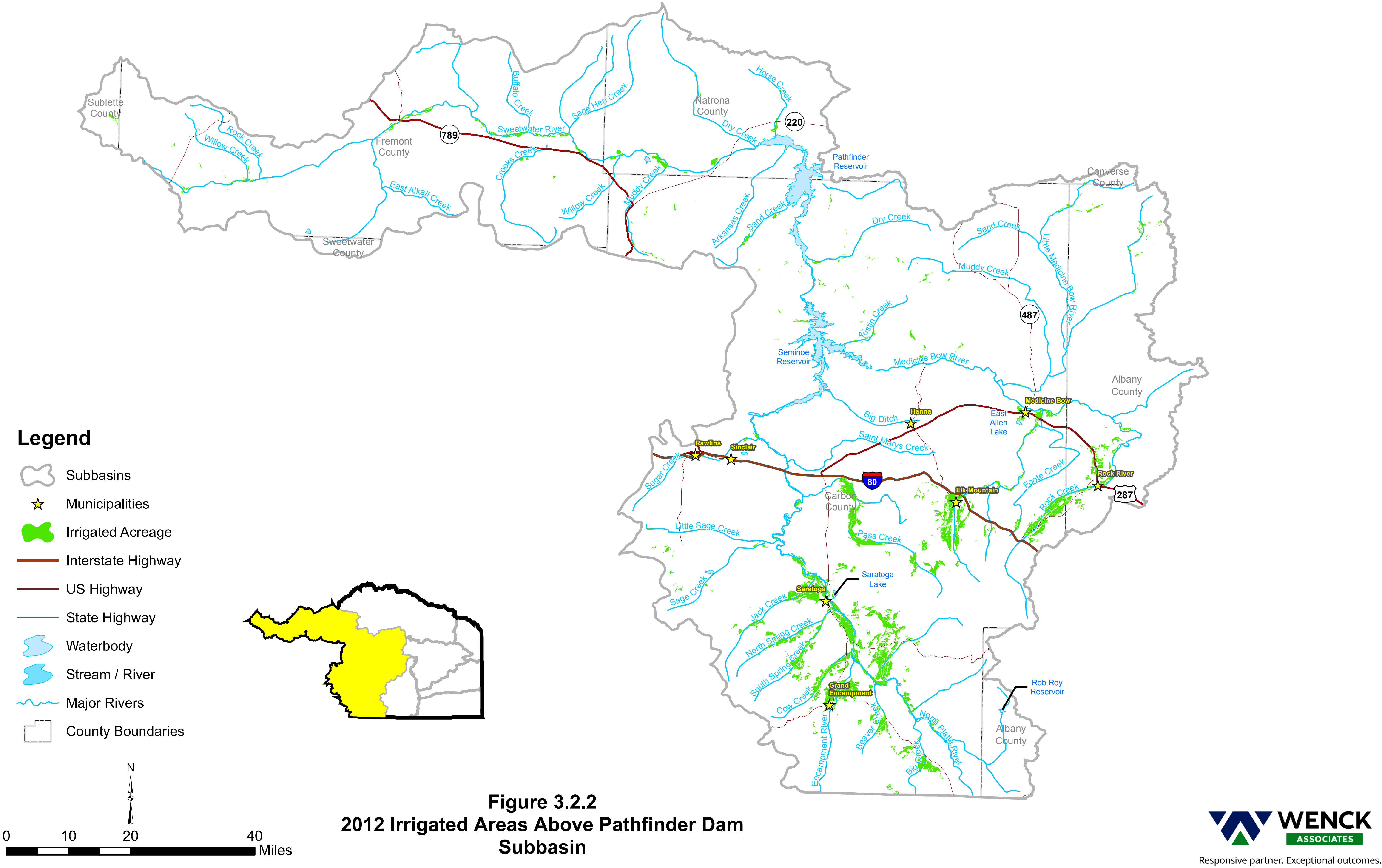


**Figure 3.2.2**
**2012 Irrigated Areas Above Pathfinder Dam Subbasin**

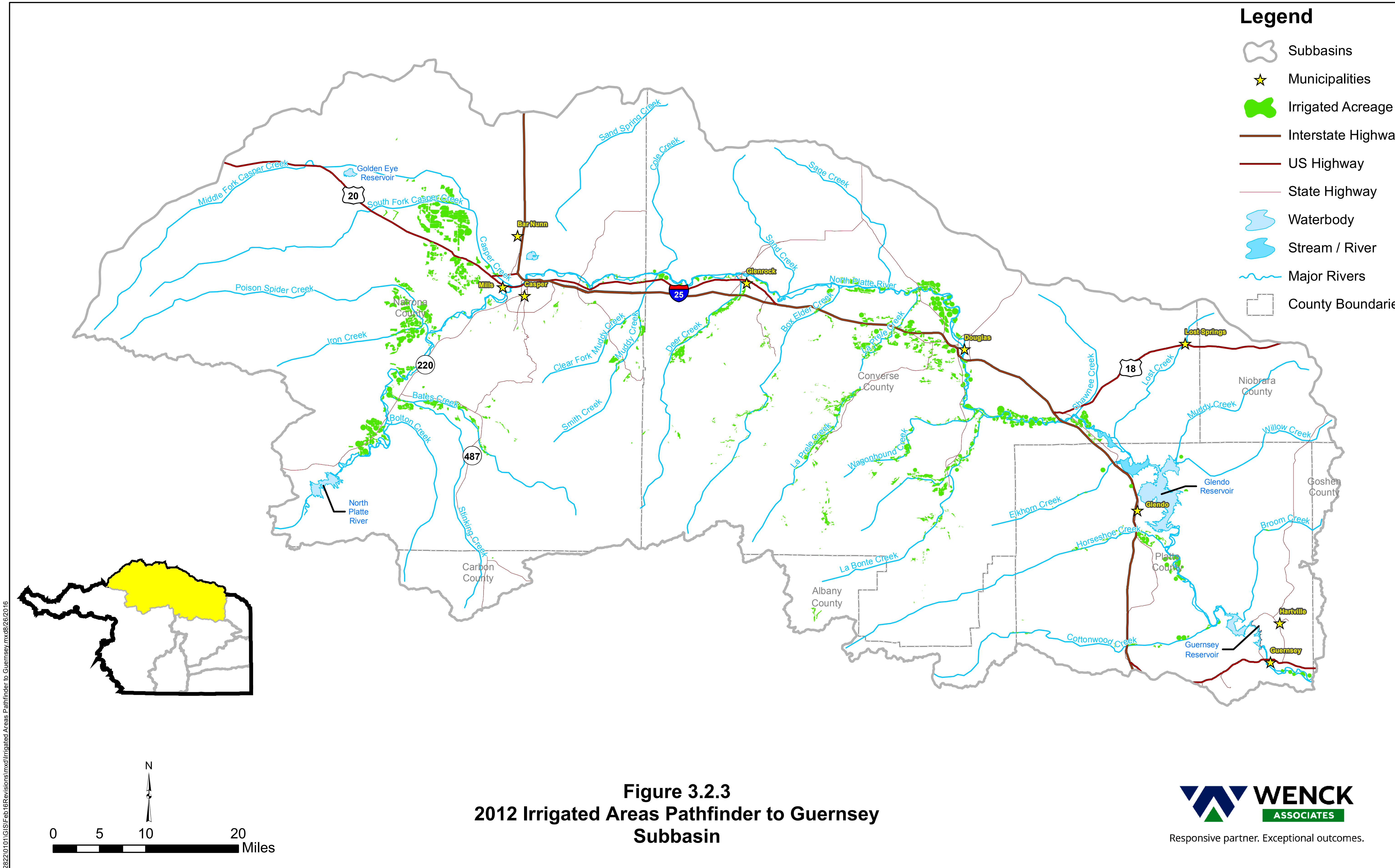


**Figure 3.2.3**
**2012 Irrigated Areas Pathfinder to Guernsey Subbasin**

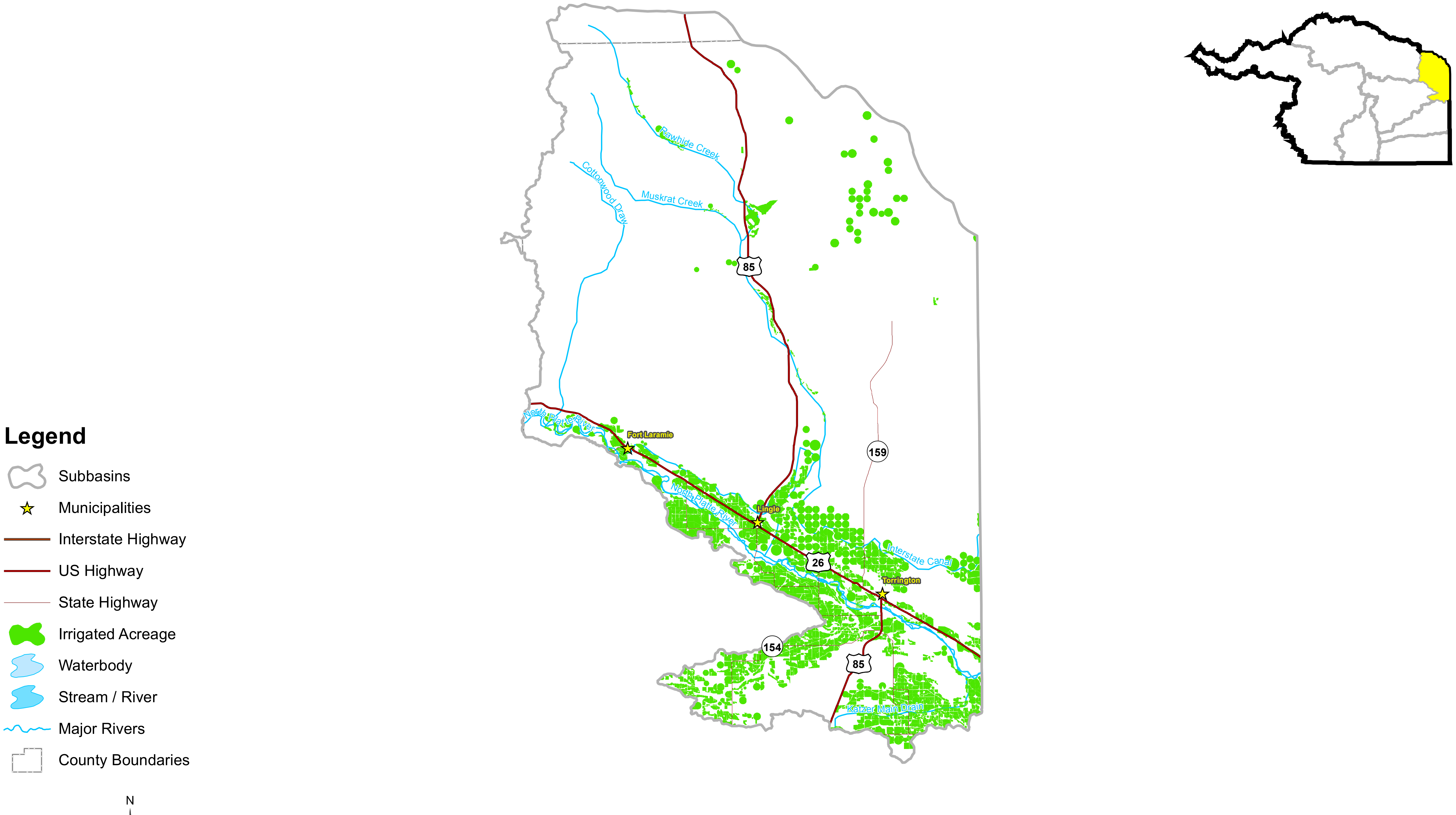


**Figure 3.2.4**
**2012 Irrigated Areas Guernsey to State Line Subbasin**

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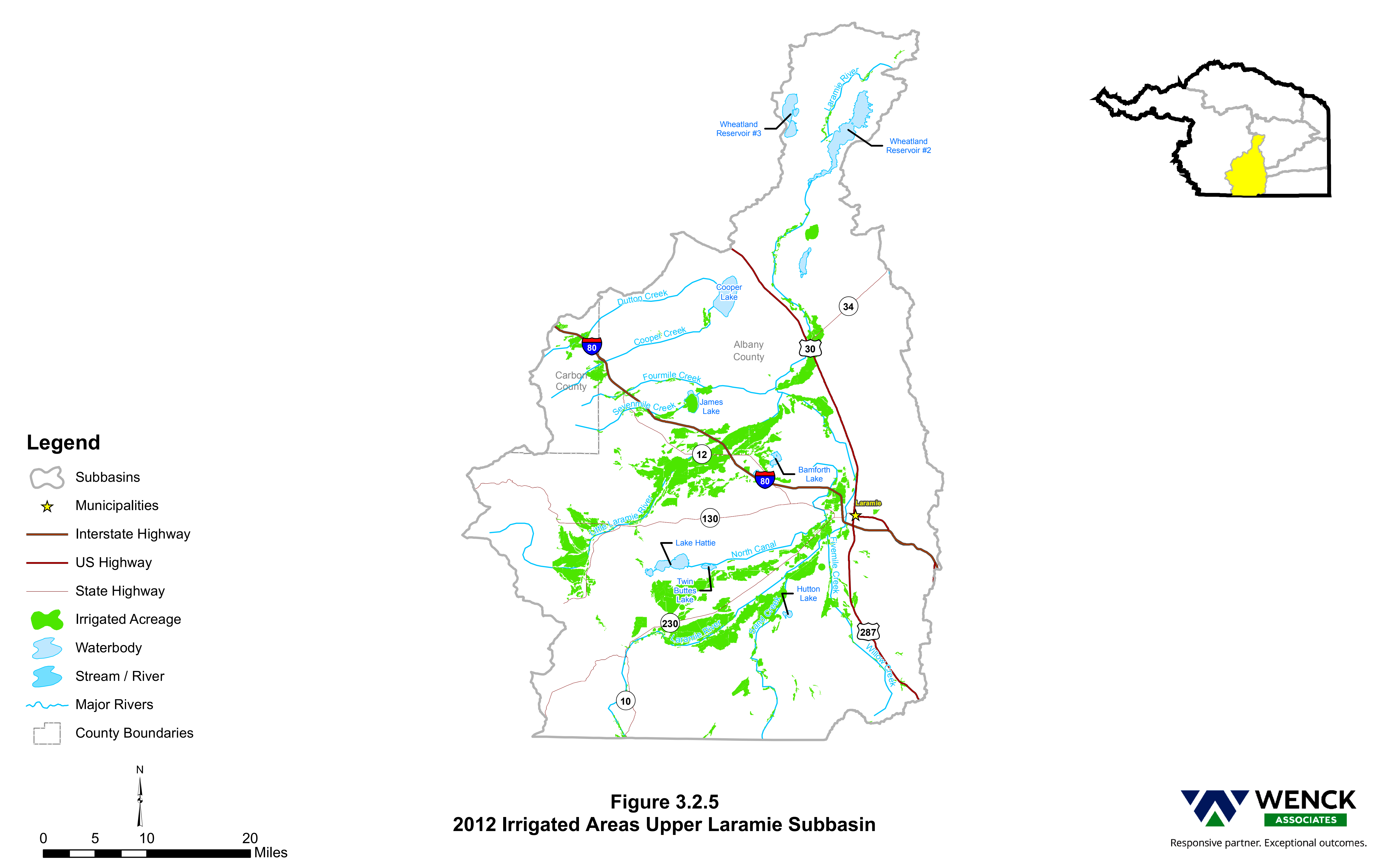


Figure 3.2.5
2012 Irrigated Areas Upper Laramie Subbasin

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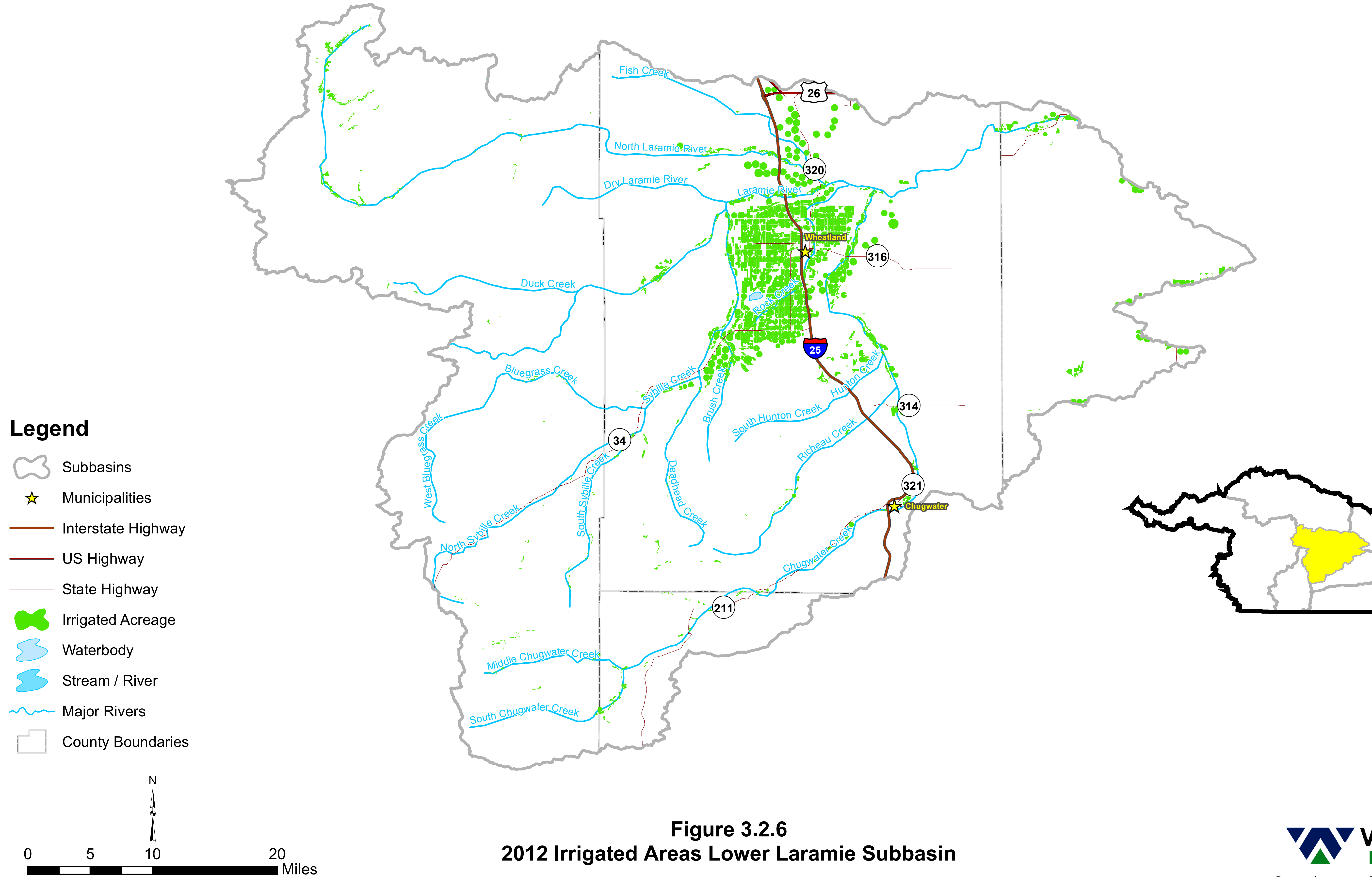


**Figure 3.2.6**
**2012 Irrigated Areas Lower Laramie Subbasin**

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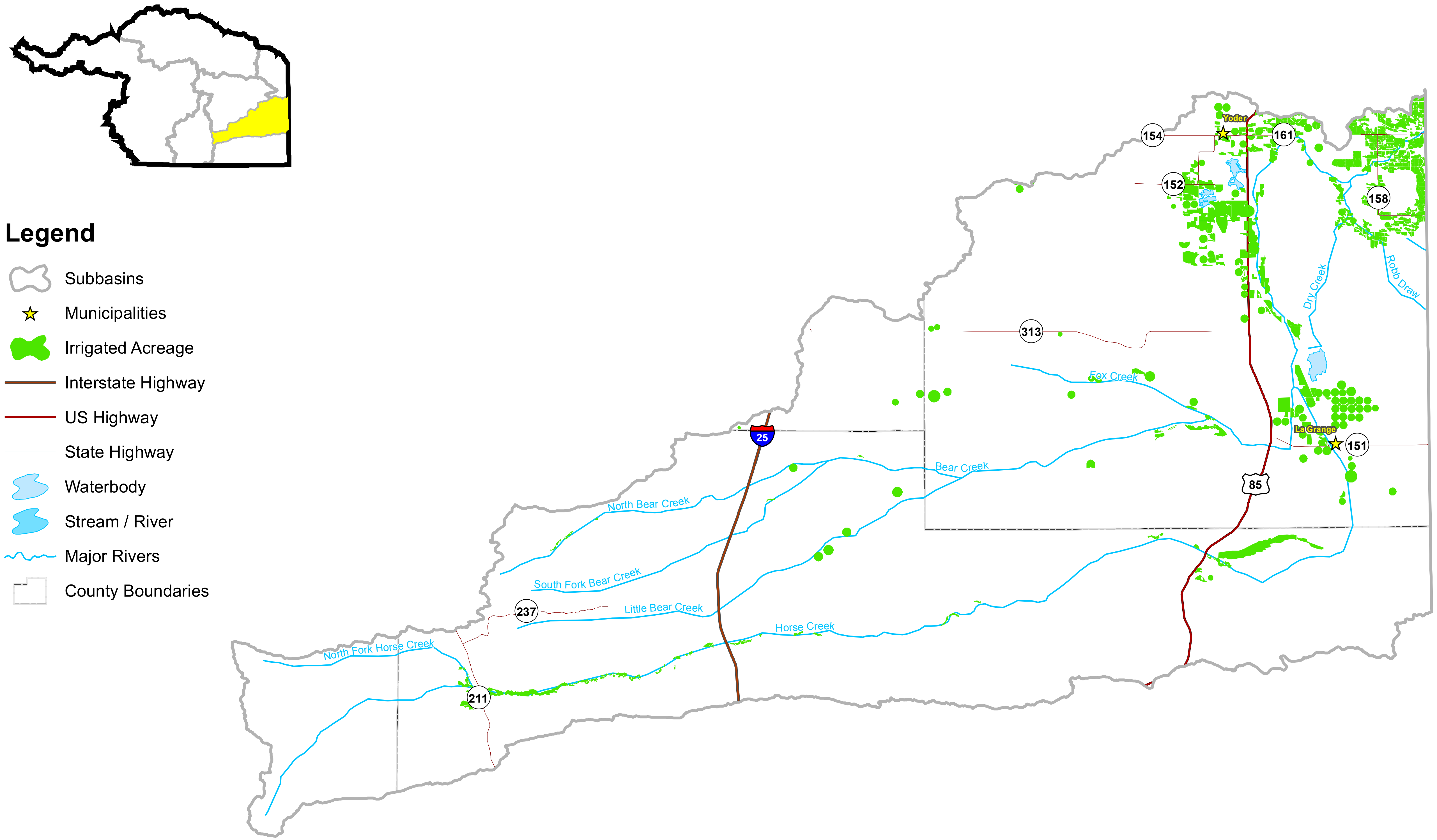


**Figure 3.2.7**
**2012 Irrigated Areas Horse Creek Subbasin**

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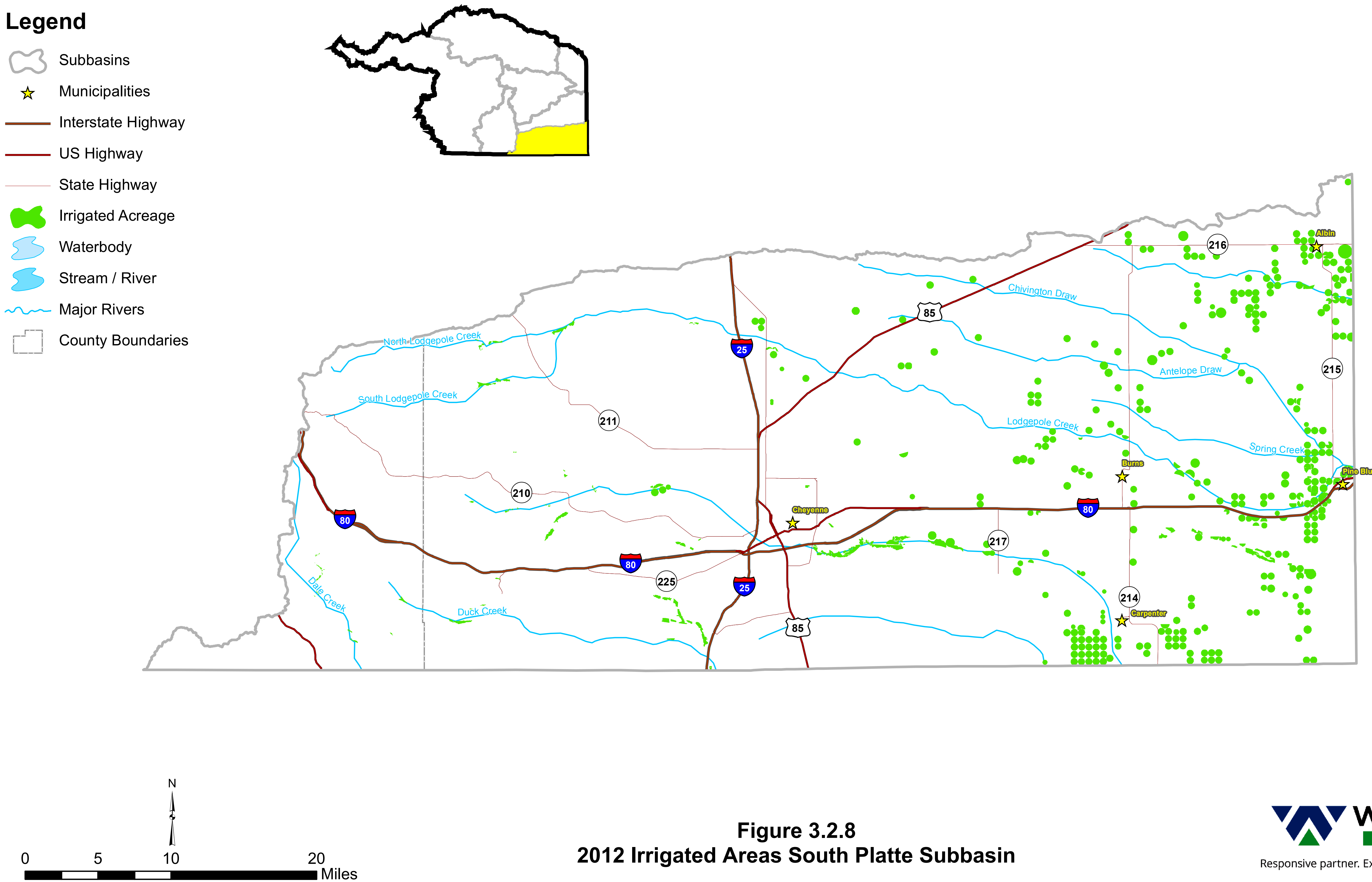


**Figure 3.2.8**
**2012 Irrigated Areas South Platte Subbasin**

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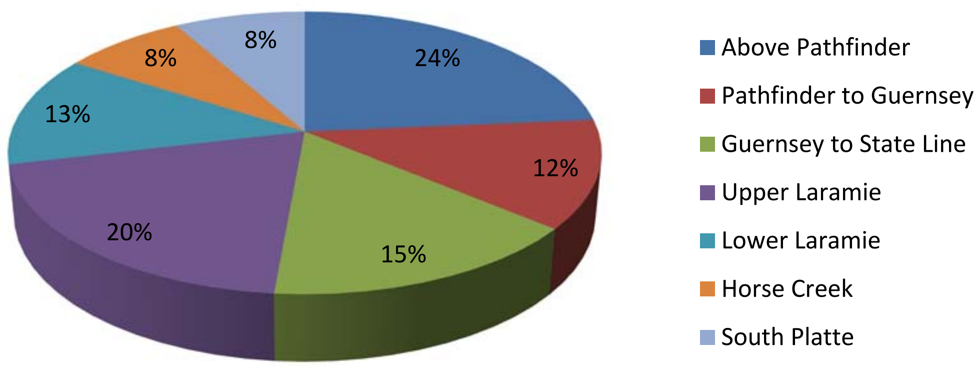
**Figure 3.2.9: Percent of Total Irrigated Acres by Subbasin in 2012**




### 3.2.5 Irrigated Acreage Comparison and Variation in Irrigated Acreage

The irrigated acreages that were delineated for 2012 for the entire Platte River Basin were compared to those from the original basin plan report. **Appendix 3-A,** summarizes the GIS delineated acreages and notes the percent differences between the irrigated lands maps. All Platte River subbasins, with the exception of the Upper Laramie, experienced an overall decrease in irrigated acreages between the two mapping periods. The subbbasins that experienced the largest reduction in irrigated acreage were Horse Creek (-32%), Pathfinder to Guernsey (-28%), and the Lower Laramie (-23%). Generally, the substantial reduction in irrigated acreages can be attributed to the below average water year of 2012, when water supplies were stressed. The only subbasin with an observed increase in irrigated acreage was the Upper Laramie (+13%). Overall, 14% fewer irrigated acres were identified through the most recent irrigated lands mapping in the Platte River Basin. Overall, as shown in **Table 3.2.2**, mapped acreage in 2012 was 14% less than reported in the period from 1995 to 2001.

**Table 3.2.2: Comparison of Original Basin Plan and 2012 Mapped Irrigated Acreages**

| Platte River Subbasin | 1995-2001 Mapped Acreages[1] | 2012 Mapped Acreages | Percent Difference |
|---|---|---|---|
| Above Pathfinder | 150,186 | 123,651 | -18 |
| Pathfinder to Guernsey | 90,028 | 65,114 | -28 |
| Guernsey to State Line | 88,034 | 80,585 | -8 |
| Upper Laramie | 92,186 | 104,038 | 13 |
| Lower Laramie | 86,380 | 66,437 | -23 |
| Horse Creek | 59,521 | 40,595 | -32 |
| South Platte | 45,454 | 43,223 | -5 |
| **Total** | **611,789** | **523,644** | **-14** |

**Note:**
1. Irrigated acres from Table 2-3 of the Platte River Basin Plan Final Report (Trihydro,2006).

To further assess the variability in irrigated acreage with water availability, the irrigated acreages identified by the SEO within the decree areas only for 2011, 2012, and 2013 were compared. Hoobler (2014) reported that 2011 was an above average water year, while 2012 was below average and 2013 was an average year. **Table 3.2.3** presents a comparison of the irrigated acreage the SEO delineated for those years. It is important to note that the discrepancy between mapped acreages shown in **Table 3.2.2** and **Table 3.2.3** is attributable to the fact that the SEO did not delineate all the irrigated acreage in the Platte River Basin in 2012 and this is reflected in **Table 3.2.3** (Hoobler, 2014). Therefore, the methodologies used to calculate irrigated acreage in the Platte River Basin differed between the analysis performed by Wenck and the SEO.

**Table 3.2.3: Irrigated Acreage Identified by the SEO within Platte River Basin Decree Areas**

| Decree Area | 2012 Mapped Acreages (below)[1] | 2013 Mapped Acreages (average)[2] | 2011 Mapped Acreages (above)[3] | Percent Difference (below) | Percent Difference (above) |
|---|---|---|---|---|---|
| Above Guernsey[4] | 169,059 | 171,696 | 203,599 | 1.5 | 18.6 |
| Guernsey to State Line | 78,533 | 72,344 | 78,389 | -8.6 | 8.4 |
| Upper Laramie | 77,440 | 68,018 | 80,294 | -13.9 | 18.0 |
| Lower Laramie | 52,370 | 54,516 | 64,095 | 3.9 | 17.6 |

**Notes:**
1. Acreage from Wyoming Depletions Report – Water Year 2012 (SEO, 2012)
2. Acreage from Wyoming Depletions Report – Water Year 2013 (SEO, 2013)
3. Acreage from Wyoming Depletions Report – Water Year 2011 (SEO, 2011)
4. Acreage above Guernsey excludes Casper Alcova Irrigation District/Kendrick Project

Based on the data presented in **Table 3.2.4**, water usage and irrigated acreages varies considerably between subbasins. The Above Guernsey area experienced an 18.6% increase in irrigated acreage in an above average water year, and decreased only 1.5% in a below average water year. This area appears to be far more dependent upon surface water flow for irrigation supplies. Similarly, water use and associated irrigated land usage in the Upper and Lower Laramie subbasins increased 18% and 17.6%, respectively, in an above average water year. During a below average water year, irrigated lands in Lower Laramie decreased 3.9%, while those in the Upper Laramie increased almost 14%. The reason for this specific increase between these years is unknown, but the limited number of years used for comparison likely has an effect. In contrast, the Guernsey to State Line area exhibited less significant swings in irrigated land of approximately 8% during above and below average years. The stability of this area could be attributed to pumping from triangle groundwater wells and/or regulation in favor of this area.

**Table 3.2.4: Estimated Percentage of Acres Irrigated by Center Pivot Irrigation System in 2012**

| Subbasin | Pivot Acres | Total Irrigated Acres in 2012 | Estimated Pivot Irrigation % |
|---|---|---|---|
| Above Pathfinder | 3,203 | 123,651 | 3 |
| Pathfinder to Guernsey | 25,018 | 64,870 | 39 |
| Guernsey to State Line | 38,093 | 80,585 | 47 |
| Upper Laramie | 1,662 | 104,038 | 2 |
| Lower Laramie | 37,682 | 66,437 | 57 |
| Horse Creek | 17,344 | 40,597 | 43 |
| South Platte | 38,667 | 43,221 | 89 |
| **Platte Basin Total** | **161,669** | **523,400** | **31** |

Notes:
1. Irrigated area was based on 2012 irrigated lands coverages from SEO North Platte modified Decree Area irrigated land inventory.
2. Pivot irrigation was estimated based on 2012 NAIP aerial imagery.

### 3.2.6 Crop Distribution

Trihydro (2006) previously summarized the distribution of crops grown in the Platte River Basin by county in Table 2-2 and by subbasin in Table 2-4 of their final report. The National Agricultural Statistics Service (NASS) 2012 Census of Agriculture for Wyoming (USDA, 2015) was reviewed to evaluate crop distribution for the irrigated lands for each of the seven Platte River subbasins. Based on that review, there is insufficient data for 2012 to complete a thorough update to the work previously completed. The principal reasons for the incomplete data sets are lack of responses from the agricultural community and privacy concerns. However, Table 4.9 in Volume 4 summarizes crop acreage for the entire Platte River Basin.

### 3.2.7 Water Use and Consumptive Use

Surface water and groundwater are both used for irrigation purposes in the Platte River Basin. Trihydro (2006) and The Wyoming Geological Survey tabulated the quantities of permitted irrigation groundwater rights. Total annual average groundwater withdrawals for irrigation were estimated to be 206,745 acre-feet (Taucher and others, 2013). Assuming surface water is applied at a rate of 1 cfs per 70 acres, total surface water use during the irrigation season based on the number of irrigated acres in 2012 would be approximately 2.4 million acre-feet.

The annual consumptive use of irrigation water for 2012 was estimated on the basis of the unit consumptive use rates and the irrigated acreages that were delineated. These rates of irrigation water use ($CU_w$) for irrigated acreage were established in the 2006 Platte River Basin Plan, and were calculated on the basis of calibrated crop coefficients derived from the supreme court (2001) consumptive use data (Trihydro, 2006). Based on the same methodologies used in the original basin plan, AMEC (2014) developed a $CU_w$ of 0.93 for Laramie County that was based on 18 years of data and encompassed a wide range of meteorologic variability. The $CU_w$ value from the AMEC study (2014) was deemed acceptable for the purposes of estimated consumptive use in this analysis, given that 99.5% of the 2012 irrigated acreage in the South Platte subbasin resides within Laramie County.

**Table 3.2.5** summarizes the 2012 consumptive use calculations, and is organized on the basis of subbasins. Overall this usage is very similar to that provided by Trihydro (2006) for a low streamflow year. The most significant increase in water use was observed in the Upper Laramie.

**Table 3.2.5: Consumptive Use of Irrigation Water by Platte River Subbasin**

| Platte River Subbasin | Annual Unit Consumptive Use ($CU_w$) Value (acre-feet/acre)[1] | 2012 Consumptive Use (acre-feet)[2] | Average Low Streamflow Consumptive Use (acre-feet)[3] |
|---|---:|---:|---:|
| Above Pathfinder | 0.74 | 91,502 | 85,920 |
| Pathfinder to Guernsey | 1.04 | 67,719 | 63,323 |
| Guernsey to State Line | 1.32 | 106,373 | 112,895 |
| Upper Laramie | 0.79 | 82,190 | 43,696 |
| Lower Laramie | 1.31 | 87,033 | 102,937 |
| Horse Creek | 1.16 | 47,090 | 61,281 |
| South Platte | 0.93[1] | 40,197 | 43,314 |
| **Total** | ---- | **522,103** | **513,366** |

**Notes:**

1. Annual consumptive use unit values taken from Trihydro (2006), with the exception of the South Platte Subbasin that was obtained from AMEC (2014).
2. Consumptive use equal to annual unit consumptive use multiplied by the 2012 irrigated acreage for each respective subbasin from **Table 3.2.2**.
3. Consumptive use during average low streamflow years from Trihydro (2006) in Technical Memorandum 2.1.4.

### 3.2.8 Livestock Water Use within the Platte River Basin

Trihydro (2006) provided maps showing the locations of stock water wells in the basin plan and provided an overview on livestock population. To supplement this information and provide a current estimate of water use by the various types of livestock in the basin, the 2012 Census of Agriculture prepared by the U.S. Department of Agriculture (USDA, 2012) was reviewed to determine the populations of livestock. The USDA prepared profiles in 2012 for each of the counties located within the Platte River Basin that included inventories for each livestock type, including cattle, sheep, horses, layers (poultry), and buffalo among others. With the exceptions of Sublette and Sweetwater Counties, the county populations for each livestock type were multiplied by the percentage of each county within the Platte Basin to estimate the basin population. The 2012 livestock population estimates are presented in **Table 3.2.6**. In Volume 4, Harvey Economics (HE) used more recent 2015 data rather than the 2012 data used in the Volume 3 analysis. Therefore, the livestock population numbers for cattle and sheep reported in Volume 4, Table 4.9 are greater than those presented in **Table 3.2.6**. It is worth noting that the water directly consumed by livestock is insignificant when compared to the use by irrigated crops.

Annual water use by livestock type for 2012 was estimated from these populations and established livestock watering requirements. Unit water usage data for different types of livestock were obtained from the 2010 Wyoming Livestock Water and Pipeline Handbook (USDA, 2010). These values were multiplied by the total estimated population of the respective livestock type to estimate total water use. As shown in **Table 3.2.6** total livestock water use in 2012 has been estimated to be approximately 8,494 acre-feet. Of that total, approximately 95% is attributed to cattle raised in the basin, while 3% was attributed to horses.

### 3.2.9 References

AMEC Environment & Infrastructure Inc., 2014, Hydrogeologic Study of the Laramie County Control Area: Consultant's report prepared for Wyoming State Engineer's Office in collaboration with Hinckley Consulting and HDR Engineering.

Anderson Consulting Engineers, 2008, Goshen Irrigation District Master Plan, Level I Study: Consultant's report prepared for the Wyoming Water Development Commission.

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United States Department of Agriculture. 2014. National Agriculture Imagery Program. Wyoming 2012, 1 meter imagery. Accessed 11/4/2014. http://gis.apfo.usda.gov/arcgis/services/NAIP/Wyoming_2012_1m_NC/ImageServer

Pavlica, J., 2014, Wyoming Water Development Office. Personal Communication. Cheyenne, WY.

Trihydro Corporation, 2006, Platte River Basin Plan Final Report: Consultant's report prepared for the Wyoming Water Development Commission in collaboration with Lidstone and Associates, Inc., Harvey Economics, and Water Rights Services LLC

**Table 3.2.6: Estimated Livestock Water Use in the Platte River Basin in 2012**

| | Livestock Population by County | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Livestock Category** | **Albany** | **Laramie** | **Platte** | **Goshen** | **Carbon** | **Natrona** | **Converse** | **Fremont** | **Niobrara** | **Livestock Totals by Type** | **Unit Daily Water Use by Livestock Type (gal/day)** | **Estimated Annual Water Use by Livestock Type (Acre-feet)** |
| Cattle and Calves | 68,725 | 83,455 | 78,634 | 108,355 | 63,732 | 29,167 | 29,529 | 15,282 | 3,192 | 480,072 | 15 | 8,066 |
| Sheep and Lambs | 2,762 | 29,749 | 417 | 1,273 | 7,203 | 12,664 | 27,234 | 3,027 | 190 | 84,519 | 1.5 | 142 |
| Horses and Ponies | 2,687 | 3,358 | 1,374 | 2,420 | 1,884 | 1,397 | 882 | 2,231 | 84 | 16,318 | 15 | 274 |
| Layers | 1,727 | - | 790 | 1,571 | 172 | 723 | 549 | 584 | 18 | 6,135 | 1.5 | 10 |
| Buffalo | - | NR | - | - | NR | - | - | - | 52 | 52 | 20 | 1 |
| Goats | - | - | - | - | - | - | 104 | - | - | 104 | 1.5 | 0.2 |
| Hogs and Pigs | NR | NR | NR | - | - | - | - | - | - | NR | | NR |
| County % in Platte River Basin | 100% | 100% | 100% | 96% | 70% | 57% | 50% | 19% | 7% | | **Total =** | 8,494 |

**Notes:**
NR – Present
- Indicates not present in county.
County percentages estimated using GIS and Platte Basin Watershed boundary. Sublette (1.1%) and Sweetwater (0.3%) Counties were not included due to their low county percentage within the Platte River Basin.
Livestock type and number obtained from 2012 USDA Census by county at the following address: http://www.agcensus.usda.gov/Publications/2012/Online_Resources/County_Profiles/Wyoming
Livestock population for each county estimated by multiplying 2012 USDA Census county data for each livestock category by county percentage within the Platte River Basin.
Estimated daily unit livestock water requirements from Wyoming Livestock Water and Pipeline Handbook, 2010.

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## 3.3 MUNICIPAL AND DOMESTIC USE

### 3.3.1 Introduction

This section presents an update on the municipal and domestic use of water within the Platte River Basin of Wyoming. The basin consists of the six subbasins of the North Platte River and the South Platte Subbasin. The principal focus of this update to the Platte River Basin Plan (Trihydro, 2006) has been a revision to the amounts of water used for municipal and domestic purposes on both an annual and a monthly basis, with a review of how that usage changes between above and below average water years. This update relied heavily on information developed and maintained by the SEO and the WWDC.

### 3.3.2 Municipal Use

Trihydro (2006) presented a comprehensive overview of the 54 community public water systems located within the subbasins of the Platte River Basin in Technical Memorandum 2.2. Since the completion of the 2006 Basin Plan, much new water usage data have been developed through master planning projects sponsored by the WWDC, the SEO's annual municipal water use surveys for subbasins within the North Platte River drainage, and the WWDC's public water system surveys. These data sources are listed in the references section at the end of this section. Water usage data were either compiled on a monthly or an annual basis and provide sufficient information for evaluating water usage changes both seasonally within a given year and annual changes in available water.

Actual water usage data are not typically available for many smaller community public water systems. For these systems, average and peak use were calculated as done in the Basin Plan by taking the average and peak usage values of entities who participated in the WWDC's 2002 survey, 226 and 575 gallons per capita per day (gpcpd), respectively, and multiplying this value by the respective entity's population. The following sections present the current water usage data.

### 3.3.3 New High Capacity Wells

Since January 1, 2004, 30 new wells or enlargements have been filed with the SEO for municipal use. Typically, these wells produce more than 50 gallons per minute (gpm), although the towns of Yoder and Glendo completed wells with smaller yields during the time period. The location, depth, and appropriation of these wells are listed in **Appendix 3-B,** Table 1. The locations of these wells are shown along with those identified by Trihydro (2006) on **Figure 3.3.1**. This documentation demonstrates that several municipalities have identified and developed new water sources as they have attempted to keep pace with water demand.

The new municipal wells include the following:

- Five North Park Aquifer wells for the Town of Saratoga, which has transitioned from a surface water only system to a groundwater only system;
- Two Lance/Fox Hills Aquifer wells for the Town of Pine Bluffs, which has lost several Brule Aquifer wells due to declining water levels;
- Two High Plains Aquifer wells for the City of Cheyenne, which has been evaluating various groundwater development options at its Belvoir Ranch including the Casper Aquifer;
- Two High Plains Aquifer wells for the Town of Albin; and,
- One Lance/Fox Hills Aquifer well for the Town of Yoder.

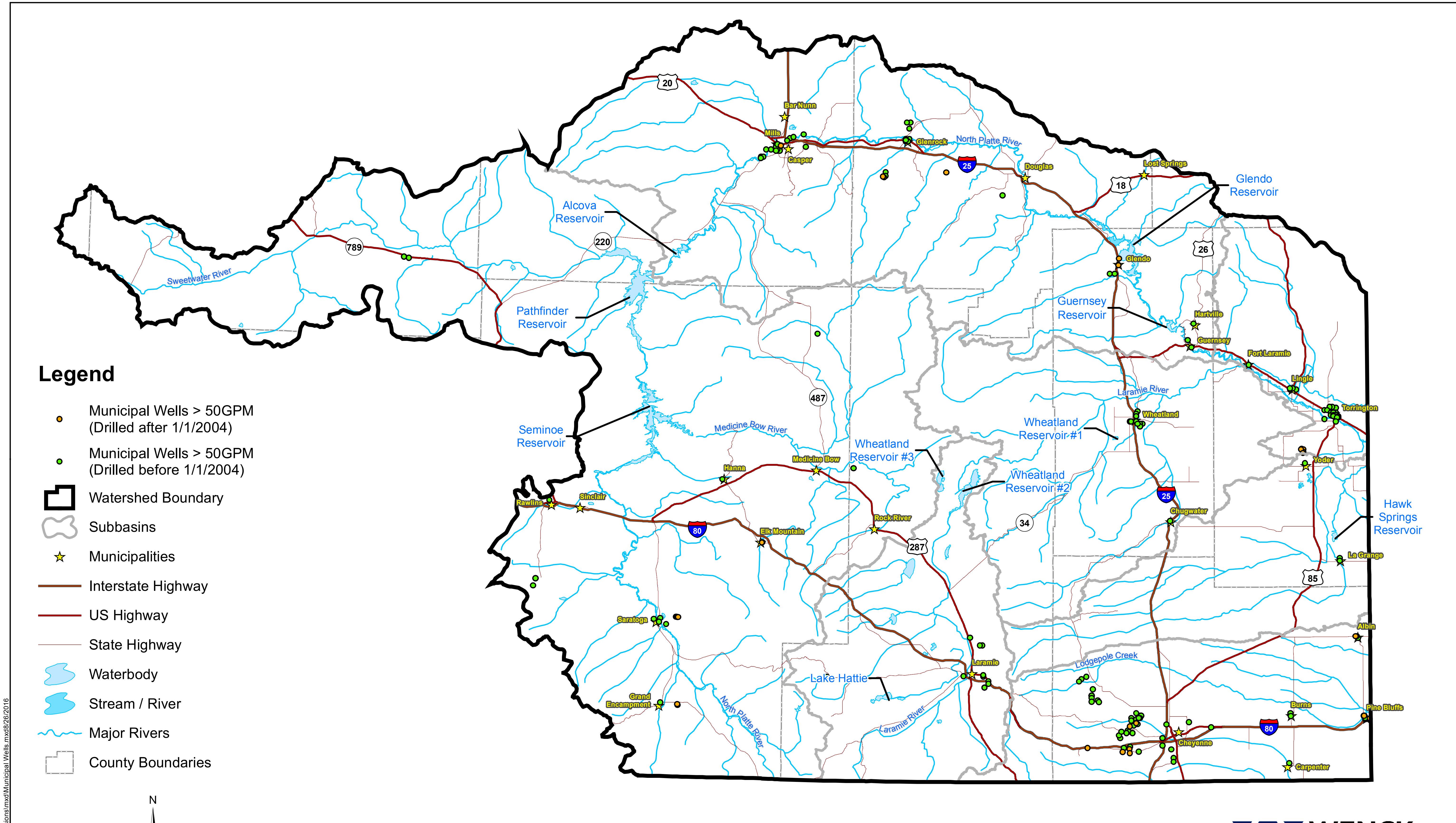



**Figure 3.3.1**
**Municipal 50+ GPM Wells**

These new wells indicate that groundwater remains a significant source of supply for many municipalities within the Platte River Basin. The fact that these wells have also been drilled to depths ranging up to 2,926 feet, completed in new aquifers, and used to replace surface water indicates the measure of the municipalities resolve to continue providing quality drinking water to Wyoming's residents.

### 3.3.4 Annual Rural Domestic and Municipal Water Usage and Usage Variations

Water usage data for the community public water systems in each subbasin were compiled from the WWDC's 2013 Public Water System Survey Report and various master plans to compare changes in water usage between 2002 as noted in the original Basin Plan (Trihydro, 2006) and 2013. **Tables 3.3.1 through 3.3.7** present the water source, average day use, and peak daily use in gallons per day (gpd) for each of the respective entities in the various subbasins. Total annual water usage for each community public water system is shown for the recent 2013 dataset. Usage data were estimated for those systems that were not included or did not provide recent information.

Comparison of these data on an individual basis indicates that water usage changes vary, likely for different reasons. With respect to the municipalities serving a population of 500 or more, average daily water usage increased for the following municipalities: Hanna, Evansville, Casper, Douglas, Wheatland, and Cheyenne; while average daily water usage declined for the following municipalities: Saratoga, Rawlins, Guernsey, Glenrock, Mills, Lingle, Torrington, Laramie, and Pine Bluffs. Most of these changes correspond to changes in population. Wheatland's increase is likely due to a reporting error from 2002. The magnitude of the other changes can be obtained from reviewing the respective tables.

For entities within subbasins of the North Platte River, the total annual usage reported by the WWDC in **Tables 3.3.1 through 3.3.7** can be compared with that obtained from the SEO for 2013 in **Table 3.3.8**. This table lists the total annual diversion or usage of each municipality within the North Platte River subbasins as reported to the SEO for water years 2011 through 2013. These data were obtained from the Wyoming Depletions Reports (SEO, 2011-2013) associated with each of these water years.

**Table 3.3.8** can also be used to evaluate changes in water usage related to water availability. While 2013 was an average water year, 2011 was an above average water year and 2012 was a below average water year. Based on these data, water usage across the subbasins of the North Platte River generally decreased during an above average water year, and increased during a below average water year. Water use increased 6.5% during a below average water year, and decreased 8.6% during an above average water year. Previously, municipalities had reported changes in usage ranging from 0 to 20% (Trihydro, 2006). Water usage between the various subbasins varied. During a below average water year, water usage increased 9% to 22% in the following subbasins: Pathfinder to Guernsey, Guernsey to State Line, Lower Laramie, and Horse Creek, while those in the other subbasins decreased slightly. During an above average water year, water usage decreased 8.5% to 20% in the following subbasins: Above Pathfinder, Pathfinder to Guernsey, Upper Laramie, and Horse Creek, while water use in the Lower Laramie and Guernsey to State Line subbasins decreased less than 3%.

**Appendix 3-B** presents detailed information on new water wells and summaries of water usage for community water systems in the Platte River Basin.

### Table 3.3.1: Summary of Rural Domestic Water Use in the Above Pathfinder Dam Subbasin, Wyoming

| 2006 Platte Basin Plan | | | | | | |
|---|---|---|---|---|---|---|
| County | Number of Domestic Wells | Area (sq mi) | Housing Density (people per house)[1] | Rural Population | Estimated Minimum Water Use (gpd)[2] | Estimated Average Water Use (gpd)[3] |
| Albany | 290 | 1,027 | 2,44 | 708 | 106,140 | 212,280 |
| Carbon | 1,105 | 5,425 | 2.46 | 2,718 | 407,745 | 815,490 |
| Converse | 3 | 20 | 2.63 | 8 | 1,184 | 2,367 |
| Fremont | 247 | 1,749 | 2.61 | 645 | 96,7-1 | 193,401 |
| Natrona | 35 | 809 | 2.52 | 88 | 13,230 | 26,460 |
| Sublette | 2 | 55 | 2.52 | 5 | 756 | 1,512 |
| Sweetwater | 0 | 35 | 2.74 | 0 | 0 | 0 |
| **Totals** | **1,682** | | | **4,172** | **625,800** | **1,251,600** |

**Notes:**
1. From 2000 U.S. Census county population data.
2. Assumed 150 gpd per capita multiplied by rural population.
3. Assumed 300 gpd per capita multiplied by rural population.
4. Water use values reflect total demand but do not necessarily reflect consumptive use.

| Platte Basin Plan Update | | | |
|---|---|---|---|
| City/Town Service Area | Population Served[1] | Estimated Minimum Water Use (gpd)[2] | Estimated Average Water Use (gpd)[4] |
| **Total Subbasin Population[1] – 15,220** | | | |
| Encampment/Riverside | 593 | | |
| Saratoga | 1,761 | | |
| Hanna | 827 | | |
| Rawlins | 9,416 | | |
| Sinclair | 432 | | |
| Rock River | 249 | | |
| Elk Mountain | 211 | | |
| Medicine Bow | 315 | | |
| **Total Municipal Population** | **13,804** | **Total =** | **Total =** |
| **Rural Population[2]** | **1,416** | **212,400** | **424,800** |

**Notes:**
1. From Wyoming Department of Administration and Information, and Wyoming SEO (2013).
2. Rural population = total subbasin population – total municipal population.
3. Assumed 150 gpd per capita multiplied by rural population.
4. Assumed 300 gpd per capita multiplied by rural population.

**Table 3.3.2: Summary of Rural Domestic Water Use in the Pathfinder Dam to Guernsey Subbasin, Wyoming**

| 2006 Platte Basin Plan | | | | | | |
|---|---|---|---|---|---|---|
| County | Number of Domestic Wells | Area (sq mi) | Housing Density (people per house)[1] | Rural Population | Estimated Minimum Water Use (gpd)[2] | Estimated Average Water Use (gpd)[3] |
| Albany | 82 | 146.46 | 2.44 | 200 | 30,012 | 60,024 |
| Carbon | 4 | 75.11 | 2.46 | 10 | 1,476 | 2,952 |
| Converse | 1,681 | 2,103.58 | 2.63 | 4,421 | 663,155 | 1,326,309 |
| Goshen | 5 | 51.24 | 2.42 | 12 | 1,815 | 3,630 |
| Natrona | 2,685 | 2,285.06 | 2.52 | 6,766 | 1,014,930 | 2,029,860 |
| Niobrara | 47 | 157.80 | 2.33 | 110 | 16,427 | 32,853 |
| Platte | 388 | 812.23 | 2.43 | 943 | 141,426 | 282,852 |
| **Totals** | **4,892** | | | **12,462** | **1,869,300** | **4,738,600** |

**Notes:**
1. From 2000 U.S. Census county population data.
2. Assumed 150 gpd per capita multiplied by rural population.
3. Assumed 300 gpd per capita multiplied by rural population.
4. Water use values reflect total demand but do not necessarily reflect consumptive use.

| Platte Basin Plan Update | | | |
|---|---|---|---|
| City / Town Service Area | Population Served[1] | Estimated Minimum Water Use (gpd)[2] | Estimated Average Water Use (gpd)[4] |
| **Total Subbasin Population[1] – 97,148** | | | |
| Mills | 3,568 | | |
| Casper | 68,284 | | |
| Evansville | 3,162 | | |
| Glenrock | 2,727 | | |
| Rolling Hills | 450 | | |
| Douglas | 6,742 | | |
| Glendo | 204 | | |
| **Total Municipal Population** | **85,137** | **Total =** | **Total =** |
| **Rural Population[2]** | **12,011** | **1,801,650** | **3,603,300** |

**Notes:**
1. From Wyoming Department of Administration and Information, and Wyoming SEO (2013).
2. Rural population = total subbasin population – total municipal population.
3. Assumed 150 gpd per capita multiplied by rural population.
4. Assumed 300 gpd per capita multiplied by rural population.

**Table 3.3.3: Summary of Rural Domestic Water Use in the State Line Subbasin, Wyoming**

| 2006 Platte Basin Plan | | | | | | |
|---|---|---|---|---|---|---|
| County | Number of Domestic Wells | Area (sq mi) | Housing Density (people per house)[1] | Rural Population | Estimated Minimum Water Use (gpd)[2] | Estimated Average Water Use (gpd)[3] |
| Goshen | 1,471 | 1,064,04 | 2.42 | 3,560 | 533,973 | 1,067,946 |
| Niobrara | 4 | 25.26 | 2.33 | 9 | 1,398 | 2,796 |
| Platte | 0 | 0.92 | 2.43 | 0 | 0 | 0 |
| **Totals** | **1,475** | | | **3,569** | **535,350** | **1,070,700** |

**Notes:**

1. From 2000 U.S. Census county population data.
2. Assumed 150 gpd per capita multiplied by rural population.
3. Assumed 300 gpd per capita multiplied by rural population.
4. Water use values reflect total demand but do not necessarily reflect consumptive use.

| Platte Basin Plan Update | | | |
|---|---|---|---|
| City / Town Service Area | Population Served[1] | Estimated Minimum Water Use (gpd)[2] | Estimated Average Water Use (gpd)[4] |
| **Total Subbasin Population[1] – 12,296** | | | |
| Guernsey | 1,184 | | |
| Hartville | 63 | | |
| Fort Laramie | 240 | | |
| Lingle | 503 | | |
| Yoder | 467 | | |
| Torrington | 7,331 | | |
| **Total Municipal Population** | **9,788** | **Total =** | **Total =** |
| **Rural Population[2]** | **2,508** | **376,200** | **752,400** |

**Notes:**

1. From Wyoming Department of Administration and Information, and Wyoming SEO (2013).
2. Rural population = total subbasin population – total municipal population.
3. Assumed 150 gpd per capita multiplied by rural population.
4. Assumed 300 gpd per capita multiplied by rural population.

**Table 3.3.4: Summary of Rural Domestic Water Use in the Upper Laramie Subbasin, Wyoming**

| 2006 Platte Basin Plan | | | | | | |
|---|---|---|---|---|---|---|
| County | Number of Domestic Wells | Area (sq mi) | Housing Density (people per house)[1] | Rural Population | Estimated Minimum Water Use (gpd)[2] | Estimated Average Water Use (gpd)[3] |
| Albany | 1,980 | 1,859 | 2.44 | 4,831 | 724,680 | 1,449,360 |
| Carbon | 41 | 72 | 2.46 | 101 | 15,129 | 30,258 |
| **Totals** | **2,021** | | | **4,932** | **739,800** | **1,479,600** |

**Notes:**
1. From 2000 U.S. Census county population data.
2. Assumed 150 gpd per capita multiplied by rural population.
3. Assumed 300 gpd per capita multiplied by rural population.
4. Water use values reflect total demand but do not necessarily reflect consumptive use.

| Platte Basin Plan Update | | | |
|---|---|---|---|
| City / Town Service Area | Population Serviced[1] | Estimated Minimum Water Use (gpd)[2] | Estimated Average Water Use (gpd)[4] |
| **Total Subbasin Population[1] – 36,558** | | | |
| Laramie | 31,874 | | |
| **Total Municipal Population** | **31,874** | **Total =** | **Total =** |
| **Rural Population[2]** | **4,684** | **702,600** | **1,405,200** |

**Notes:**
1. From Wyoming Department of Administration and Information, and Wyoming SEO (2013).
2. Rural population = total subbasin population – total municipal population.
3. Assumed 150 gpd per capita multiplied by rural population.
4. Assumed 300 gpd per capita multiplied by rural population.

**Table 3.3.5: Summary of Rural Domestic Water Use in the Lower Laramie Subbasin, Wyoming**

| 2006 Platte Basin Plan | | | | | | |
|---|---|---|---|---|---|---|
| County | Number of Domestic Wells | Area (sq mi) | Housing Density (people per house)[1] | Rural Population | Estimated Minimum Water Use (gpd)[2] | Estimated Average Water Use (gpd)[3] |
| Albany | 193 | 959 | 2.44 | 471 | 70,638 | 141,276 |
| Goshen | 124 | 324 | 2.42 | 300 | 40,012 | 90,024 |
| Laramie | 20 | 125 | 2.54 | 51 | 7,620 | 15,240 |
| Platte | 1,118 | 1,244 | 2.43 | 2,717 | 407,511 | 815,022 |
| **Totals** | **1,455** | | | **3,539** | **530,850** | **1,061,700** |

**Notes:**
1. From 2000 U.S. Census county population data.
2. Assumed 150 gpd per capita multiplied by rural population.
3. Assumed 300 gpd per capita multiplied by rural population.
4. Water use values reflect total demand but do not necessarily reflect consumptive use.

| Platte Basin Plan Update | | | |
|---|---|---|---|
| City / Town Service Area | Population Served[1] | Estimated Minimum Water Use (gpd)[2] | Estimated Average Water Use (gpd)[4] |
| **Total Subbasin Population[1] – 6,808** | | | |
| Wheatland | 3,820 | | |
| Chugwater | 214 | | |
| **Total Municipal Population** | **4,034** | **Total =** | **Total =** |
| **Rural Population[2]** | **2,774** | **416,100** | **832,200** |

**Notes:**
1. From Wyoming Department of Administration and Information, and Wyoming SEO (2013).
2. Rural population = total subbasin population – total municipal population.
3. Assumed 150 gpd per capita multiplied by rural population.
4. Assumed 300 gpd per capita multiplied by rural population.

**Table 3.3.6: Summary of Rural Domestic Water Use in the Horse Creek Subbasin, Wyoming**

| 2006 Platte Basin Plan | | | | | | |
|---|---|---|---|---|---|---|
| **County** | **Number of Domestic Wells** | **Area (sq mi)** | **Housing Density (people per house)[1]** | **Rural Population** | **Estimated Minimum Water Use (gpd)[2]** | **Estimated Average Water Use (gpd)[3]** |
| Albany | 8 | 86 | 2.44 | 20 | 2,928 | 5,865 |
| Goshen | 520 | 709 | 2.42 | 1,258 | 188,760 | 377,520 |
| Laramie | 149 | 740 | 2.54 | 378 | 56,769 | 113,538 |
| Platte | 17 | 52 | 2.43 | 41 | 6,197 | 12,393 |
| **Totals** | **694** | | | **1,698** | **254,700** | **509,400** |

**Notes:**

1. From 2000 U.S. Census county population data.
2. Assumed 150 gpd per capita multiplied by rural population.
3. Assumed 300 gpd per capita multiplied by rural population.
4. Water use values reflect total demand but do not necessarily reflect consumptive use.

| Platte Basin Plan Update | | | |
|---|---|---|---|
| **City / Town Service Area** | **Population Served[1]** | **Estimated Minimum Water Use (gpd)[2]** | **Estimated Average Water Use (gpd)[4]** |
| **Total Subbasin Population[1] – 1,910** | | | |
| LaGrange | 455 | | |
| **Total Municipal Population** | **455** | **Total =** | **Total =** |
| **Rural Population[2]** | **2,455** | **218,250** | **436,500** |

**Notes:**

1. From Wyoming Department of Administration and Information, and Wyoming SEO (2013).
2. Rural population = total subbasin population – total municipal population.
3. Assumed 150 gpd per capita multiplied by rural population.
4. Assumed 300 gpd per capita multiplied by rural population.

**Table 3.3.7: Summary of Rural Domestic Water Use in the South Platte Subbasin, Wyoming**

| 2006 Platte Basin Plan | | | | | | |
|---|---|---|---|---|---|---|
| County | Number of Domestic Wells | Area (sq mi) | Housing Density (people per house)[1] | Rural Population | Estimated Minimum Water Use (gpd)[2] | Estimated Average Water Use (gpd)[3] |
| Albany | 163 | 228 | 2.44 | 398 | 59,658 | 119,316 |
| Laramie | 6,444 | 1,820 | 2.54 | 16,368 | 2,455,164 | 4,910,328 |
| **Totals** | **6,607** | | | **16,766** | **2,514,900** | **5,029,800** |

**Notes:**
1. From 2000 U.S. Census county population data.
2. Assumed 150 gpd per capita multiplied by rural population.
3. Assumed 300 gpd per capita multiplied by rural population.
4. Water use values reflect total demand but do not necessarily reflect consumptive use.

| Platte Basin Plan Update | | | |
|---|---|---|---|
| City / Town Service Area | Population Served[1] | Estimated Minimum Water Use (gpd)[2] | Estimated Average Water Use (gpd)[4] |
| **Total Subbasin Population[1] – 95,548** | | | |
| Albin | 196 | | |
| Burns | 308 | | |
| Cheyenne | 73,836 | | |
| Pine Bluffs | 1,153 | | |
| **Total Municipal Population** | **75,493** | **Total =** | **Total =** |
| **Rural Population[2]** | **20,091** | **3,013,650** | **6,027,300** |

**Notes:**
1. From Wyoming Department of Administration and Information, and Wyoming SEO (2013).
2. Rural population = total subbasin population – total municipal population.
3. Assumed 150 gpd per capita multiplied by rural population.
4. Assumed 300 gpd per capita multiplied by rural population.

**Table 3.3.8: Total Annual Diversions in Million Gallons by Water Year for Municipal Water Systems**

| | 2011 (wet year) Million Gallons | 2012 (dry year) Million Gallons | 2013 (average year) Million Gallons | Percent difference (between 2012 and 2013 water years)[3] | Percent difference (between 2011 and 2013 water years)[3] |
|---|---|---|---|---|---|
| **Above Pathfinder Subbasin** | | | | | |
| Encampment | 27.50 | 27.50 | 27.50 | 0.0% | 0.0% |
| Sierra Madre Joint Powers Board | 7.09 | 8.98 | 8.74 | 2.7% | -18.9% |
| Saratoga | 142.16 | 168.80 | 180.20 | -6.3% | -21.1% |
| Hanna | 92.00 | 96.00 | 90.00 | 6.7% | 2.2% |
| Rawlins | 742.35 | 767.56 | 832.37 | -7.8% | -10.8% |
| Sinclair | 34.85 | 37.34 | 31.39 | 19.0% | 11.0% |
| Rock River | 48.55 | 35.88 | 21.50 | 66.9% | 125.8% |
| Elk Mountain | 7.52 | 10.82 | 11.23 | -3.7% | -33.0% |
| Medicine Bow | 38.00 | 53.00 | 43.00 | 23.3% | -11.6% |
| **Total =** | **1,140.02** | **1,205.88** | **1,245.93** | **-3.2%** | **-8.5%** |
| **Pathfinder to Guernsey Subbasin** | | | | | |
| Mills | 231.00 | 268.00 | 250.00 | 7.2% | -7.6% |
| Central Wyoming Regional Water | 4,705.51 | 5,649.20 | 5,156.13 | 9.6% | -8.7% |
| Evansville | 249.97 | 290.38 | 261.81 | 10.9% | -4.5% |
| Glenrock | 159.01 | 205.84 | 217.63 | -5.4% | -26.9% |
| Douglas | 530.79 | 620.60 | 591.10 | 5.0% | -10.2% |
| Glendo | 16.45 | 20.06 | 16.69 | 20.2% | -1.4% |
| **Total =** | **5,892.73** | **7,054.08** | **6,493.36** | 8.6% | -9.2% |
| **Guernsey to State Line Subbasin** | | | | | |
| Guernsey | 123.90 | 153.60 | 147.50 | 4.1% | -16.0% |
| Hartville[1] | 5.83 | 5.83 | 5.83 | 0.0% | 0.0% |
| Fort Laramie[2] | 33.26 | 33.26 | 18.77 | 77.2% | 77.2% |
| Lingle | 90.40 | 104.40 | 83.42 | 25.1% | 8.4% |
| Torrington | 558.14 | 684.22 | 583.02 | 17.4% | -4.3% |
| **Total =** | **811.53** | **981.31** | **838.54** | 17.0% | -3.2% |
| **Upper Laramie Subbasin** | | | | | |
| Laramie | 1,891.56 | 2,051.11 | 2,098.81 | -2.3% | -9.9% |
| **Total =** | **1,891.56** | **2,051.11** | **2,098.81** | -2.3% | -9.9% |
| | | | | | |
| **Lower Laramie Subbasin** | | | | | |
| Wheatland | 426.40 | 531.10 | 433.10 | 22.6% | -1.5% |
| Chugwater | 19.39 | 21.72 | 19.12 | 13.6% | 1.4% |
| **Total =** | **445.79** | **552.82** | **452.22** | 22.2% | -1.4% |

**Table 3.3.8: Total Annual Diversions in Million Gallons by Water Year for Municipal Water Systems**

| | 2011 (wet year) Million Gallons | 2012 (dry year) Million Gallons | 2013 (average year) Million Gallons | Percent difference (between 2012 and 2013 water years)[3] | Percent difference (between 2011 and 2013 water years)[3] |
|---|---|---|---|---|---|
| **Horse Creek Subbasin** | | | | | |
| LaGrange | 36.67 | 54.17 | 45.90 | 18.0% | -20.1% |
| **Total =** | **36.67** | **54.17** | **45.90** | 18.0% | -20.1% |
| | | | | | |
| **Total =** | **10,218.30** | **11,899.37** | **11,174.76** | **6.5%** | **-8.6%** |

**Notes:**

Total annual diversions obtained from the Wyoming Depletions Reports prepared by the Wyoming State Engineer's Office (2011, 2012, 2013).

1. Wyoming State Engineer's Office Estimated the amounts for all three years.
2. Wyoming State Engineer's Office estimated amounts for 2011 and 2012.
3. Positive percentage represents an increase in water use. Negative percentage indicates a decrease in water use.

### 3.3.5 Monthly Water Usage

Monthly water usage data from 28 of the community public water systems were compiled to evaluate seasonal use during the average water year of 2013, and in some instances, to estimate consumptive use. **Table 3.3.9** presents the monthly water usage data by municipality and subbasin, the total amount of water diverted from surface or groundwater sources, and where available, the amount of water returned to the surface stream monthly for each entity. Water from interbasin transfers is included in these figures. The locations of treated return flows are shown on **Figure 3.3.2** along with surface water intakes for the municipalities. These data were obtained from the Wyoming Depletions Report compiled by the SEO for 2013, and for entities in the South Platte subbasin, from recent master plan reports. The data presented generally do not include that used by independent raw water irrigation systems for those municipalities that utilize them.

For those systems that reported both diversions and return flows, consumptive use estimates range from 27% to 92%, and compare similarly to those reported by Trihydro (2006) that ranged from 26% to 65%. Aside from other groundwater systems, the Sierra Madre Joint Powers Board had the highest consumptive use at 92%. Of the systems for which consumptive use estimates were previously made, Cheyenne had the lowest consumptive use at 27%, compared with 65% previously; Laramie increased from 26% to 46%; Glenrock increased to 70% from 46%; and Torrington increased to 60% from 50%. Casper had an estimated consumptive use of 54%.

### 3.3.6 Rural Domestic Use

Excluding non-community public water systems, rural domestic water usage was estimated on the basis of the estimated rural population and the same assumed domestic usage values applied by Trihydro (2006). This approach is markedly different from that applied during the original Basin Plan that used housing density and the number of domestic wells completed in each subbasin. The Wyoming Department of Administration and Information (2015) provided estimates of the 2013 population for each subbasin. The estimated rural population was obtained by subtracting the population served by each municipality within its water service area from the total subbasin population. The following sections present the estimated water usage based on this approach.

#### New Domestic Wells

Between January 1, 2004 and January 26, 2015, 5,043 well permits were obtained and presumably completed within the subbasins of the Platte River Basin. The locations of these wells are shown along with those wells previously identified by Trihydro (2006) on **Figure 3.3.3**. **Figure 3.3.3** illustrates that most of these wells have been drilled in close proximity to existing areas of development, including east of Cheyenne; around Wheatland, Douglas, and Casper; and within the triangle near Torrington. More rural areas did not experience as much development.

#### Estimated Rural Domestic Water Use

Based on an assumed per capita usage rate of 150 to 300 gpd used in the Basin Plan, rural domestic water usage for each of the subbasins has been estimated. **Appendix 3-B,** Tables 2 through 8 present the minimum to average water usage estimates for the various subbasins. With a total rural population of approximately 20,000, the South Platte subbasin has the highest estimated usage at approximately 3.0 to 6.0 million gpd. The Pathfinder to Guernsey subbasin had the second highest usage estimated at 1.8 to 3.6 million gpd. With the lowest rural population, the Horse Creek subbasin had the lowest estimated usage at 0.2 to 0.4 million gpd.

**Table 3.3.9: Monthly Municipal Surface Water and Groundwater Diversions and Return Flow in Million Gallons**

| | Water Year 2013[1] | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Oct | Nov | Dec | Jan | Feb | Mar | Apr | May | June | July | Aug | Sep | Total | Total Groundwater Diversions (MG) | Total Surface Water Diversions (MG) | Total Diversions (MG) | Total Return Flow (MG) | Estimated Consumptive Use % | Remarks |
| **Above Pathfinder Dam Subbasin** | | | | | | | | | | | | | | | | | | | |
| **Encampment** | | | | | | | | | | | | | | | | | | | |
| Surface water diverted into primary supply / treatment system (MG) | 2.20 | 1.50 | 2.50 | 2.50 | 2.30 | 1.50 | 1.50 | 1.80 | 2.70 | 3.60 | 2.80 | 2.60 | 27.50 | | | | | | |
| | | | | | | | | | | | | | | 0.00 | 27.50 | 27.50 | Unknown | Unknown | |
| **Sierra Madre Joint Powers Board** | | | | | | | | | | | | | | | | | | | |
| Groundwater diverted into primary supply / treatment system (MG) | 0.55 | 0.31 | 0.31 | 0.24 | 0.29 | 0.23 | 0.35 | 0.58 | 1.67 | 1.98 | 1.29 | 0.95 | 8.74 | | | | | | |
| Water returned to river through wastewater system (MG) | 0.00 | 0.00 | 0.45 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.22 | 0.00 | 0.00 | 0.00 | 0.66 | | | | | | |
| | | | | | | | | | | | | | | 8.74 | 0.00 | 8.74 | 0.66 | 92% | |
| **Saratoga** | | | | | | | | | | | | | | | | | | | |
| Groundwater diverted into primary supply / treatment system (MG) | 9.70 | 8.70 | 9.50 | 11.40 | 10.60 | 12.00 | 11.80 | 16.70 | 26.00 | 25.20 | 22.80 | 15.80 | 180.20 | | | | | | |
| Water returned to river through wastewater system (MG) | 6.30 | 5.10 | 6.40 | 5.70 | 4.70 | 6.50 | 5.80 | 17.40 | 13.30 | 8.60 | 7.20 | 9.20 | 96.20 | | | | | | |
| | | | | | | | | | | | | | | 180.20 | 0.00 | 180.20 | 96.20 | 47% | Excludes independent raw water irrigation. |
| **Hanna** | | | | | | | | | | | | | | | | | | | |
| Surface water diverted into primary supply / treatment system (MG) | 5.00 | 4.00 | 5.00 | 4.00 | 4.00 | 5.00 | 5.00 | 6.00 | 9.00 | 10.00 | 10.00 | 7.00 | 74.00 | | | | | | |
| Surface water sold to users outside corporate limits (MG) | 1.00 | 1.00 | 0.00 | 0.00 | 0.00 | 0.00 | 1.00 | 2.00 | 3.00 | 3.00 | 3.00 | 2.00 | 16.00 | | | | | | |
| | | | | | | | | | | | | | | 0.00 | 90.00 | 90.00 | Unknown | Unknown | |
| **Rawlins** | | | | | | | | | | | | | | | | | | | |
| Surface water diverted into primary supply / treatment system (MG) | 41.82 | 42.54 | 36.25 | 38.59 | 37.86 | 43.39 | 35.17 | 65.57 | 106.10 | 114.94 | 103.09 | 59.64 | 724.96 | | | | | | |
| Groundwater diverted into primary supply / treatment system (MG) | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 7.20 | 34.56 | 31.25 | 33.48 | 32.40 | 138.89 | | | | | | |
| Water returned to river through wastewater system (MG) | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 31.97 | 42.53 | 44.97 | 0.00 | 0.00 | 0.00 | 119.47 | | | | | | |
| Surface water sold to Sinclair (MG) | 2.38 | 1.98 | 1.59 | 1.83 | 1.41 | 1.82 | 1.72 | 3.33 | 4.75 | 4.47 | 4.02 | 2.18 | 31.48 | 138.89 | 693.48 | 832.37 | 119.47 | 86% | Excludes golf course raw water irrigation. Surface water sold to Sinclair excluded from total diversion. |
| **Sinclair** | | | | | | | | | | | | | | | | | | | |
| Surface water from Rawlins (MG) | 2.38 | 1.98 | 1.58 | 1.73 | 1.41 | 1.82 | 1.72 | 3.33 | 4.67 | 4.47 | 4.02 | 2.28 | 31.39 | | | | | | |
| | | | | | | | | | | | | | | 0.00 | 31.39 | 31.39 | Unknown | Unknown | |
| **Rock River** | | | | | | | | | | | | | | | | | | | |
| Surface water diverted into primary supply / treatment system (MG) | 1.30 | 0.68 | 0.64 | 1.02 | 0.91 | 1.23 | 1.20 | 2.24 | 4.40 | 3.03 | 3.22 | 1.64 | 21.50 | | | | | | |
| | | | | | | | | | | | | | | 0.00 | 21.50 | 21.50 | Unknown | Unknown | |
| **Elk Mountain** | | | | | | | | | | | | | | | | | | | |
| Groundwater diverted into primary supply / treatment system (MG) | 0.81 | 0.74 | 0.64 | 0.58 | 0.52 | 0.52 | 0.47 | 0.78 | 1.72 | 1.87 | 1.72 | 0.87 | 11.23 | | | | | | |
| | | | | | | | | | | | | | | 11.23 | 0 | 11.23 | Unknown | Unknown | |

**Table 3.3.9: Monthly Municipal Surface Water and Groundwater Diversions and Return Flow in Million Gallons**

| | Water Year 2013[1] | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Oct | Nov | Dec | Jan | Feb | Mar | Apr | May | June | July | Aug | Sep | Total | Total Groundwater Diversions (MG) | Total Surface Water Diversions (MG) | Total Diversions (MG) | Total Return Flow (MG) | Estimated Consumptive Use % | Remarks |
| **Medicine Bow** | | | | | | | | | | | | | | | | | | | |
| Groundwater diverted into primary supply / treatment system (MG) | 3.00 | 2.00 | 4.00 | 3.00 | 3.00 | 3.00 | 3.00 | 4.00 | 4.00 | 5.00 | 5.00 | 4.00 | 43.00 | | | | | | |
| | | | | | | | | | | | | | | 43.00 | 0 | 43.00 | Unknown | Unknown | |
| **Pathfinder Dam to Guernsey Subbasin** | | | | | | | | | | | | | | | | | | | |
| **Mills** | | | | | | | | | | | | | | | | | | | |
| Surface and groundwater diverted into primary supply / treatment system (MG) | 15.00 | 13.00 | 14.00 | 16.00 | 13.00 | 15.00 | 14.00 | 24.00 | 35.00 | 34.00 | 32.00 | 25.00 | 250.00 | | | | | | |
| | | | | | | | | | | | | | | 250.00 | | 250.00 | Unknown | Unknown | Wastewater treated by City of Casper. |
| **Casper/Central Wyoming Regional Water System** | | | | | | | | | | | | | | | | | | | |
| Surface water diverted into primary supply / treatment system (MG) | 197.35 | 143.91 | 116.89 | 144.99 | 166.74 | 218.95 | 248.88 | 235.48 | 515.07 | 569.64 | 509.22 | 320.80 | 3387.92 | | | | | | |
| Groundwater diverted into primary supply / treatment system (MG) | 116.15 | 83.16 | 105.13 | 87.40 | 34.84 | 3.78 | 40.45 | 183.69 | 249.06 | 296.91 | 304.30 | 263.34 | 1768.20 | | | | | | |
| Water returned to river through wastewater system (MG) | 202.15 | 193.03 | 187.50 | 190.13 | 169.79 | 193.94 | 198.64 | 207.15 | 196.86 | 206.33 | 208.58 | 205.17 | 2359.27 | | | | | | |
| | | | | | | | | | | | | | | 1768.20 | 3387.92 | 5156.13 | 2359.27 | 54% | Excludes independent raw water irrigation. Consumptive use estimate affected by Mills and Evansville return flows. |
| **Evansville** | | | | | | | | | | | | | | | | | | | |
| Surface water diverted into primary supply / treatment system (MG) | 18.47 | 16.34 | 15.77 | 17.58 | 15.14 | 17.52 | 16.98 | 23.51 | 33.03 | 32.40 | 31.28 | 23.80 | 261.81 | | | | | | |
| | | | | | | | | | | | | | | 0.00 | 261.81 | 261.81 | Unknown | Unknown | Wastewater treated by City of Casper. |
| **Glenrock** | | | | | | | | | | | | | | | | | | | |
| Groundwater diverted into primary supply / treatment system (MG) | 9.37 | 7.59 | 9.58 | 11.51 | 9.88 | 10.09 | 9.90 | 20.04 | 35.87 | 40.25 | 32.06 | 21.50 | 217.63 | | | | | | |
| Water returned to river through wastewater system (MG) | 5.14 | 5.24 | 5.20 | 6.32 | 5.31 | 5.60 | 5.65 | 5.43 | 4.73 | 4.98 | 5.29 | 5.37 | 64.27 | | | | | | |
| | | | | | | | | | | | | | | 217.63 | 0.00 | 217.63 | 64.27 | 70% | Excludes independent raw water irrigation. |
| **Douglas** | | | | | | | | | | | | | | | | | | | |
| Surface water diverted into primary supply / treatment system (MG) | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 15.60 | 18.50 | 5.10 | 39.20 | | | | | | |
| Groundwater diverted into primary supply / treatment system (MG) | 38.00 | 25.80 | 28.90 | 29.20 | 25.90 | 29.30 | 30.20 | 51.40 | 78.10 | 83.20 | 72.20 | 59.70 | 551.90 | | | | | | |
| Total Return Flows (MG) | 19.50 | 19.00 | 19.00 | 18.90 | 16.90 | 17.90 | 18.40 | 29.20 | 31.80 | 27.50 | 33.10 | 27.70 | 278.90 | | | | | | |
| | | | | | | | | | | | | | | 551.90 | 39.20 | 591.10 | 278.90 | 53% | Excludes independent raw water irrigation. |
| **Glendo** | | | | | | | | | | | | | | | | | | | |
| Groundwater diverted into primary supply / treatment system (MG) | 1.22 | 0.52 | 0.53 | 1.25 | 0.46 | 0.52 | 0.72 | 1.28 | 2.70 | 3.56 | 2.48 | 1.45 | 16.69 | | | | | | |
| | | | | | | | | | | | | | | 16.69 | 0 | 16.69 | Unknown | Unknown | |
| **Guernsey** | | | | | | | | | | | | | | | | | | | |
| Groundwater diverted into primary supply / treatment system (MG) | 9.20 | 5.80 | 6.10 | 5.70 | 5.00 | 7.10 | 9.80 | 14.90 | 23.70 | 21.70 | 23.70 | 14.80 | 147.50 | | | | | | |
| | | | | | | | | | | | | | | 147.50 | 0 | 147.50 | Unknown | Unknown | |

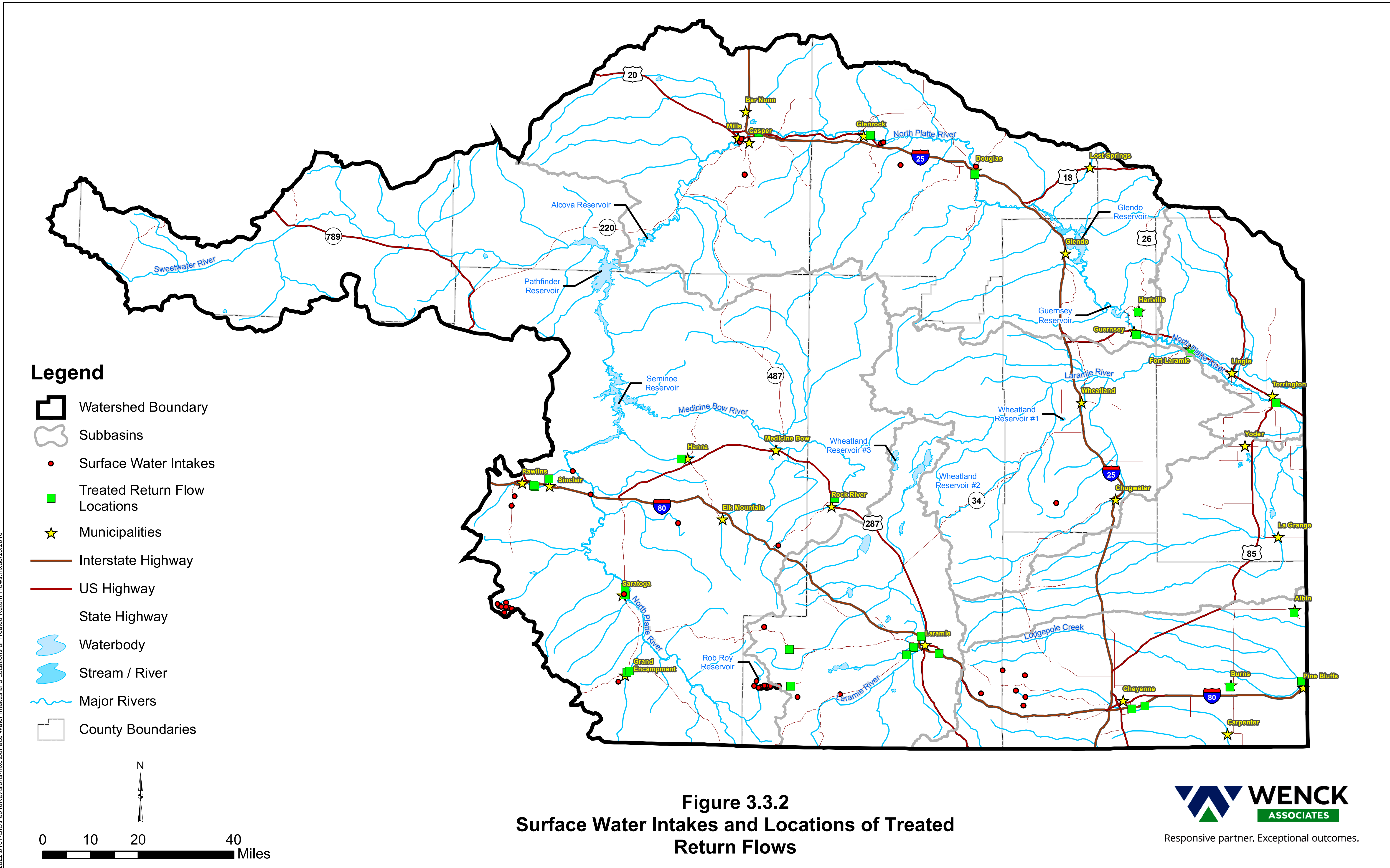
**Table 3.3.9: Monthly Municipal Surface Water and Groundwater Diversions and Return Flow in Million Gallons**

| | Water Year 2013[1] | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Oct | Nov | Dec | Jan | Feb | Mar | Apr | May | June | July | Aug | Sep | Total | Total Groundwater Diversions (MG) | Total Surface Water Diversions (MG) | Total Diversions (MG) | Total Return Flow (MG) | Estimated Consumptive Use % | Remarks |
| **Hartville** | | | | | | | | | | | | | | | | | | | |
| Groundwater diverted into primary supply / treatment system (MG) | 0.23 | 0.27 | 0.47 | 0.18 | 0.20 | 0.23 | 0.34 | 0.37 | 0.60 | 0.92 | 1.10 | 0.92 | 5.83 | | | | | | |
| Water returned to river through wastewater system (MG) | 0.03 | 0.04 | 0.06 | 0.01 | 0.01 | 0.01 | 0.12 | 0.29 | 0.58 | 0.87 | 0.24 | 0.14 | 2.40 | | | | | | |
| | | | | | | | | | | | | | | 5.83 | 0 | 5.83 | 2.40 | 59% | |
| **Guernsey to State Line Subbasin** | | | | | | | | | | | | | | | | | | | |
| **Fort Laramie** | | | | | | | | | | | | | | | | | | | |
| Groundwater diverted into primary supply / treatment system (MG) | 1.05 | 0.79 | 0.78 | 0.68 | 0.66 | 0.77 | 0.81 | 2.00 | 3.11 | 3.51 | 2.78 | 1.82 | 18.77 | | | | | | |
| | | | | | | | | | | | | | | 18.77 | 0.00 | 18.77 | Unknown | Unknown | Excludes independent raw water irrigation. |
| **Lingle** | | | | | | | | | | | | | | | | | | | |
| Groundwater diverted into primary supply / treatment system (MG) | 7.14 | 2.64 | 1.81 | 1.87 | 2.18 | 1.95 | 3.35 | 6.04 | 11.15 | 14.88 | 16.28 | 14.13 | 83.42 | | | | | | |
| | | | | | | | | | | | | | | 0.00 | 83.42 | 83.42 | Unknown | Unknown | |
| **Torrington** | | | | | | | | | | | | | | | | | | | |
| Groundwater diverted into primary supply / treatment system (MG) | 38.15 | 25.20 | 26.56 | 29.10 | 26.57 | 31.54 | 28.72 | 50.78 | 81.98 | 91.56 | 87.26 | 65.60 | 583.02 | | | | | | |
| Water returned to river through wastewater system (MG) | 22.08 | 16.18 | 18.36 | 20.79 | 18.79 | 17.16 | 15.85 | 21.19 | 20.48 | 16.99 | 20.72 | 22.60 | 231.19 | | | | | | |
| | | | | | | | | | | | | | | 583.02 | 0 | 583.02 | 231.19 | 60% | Excludes independent raw water irrigation. |
| **Upper Laramie Subbasin** | | | | | | | | | | | | | | | | | | | |
| **Laramie** | | | | | | | | | | | | | | | | | | | |
| Surface water diverted into primary supply / treatment system (MG) | 58.30 | 41.30 | 36.06 | 37.06 | 54.47 | 91.76 | 71.93 | 96.57 | 156.07 | 140.24 | 148.46 | 98.30 | 1030.52 | | | | | | |
| Groundwater diverted into primary supply / treatment system (MG) | 66.49 | 65.45 | 63.15 | 74.29 | 72.67 | 82.31 | 80.75 | 98.09 | 143.45 | 136.79 | 109.57 | 75.28 | 1068.29 | | | | | | |
| Estimated return flows to river (MG) | 81.11 | 90.74 | 84.33 | 94.65 | 108.07 | 147.96 | 99.24 | 107.06 | 98.84 | 72.03 | 72.25 | 78.11 | 1134.39 | | | | | | |
| | | | | | | | | | | | | | | 1068.29 | 1030.52 | 2098.81 | 1134.39 | 46% | |
| **Lower Laramie Subbasin** | | | | | | | | | | | | | | | | | | | |
| **Wheatland** | | | | | | | | | | | | | | | | | | | |
| Groundwater diverted into primary supply / treatment system (MG) | 21.00 | 14.50 | 14.40 | 13.90 | 12.00 | 14.90 | 17.70 | 39.70 | 71.20 | 77.00 | 66.50 | 42.30 | 405.10 | | | | | | |
| Groundwater diverted into raw water irrigation system (MG) | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 3.00 | 6.00 | 7.00 | 8.00 | 4.00 | 28.00 | | | | | | |
| Estimated return flows to river (MG) | 4.76 | 4.76 | 4.76 | 4.76 | 4.76 | 4.76 | 4.76 | 4.76 | 4.76 | 4.76 | 4.76 | 4.76 | 57.12 | | | | | | |
| | | | | | | | | | | | | | | 433.10 | 0 | 433.10 | 57.12 | 87% | Includes raw water irrigation. |
| **Chugwater** | | | | | | | | | | | | | | | | | | | |
| Groundwater diverted into primary supply / treatment system (MG) | 1.00 | 0.68 | 0.61 | 0.72 | 0.94 | 0.38 | 0.61 | 1.04 | 2.94 | 4.39 | 3.71 | 2.10 | 19.12 | | | | | | |
| | | | | | | | | | | | | | | 19.12 | 0 | 19.12 | Unknown | Unknown | |
| **Horse Creek Subbasin** | | | | | | | | | | | | | | | | | | | |
| **LaGrange** | | | | | | | | | | | | | | | | | | | |
| Groundwater diverted into primary supply / treatment system (MG) | 2.87 | 1.86 | 0.93 | 1.19 | 1.02 | 1.08 | 0.84 | 4.58 | 8.48 | 9.25 | 8.66 | 5.14 | 45.90 | | | | | | |
| | | | | | | | | | | | | | | 45.90 | 0 | 45.90 | Unknown | Unknown | |

**Table 3.3.9: Monthly Municipal Surface Water and Groundwater Diversions and Return Flow in Million Gallons**

| | Water Year 2013[1] | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Oct | Nov | Dec | Jan | Feb | Mar | Apr | May | June | July | Aug | Sep | Total | Total Groundwater Diversions (MG) | Total Surface Water Diversions (MG) | Total Diversions (MG) | Total Return Flow (MG) | Estimated Consumptive Use % | Remarks |
| **South Platte Subbasin** | | | | | | | | | | | | | | | | | | | |
| **Cheyenne[2]** | | | | | | | | | | | | | | | | | | | |
| Groundwater pumped into treatment system (MG) | 88.72 | 63.00 | 66.65 | 82.26 | 51.74 | 62.03 | 69.00 | 108.81 | 170.28 | 239.72 | 223.20 | 159.39 | 1384.81 | | | | | | |
| Surface Water diverted into treatment system (MG) | 239.88 | 189.00 | 199.95 | 187.44 | 163.86 | 207.67 | 207.00 | 309.69 | 345.72 | 408.18 | 396.80 | 323.61 | 3178.79 | | | | | | |
| Water returned to river through wastewater system (MG) | 279.00 | 270.00 | 269.70 | 266.60 | 246.40 | 275.90 | 273.00 | 294.50 | 294.00 | 297.60 | 294.50 | 267.00 | 3328.20 | | | | | | |
| | | | | | | | | | | | | | | 1384.81 | 3178.79 | 4563.60 | 3328.20 | 27% | |
| **Pine Bluffs[3]** | | | | | | | | | | | | | | | | | | | |
| Groundwater delivered to customers (MG) | 7.19 | 3.04 | 3.17 | 2.90 | 2.87 | 2.94 | 6.02 | 11.49 | 12.03 | 17.20 | 16.00 | 13.47 | 98.32 | | | | | | |
| | | | | | | | | | | | | | | 98.32 | 0 | 98.32 | Unknown | Unknown | |
| **Burns[4]** | | | | | | | | | | | | | | | | | | | |
| Groundwater delivered to customers (MG) | 2.66 | 1.75 | 1.95 | 1.41 | 1.28 | 1.66 | 2.11 | 4.13 | 5.29 | 6.68 | 5.79 | 4.12 | 38.83 | | | | | | |
| | | | | | | | | | | | | | | 38.83 | 0 | 38.83 | Unknown | Unknown | |
| **Albin[5]** | | | | | | | | | | | | | | | | | | | |
| Groundwater delivered to customers (MG) | 3.00 | 1.16 | 0.74 | 1.38 | 1.57 | 1.68 | 1.29 | 1.85 | 2.48 | 4.09 | 3.29 | 4.12 | 26.65 | | | | | | |
| | | | | | | | | | | | | | | 26.65 | 0 | 26.65 | Unknown | Unknown | |

Notes:
(1) Based on 2013 Water Year Depletions Report from the Wyoming State Engineers Office (2013).
(2) Source: HDR, 2013 - Average monthly water demand between 2003 and 2012 (Chart 2-8 of Volume 2 and Figure 3-29 of Volume 3) and average monthly wastewaster discharge between 2005-2012 (Chart 2-23 of Volume 2)
(3) Source: Lidstone, 2015 - 2012-2013 water demand data
(4) Source: Lidstone, 2011 - Average monthly water demand between 2000 and 2009 (Figure 4)
(5) Source: Benchmark, 2005 - 2001 water demand data (Table 3.1)




# Figure 3.3.2
## Surface Water Intakes and Locations of Treated Return Flows

WENCK ASSOCIATES
Responsive partner. Exceptional outcomes.

Source: SEO GIS Database

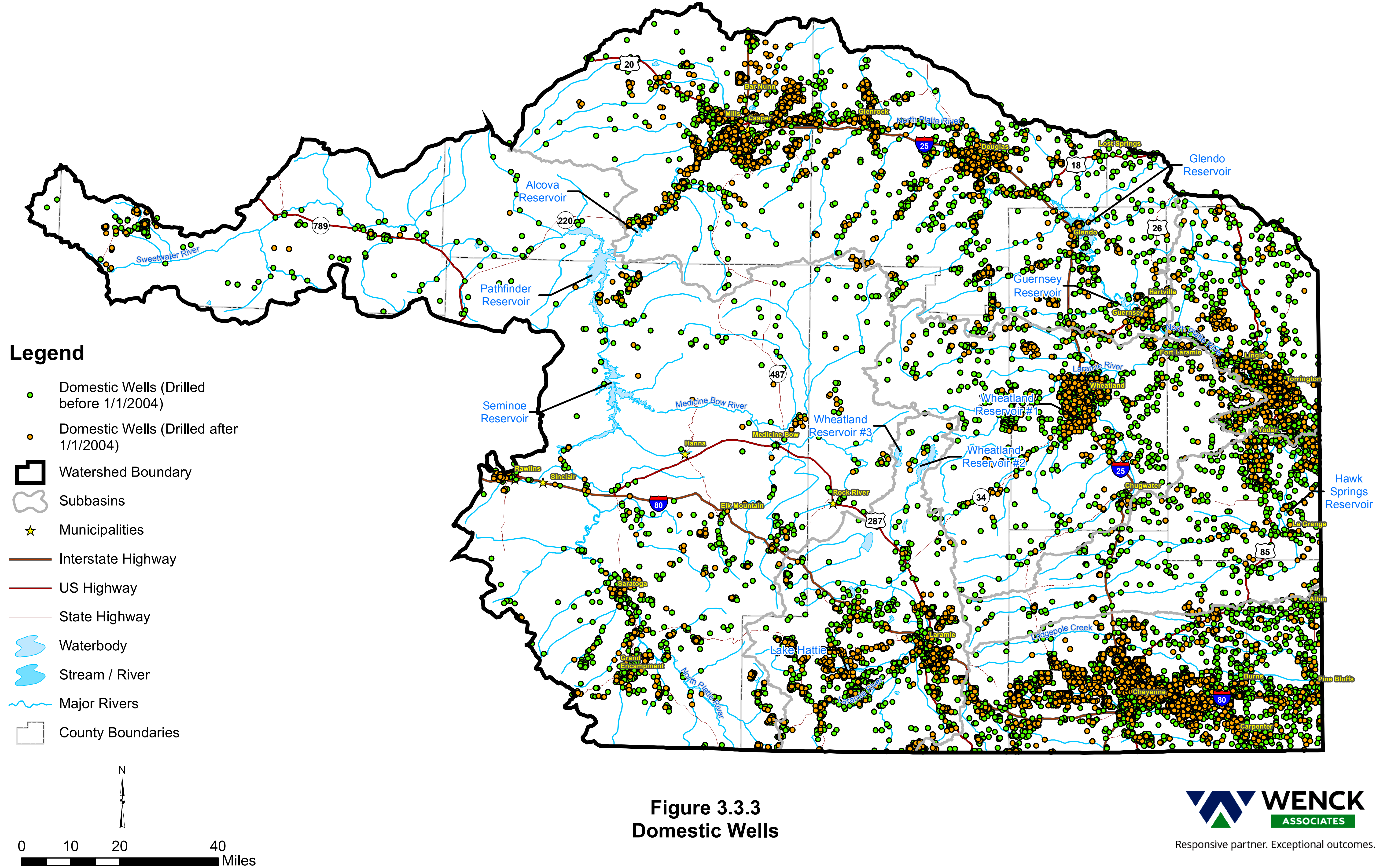



Figure 3.3.3
Domestic Wells

Source: SEO GIS Database

L:\2822\0101\GIS\Feb16Revisions\mxd\Domestic Wells.mxd 8/26/2016

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## 3.4 INDUSTRIAL USE (MODIFIED FROM THE INDUSTRIAL USE TECH MEMO)

### 3.4.1 Introduction

This section presents an update on the industrial use within the Platte River Basin of Wyoming. The Platte River Basin in Wyoming consists of the six subbasins of the North Platte River and the South Platte Subbasin. The principal focus of this update to the Platte River Basin Plan (Trihydro, 2006) has been to identify new groundwater and surface water industrial users not supplied through municipal systems, and to evaluate usage changes during above and below average water years. This update relied on information developed and maintained by the SEO. Because the original basin plan included data through 2003, this update covers the period between January 1, 2004 and September 30, 2014.

### 3.4.2 Platte River Basin Industrial Water Use Overview

A thorough inventory of industrial water use within the Platte River Basin for 1981 through 2000 is presented in Technical Memorandum 2.3 of the Platte River Basin Plan (Trihydro, 2006). The industries that have typically used the most water for industrial purposes in the Basin are oil and gas, coal, and uranium. Power generation, aggregate mining, cement production, chemical processing, and ethanol production have also played a role. Taucher and others (2013) provided updated data on industrial groundwater use through 2011. The SEO maintains annual water use records for some of the largest industrial water users in the basin.

Generally, the types of industries that use water in the Platte River Basin have not changed appreciably since the completion of the original plan, but the amount of use in some areas has increased based upon the number of groundwater water rights filed with the SEO since 2004. Over this same timeframe, no surface water diversion permits were issued by the SEO for industrial use.  Permits issued for various reservoirs of limited use are included in **Appendix 3-C.**

### 3.4.3 New High Capacity Wells and Water Wells for Oil and Gas Production

Since January 1, 2004, 167 new wells or enlargements have been filed with the SEO for industrial use. This total includes 95 wells that produce more than 50 gpm for industry, and 72 wells of any permitted rate that are utilized for oil and gas production. The location, owner, and permitted discharge rate for these new wells are listed in **Appendix 3-D**, Table 1 for industry and **Appendix 3-D**, Table 2 for oil and gas production. The locations of the 50+ gpm industrial wells are shown along with those identified by Trihydro (2006) in **Appendix 3-D**, Tables 1 and 2. The locations of the water wells associated with oil and gas production in the basin are shown in **Appendix 3-D**, Table 2.

### 3.4.4 Annual Usage and Usage Variations

Water usage data for several of the major industrial water users within the Platte River Basin were obtained from the Wyoming Depletion Reports (SEO, 2011-2013). These reports include both annual diversion and depletion information for the following industrial water users: Sinclair Refinery, Sinclair Casper Refinery, Texaco Refinery, BP Products Refinery, Dave Johnston Power Plant, and Western Ethanol. The locations of these users are shown in the basin in **Appendix 3-D**, Table 1.  Of these users, the Texaco Refinery and BP Products Refinery shown in **Appendix 3-D**, Table 1 are no longer active, and their usage has not been reported here for that reason. The Texaco Refinery ceased operations in August 1982. The SEO identifies evaporation and irrigation of the Veteran's Cemetery as industrial use because it is conducted with the water rights of the former refinery. BP Products has some shallow wells that pump near the river and divert directly into the river. At the time BP

Products was active, from 1957 to 1990, the SEO was mainly concerned with their diversion of process water into Soda Lake. Shown on **Figure 3.4.1** near Torrington, the Western Ethanol Plant has closed due to a drop in corn and crude prices and expiration of a state tax credit (Casper Star Tribune, 2015).

New industrial reservoirs have been permitted in the Platte River Basin by the SEO since 2006. A total of approximately 53 industrial reservoirs have been permitted basin-wide and are shown in **Appendix 3-D**, Table 3

Data from 2011 through 2013 were obtained from the SEO permit records to assess how industrial water usage changed between average, wet, and dry years. The data generally seem to indicate that industrial water use for these established users varies little but mask the variability with lower volume users. While 2013 was an average water year, 2011 was an above average water year and 2012 was a below average water year. The data from these years for the respective industries are summarized in **Table 3.4.1**. The tabulated results in **Table 3.4.1** indicate that overall water use increased only 3.9% from average during the dry year of 2012. Similarly, there was an overall decrease in water use of 2.7% from average during the wet year of 2011. The Dave Johnston Power Plant shown on **Figure 3.4.1** east of Glenrock accounted for the majority of the industrial water usage reported by the SEO, or roughly 60 billion gallons annually. The high volume usage (diversion) of this plant also accounts for the limited variation in the total water use of the four users listed in **Table 3.4.1.** The Power Plant water usage varied within 4% from average between wet and dry years. Industrial water usage among the refineries and ethanol plant generally diminished during the wet water year, and increased during the dry water year. While the refineries usage was up 8.3% to 9.2% during the dry year, Western Ethanol's usage diminished approximately 1.9%. Water usage by the refineries and ethanol plant during the wet year was reduced between 2.5% and 21.5%.

**Table 3.4.1: Total Diversions to Million Gallons by Water Year for Industrial Water Users**

| | **2001 (wet year) (million gallons)** | **2012 (dry year) (million gallons)** | **2013 (average year) (million gallons)** | **Percent Difference (between 2012 and 2013 water years[1])** | **Percent difference (between 2011 and 2013 water years[1])** |
|---|---|---|---|---|---|
| **Above Pathfinder Subbasin** | | | | | |
| Sinclair Refinery | 905.5 | 1,014.1 | 929.0 | 9.16% | -2.53% |
| **Subtotal** | **905.5** | **1,014.1** | **929.0** | **9.16%** | **-2.53%** |
| **Pathfinder to Guernsey Subbasin** | | | | | |
| Sinclair Casper Refinery | 236.4 | 271.9 | 251.0 | 8.33% | -5.82% |
| Pacific Corp/Dave Johnston Power Plant | 60,359.2 | 64,315.0 | 61,932.2 | 3.85% | -2.54% |
| **Subtotal** | **60,595.6** | **64,586.9** | **62,183.2** | **3.87%** | **-2.55%** |
| **Guernsey to State Line Subbasin** | | | | | |
| Western Sugar Coop./Western Ethanol | 407.3 | 509.3 | 519.2 | -1.92% | -21.56% |
| **Subtotal** | **407.3** | **509.3** | **519.2** | **-1.92%** | **-21.56%** |
| | | | | | |
| **Total** | **61,908.4** | **66,110.3** | **63,631.4** | **3.90%** | **-2.71%** |

**Notes:**
Total Annual diversions obtained from Wyoming Depletion Reports prepared by the Wyoming State Engineer's Office (2011, 2012 and 2013).

1. Positive percentage represents an increase in water use. Negative percentage indicates a decrease in water use.

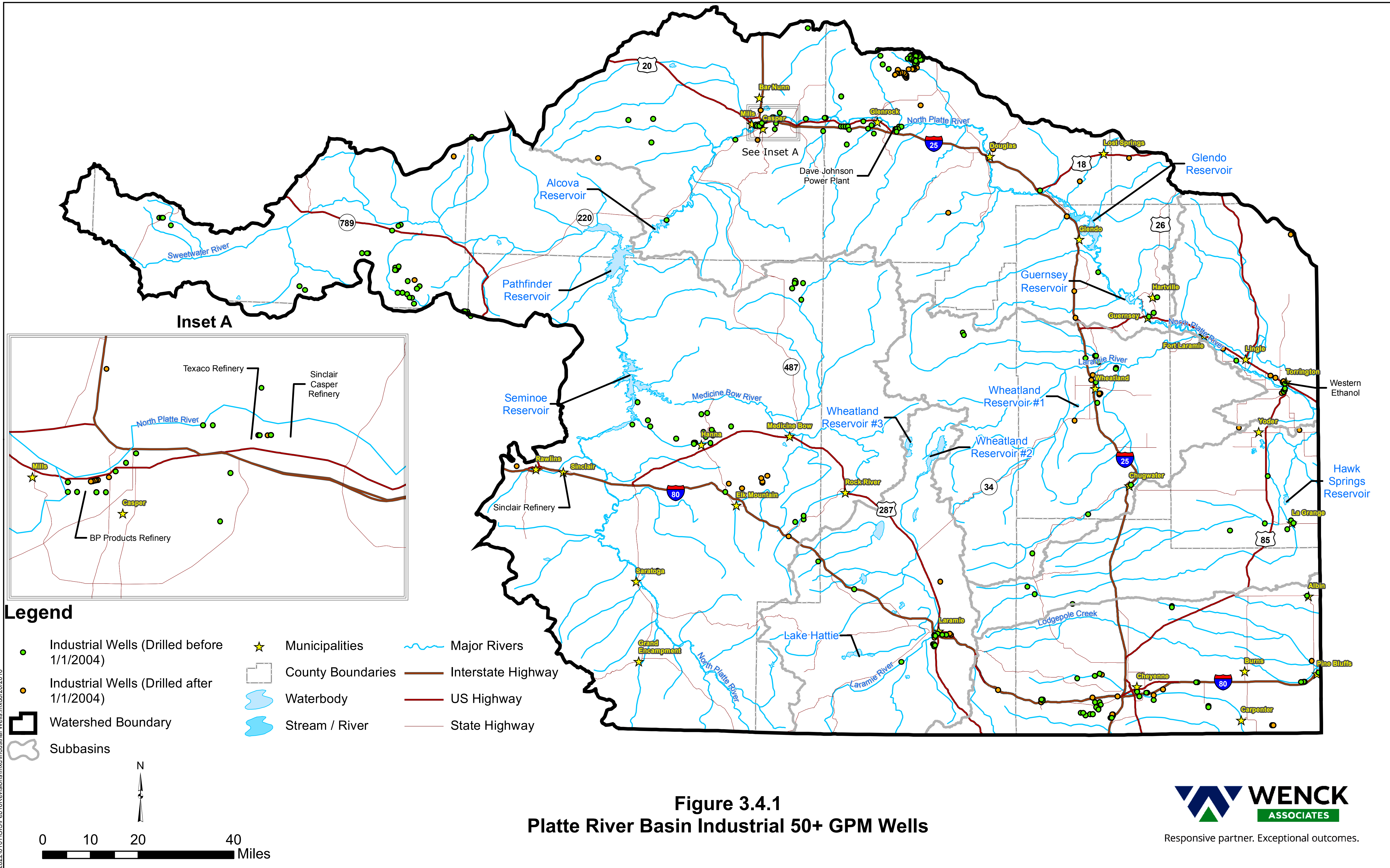


**Figure 3.4.1**
**Platte River Basin Industrial 50+ GPM Wells**

### 3.4.5 Monthly Water Usage

Monthly water usage data for the four industrial water users were compiled to evaluate seasonal use within the 2011, 2012, and 2013 water years, and in some instances, to estimate consumptive use. **Table 3.4.2** presents the monthly water usage data by user and subbasin, the total amount of water diverted from surface water sources, and where available, the amount of water returned to the surface stream monthly for each entity. These data were obtained from the Wyoming Depletions Report compiled by the SEO for 2011, 2012, and 2013.

Monthly and consumptive use appeared to vary little for the Dave Johnston Power Plant over this time period. Water usage by the refineries and ethanol plant varied seasonally and on an annual basis. Water usage by the refineries tended to increase during the summer months. Western Ethanol used very little water during the late spring through summer months, and used most water between the fall and winter months. Water use for the Dave Johnston Power Plant was fairly uniform throughout the year. Based on the reported return flows, the refineries and ethanol plant consumptively use 100% of the water they divert. The Dave Johnston Power Plant consumptively uses approximately 4% of its diverted flows and returns the rest to the North Platte River.

### 3.4.6 Recent Industrial Water Use within the Platte River Basin

The following sections describe the various industries and companies that have acquired groundwater permits from the SEO for water supply to begin or supplement their respective industrial practices. The use associated with these permits is presented by subbasin, and only for those particular industrial sectors for which permitting activity had been reported. The industries presented include: Mining and Mine Reclamation; Oil Exploration, Refining and Reclamation; Road and Bridge Construction and Maintenance; Power Generation; Aggregate, Cement, and Concrete Production; and Miscellaneous Industrial Water Use. Unless noted otherwise, details on the permits and associated uses were identified from review of the groundwater permits on file with the SEO (Various). **Table 3.4.3** presents an update of Table 2-6 from the 2006 basin plan.

#### Above Pathfinder Subbasin Industrial Water Use

Within the Above Pathfinder Subbasin, new groundwater rights were filed for mining and oil development, but have not resulted in much additional water use to date. As shown on **Figures 3.4.1 and 3.4.2**, new permits were filed for wells located near Elk Mountain and south of Jeffery City. Details on the individual permits referenced are included in **Appendix 3-D**, Tables 1 and 2.

**Mining and Mine Reclamation.** Five new permits were issued for uranium mining and mine dewatering to Energy Fuels, Arch of Wyoming, and Kennecott. Energy Fuels Wyoming, Inc. has permits totaling 2,000 gpm. This water will be obtained from dewatering of the Sheep Mountain underground workings and be used for the heap leaching of uranium at their Sheep Mountain Mine. This project has been in the permitting phase with the Nuclear Regulatory Commission (NRC) and the Wyoming Land Quality Division (LQD) since 2010, and is not currently consuming water. A secondary use of the water for this project is for culinary supply within a shop and warehouse. Energy Fuels anticipates the project will start up sometime between late 2016 and 2017.

Arch of Wyoming (Arch Coal) intends to use their 2,300 gpm of water rights for mine dewatering and dust suppression in mining coal at the Saddleback Hills Mine near Elk Mountain. According to a letter to the SEO dated October 16, 2014, this mine has yet to be developed due to market demand; therefore, there has been no use of the permitted wells to date.

**Table 3.4.2: Monthly Industrial Water Diversions and Return Flow in Million Gallons**

| User | Water Year[1] | Diversion / Return Flow | Oct | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Total | Total Surface Water Diversions (MG) | Total Return Flow (MG) | Estimated Consumptive Use % |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | (Reported Monthly Diversion, MG) | | | | | | | | | | | | | | | |
| **Above Pathfinder Subbasin** | | | | | | | | | | | | | | | | | | |
| Sinclair Refinery | 2011 | Surface water diversions | 74.5 | 71.9 | 64.9 | 62.8 | 63.3 | 80.9 | 78.0 | 85.0 | 81.9 | 93.4 | 89.0 | 59.9 | 905.5 | | | |
| | | Water returned to river | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 905.5 | 0.0 | 100.0 |
| | 2012 | Surface water diversions | 70.9 | 67.2 | 64.9 | 70.3 | 70.4 | 81.0 | 78.3 | 90.6 | 117.2 | 109.5 | 108.2 | 85.8 | 1,014.2 | | | |
| | | Water returned to river | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 1,014.2 | 0.0 | 100.0 |
| | 2013 | Surface water diversions | 77.3 | 78.4 | 70.1 | 76.9 | 69.1 | 77.6 | 73.7 | 82.6 | 79.9 | 74.2 | 90.2 | 79.2 | 929.0 | | | 100.0 |
| | | Water returned to river | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 929.0 | 0.0 | |
| **Pathfinder to Guernsey Subbasin** | | | | | | | | | | | | | | | | | | |
| Sinclair Casper Refinery | 2011 | Surface water diversions | 22.9 | 20.4 | 20.5 | 20.0 | 10.7 | 10.2 | 20.1 | 20.9 | 19.8 | 24.3 | 24.6 | 22.0 | 236.4 | | | |
| | | Water returned to river | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 236.4 | 0.0 | 100.0 |
| | 2012 | Surface water diversions | 24.8 | 21.9 | 21.3 | 21.5 | 20.5 | 22.3 | 22.6 | 22.2 | 22.9 | 23.9 | 24.8 | 23.2 | 271.9 | | | |
| | | Water returned to river | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 271.9 | 0.0 | 100.0 |
| | 2013 | Surface water diversions | 23.0 | 20.4 | 22.0 | 21.4 | 18.1 | 8.9 | 20.6 | 22.3 | 22.6 | 24.1 | 24.6 | 23.0 | 251.0 | | | |
| | | Water returned to river | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 251.0 | 0.0 | 100.0 |
| Pacific Corp / Dave Johnston Power Plant | 2011 | Surface water diversions | 5,158.8 | 4,992.0 | 5,170.8 | 5,164.8 | 4,661.4 | 5,152.8 | 4,779.0 | 4,588.0 | 4,725.0 | 5,152.8 | 5,170.8 | 5,643.0 | 60,359.2 | | | |
| | | Water returned to river | 4,965.8 | 4,833.0 | 4,995.1 | 4,987.2 | 4,507.0 | 4,981.1 | 4,608.8 | 4,384.5 | 4,496.1 | 4,914.4 | 4,911.1 | 5,407.3 | 57,991.4 | 60,359.2 | 57,991.4 | 3.9 |
| | 2012 | Surface water diversions | 5,170.8 | 5,022.0 | 5,344.4 | 5,170.8 | 4,670.4 | 5,125.8 | 4,920.0 | 5,147.2 | 5,630.3 | 6,106.5 | 6,083.7 | 5,923.1 | 64,315.0 | | | |
| | | Water returned to river | 4,961.9 | 4,853.4 | 5,158.1 | 4,979.1 | 4,506.0 | 4,986.0 | 4,827.6 | 4,925.0 | 5,360.9 | 5,831.8 | 5,813.2 | 5,610.2 | 61,813.2 | 64,315.0 | 61,813.2 | 3.9 |
| | 2013 | Surface water diversions | 5,859.4 | 5,050.9 | 5,198.3 | 5,213.7 | 4,704.3 | 5,183.0 | 5,042.3 | 5,361.2 | 5,059.0 | 4,970.7 | 5,242.4 | 5,047.0 | 61,932.2 | | | 4.8 |
| | | Water returned to river | 5,611.6 | 4,828.0 | 4,992.2 | 4,993.8 | 4,498.5 | 4,981.5 | 4,829.5 | 5,136.7 | 4,762.0 | 4,650.4 | 4,910.4 | 4,781.0 | 58,975.6 | 61,932.2 | 58,975.6 | |
| **Guernsey to Stateline Subbasin** | | | | | | | | | | | | | | | | | | |
| Western Sugar Coop. / Western Ethanol | 2011 | Surface water diversions | 90.3 | 104.0 | 74.6 | 64.9 | 54.7 | 8.8 | 0.9 | 0.2 | 0.0 | 0.8 | 1.7 | 6.5 | 407.3 | | | |
| | | Water returned to river | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 407.3 | 0.0 | 100.0 |
| | 2012 | Surface water diversions | 58.7 | 72.7 | 96.9 | 91.1 | 86.6 | 44.0 | 0.7 | 1.0 | 1.0 | 0.9 | 2.0 | 53.7 | 509.3 | | | |
| | | Water returned to river | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 509.3 | 0.0 | 100.0 |
| | 2013 | Surface water diversions | 103.3 | 90.4 | 83.7 | 98.6 | 81.1 | 35.6 | 0.6 | 0.2 | 0.3 | 0.6 | 1.3 | 23.5 | 519.2 | | | 100.0 |
| | | Water returned to river | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 519.2 | 0.0 | |

**Notes:** 1. Based on 2011, 2012, & 2013 Water Year Depletions Report from the Wyoming State Engineers Office

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**Table 3.4.3: Summary of Industrial Permitted Water Rights and Actual Water Use within Wyoming's Platte River Basin**

| Industry – Ranked in Descending Order by Total Industrial Water Use | Gallons per minute (gpm) | | | | | | | | | | | | | | | | | Percent of Total Water Use by Industry |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Subbasin – Ranked in Descending Order by Total Industrial Water Use | | | | | | | | | | | | | | Water Use by Industry | | | |
| | Pathfinder to Guernsey | | Above Pathfinder | | Lower Laramie | | South Platte | | Horse Creek | | Upper Laramie | | Guernsey to State Line | | Subtotal of Water Use by Industry | | Total of Water Use by Industry | |
| | **GW** | **SW** | **GW** | **SW** | **GW** | **SW** | **GW** | **SW** | **GW** | **SW** | **GW** | **SW** | **GW** | **SW** | **GW** | **SW** | **GW & SW** | |
| Oil exploration, refining and reclamation | 8,896 | 1,921 | 8,640 | 752 | 485 | | 1,168 | | 300 | | 50 | | 500 | | 20,039 | 2,674 | 22,713 | 25 |
| Mining and mine reclamation | 4,683 | 449 | 16,974 | 2 | 0 | | | | | | | | | | 21,657 | 451 | 22,108 | 24 |
| Power generation | 5,215 | | | | 960 | 10,303 | 200 | | | | | | | | 6,375 | 10,303 | 16,678 | 18 |
| Miscellaneous | 1,830 | 2,886 | 275 | 1,580 | 100 | | 2,383 | | 4,485 | 100 | | | 1,432 | | 10,505 | 4,566 | 15,071 | 16 |
| Aggregate, cement and concrete production | 8,740 | | 50 | | 275 | | 2,585 | | 25 | | 870 | 583 | | | 12,545 | 583 | 13,128 | 14 |
| Road and bridge construction and maintenance[1] | | 197 | | 592 | | 395 | 50 | 197 | | | | 592 | | | 50 | 1,974 | 2,024 | 2 |
| Subtotal, gpm | 29,364 | 5,454 | 25,939 | 2,926 | 1,820 | 10,698 | 6,386 | 197 | 4,180 | 100 | 920 | 1,176 | 1932 | | 71,171 | 20,552 | 91,723 | |
| Subbation Total, gpm | 34,818 | | 28,865 | | 12,518 | | 6,583 | | 4,910 | | 2,096 | | 1,932 | | | | | |
| Platte River Basin Total, gpm | 91,723 | | | | | | | | | | | | | | | | | |
| Platte River Basin Total, ac-ft/yr | 147,950 | | | | | | | | | | | | | | | | | |
| Percent of total water use by subbasin | 38.0 | | 31.5 | | 13.6 | | 7.2 | | 5.4 | | 2.3 | | 2.1 | | | | | |
| Percent of total water use by subbasin **(Original Basin Plan)** | 36.4 | | 35.0 | | 13.4 | | 6.1 | | 5.7 | | 2.3 | | 1.1 | | | | | |

**Notes:**
Permitted water use data was used where information on actual industrial water use was not available.
GW – Groundwater   SW = Surface Water
1. Water is used when construction and/or maintenance activities are in progress.

**Oil Exploration, Refining, and Reclamation.** Six new groundwater well permits have been issued for oil related industry in the subbasin, but only four of those permits are significant in terms of potential usage. Medicine Bow Fuel and Power, LLC (DKRW Energy) filed for four 1,000 gpm permits to use the water from the Mesaverde Aquifer for converting coal to liquid fuel. Mr. Bill Gathmann (2015) of DKRW Energy indicated that only one well permit was issued, and also explained that the facility has not yet been constructed. Hence, there has been no consumptive use to date. Once the facility is operational, it will consume approximately 300 gpm with zero return on a 24/7 operational basis. Construction of the facility is anticipated to take up to four years to complete once initiated.

**Road and Bridge Construction and Maintenance.** One new permit was issued to McMurry Ready Mix to use water for dust control and compaction operations for a Wyoming Department of Transportation (WYDOT) project on U.S. Highway 287. The estimated project duration was two years based on the SEO permit.

**Aggregate, Cement, and Concrete Production.** One new 50 gpm permit was issued to WYDOT for dust control and for crushing operations for the reconstruction of a 10.34 mile section of U.S. Highway 287 between Rawlins and Muddy Gap in Carbon County (State project SCP-SL13-N211056). The water source is groundwater from the Brokaw Pit. The permit has a 15-year limit for operations.

**Miscellaneous Industrial Use.** Two new permits were issued to Arch of Wyoming, LLC and Wyoming State Game & Fish Department with a primary use for stock watering. Arch of Wyoming's secondary use is dust abatement and reclamation. Both permits total 275 gpm.

#### Pathfinder to Guernsey Subbasin Industrial Water Use

Within the Pathfinder to Guernsey Subbasin, new groundwater rights were principally filed for uranium mining and oil development. The expansion of these industries involved significant additional water use in the subbasin. As shown on **Figures 3.4.1 and 3.4.2**, new permits were filed for wells located principally north of Glenrock and northeast of Douglas. Details on the individual permits referenced are included in **Appendix 3-D**, Tables 1 and 2.

**Mining and Mine Reclamation.** Of the 57 new 50+ gpm groundwater permits issued, 47 were issued for uranium recovery and processing operations in the southern Powder River Basin. Cameco Resources dba Power Resources owns 43 of the permits with a total permitted yield of 34,900 gpm. The remaining four mining related permits accounted for a total of 670 gpm. Cameco has been in operation since 1987 at their Smith Ranch/Highland Mine which has four operating plants and mines uranium via the in situ recovery process. Each of the four plants can use up to 4,200 gpm of water, but consumptively uses only 1% of the volume that is pumped as 99% is reinjected and further utilized for mining uranium. While the actual groundwater production volume varies, it can range up 16,800 gpm with a consumptive use of only 168 gpm.

**Oil Exploration, Refining, and Reclamation.** An additional 47 permits for industrial water supply wells were issued for oil related operations, seven of which were for enlargements on existing wells. Most of the permits, 34, were issued for oil exploration and refining while the remaining 13 permits were issued for reclamation purposes. Chesapeake Operating Inc. obtained permits for 15 water wells for a total appropriation of 2,740 gpm. The wells are all located near Douglas. The water is used for the construction and preparation of drill sites, and hydraulic fracturing of oil wells. Another 3,016 gpm is permitted for oil and gas exploration by several other companies.

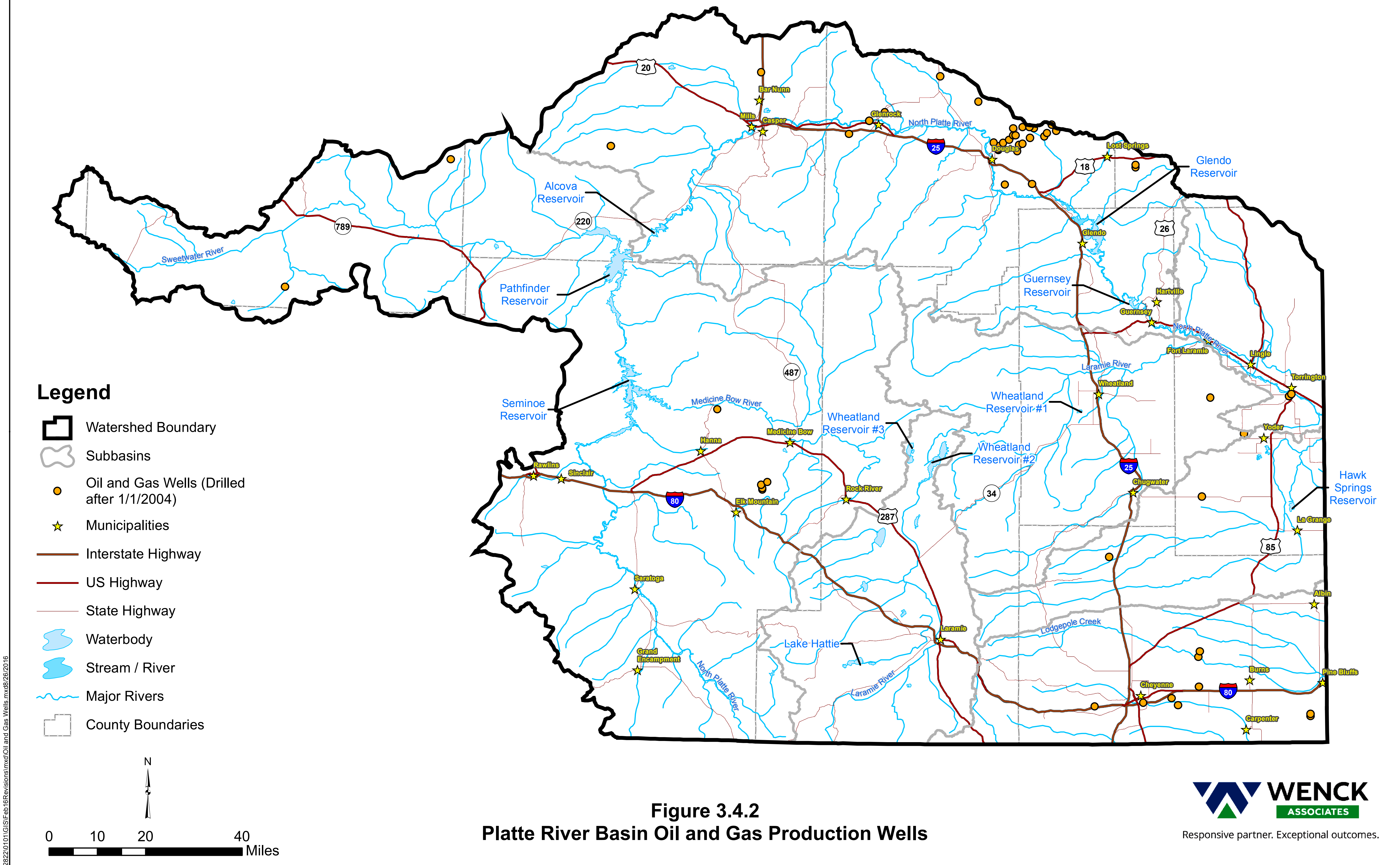


**Figure 3.4.2**
**Platte River Basin Oil and Gas Production Wells**

Mr. Kyle Bradley (2015), a Regulatory Analyst for Chesapeake Energy Corp., provided water usage data for several recent years and indicated that active drilling did not commence until 2009. Chesapeake Energy Corp. has surface water contracts to purchase water from the U.S. Bureau of Reclamation (USBR) for hauling water during years of excess water on the North Platte River, and also purchases water from irrigators via Temporary Water Use Agreements. Mr. Bradley (2015) provided groundwater usage data for 2013, 2014, and 2015. In addition to their own permits, Chesapeake Energy Corp. has agreed to handle reporting to SEO for some well permits that are privately held. In some instances, the well owner has sold water to other oil and gas operators or other parties needing fresh water. Due to this fact, the total water use reported may not always reflect what Chesapeake Operating, LLC has actually put to beneficial use in their operations. According to Mr. Bradley, a total of 166.85 MG, 95.80 MG, and 99.57 MG were used in 2013, 2014, and 2015, respectively.

Two companies, Texaco Downstream Properties, Inc. and BP Products North America use water for hydrocarbon recovery and reclamation at former refinery sites in Casper. Combined they have 13 permits that have total permitted water rights of 1,150 gpm.

**Road and Bridge Construction and Maintenance.** WYDOT was issued three permits totaling 350 gpm for construction purposes related to the reconstruction of a 3.32 mile section of Interstate 25 north of Wheatland and 3.57 miles of Wyoming 319, for a combined length of 6.89 miles.

**Aggregate, Cement, and Concrete Production.** GGH Aggregate LLC was issued a permit at a production rate of 1,000 gpm. The water is to be used for dust suppression, construction, and sanitary uses. Croell Redi-Mix Inc. has two permits on one well that provides 500 gpm to the Elkhorn Sand & Gravel Pit. The water is used to wash sand from the aggregate resource and for dust abatement related to mining operations.

**Miscellaneous Industrial Water Use.** Two miscellaneous permits for a total of 125 gpm were issued. The main use of the water is for washing down of equipment, while secondary uses include irrigation, dust suppression, and restrooms.

#### Guernsey to State Line Subbasin Industrial Water Use

Within the Guernsey to Stateline Subbasin, new groundwater rights were filed for oil development and miscellaneous industrial purposes. As shown on **Figures 3.4.1 and 3.4.2**, these permits were filed for wells located primarily near Torrington. Details on the individual permits referenced are included in **Appendix 3-D**, Tables 1 and 2.

**Oil Exploration, Refining, and Reclamation.** One permit was issued to John's Pump Service for 500 gpm for oil exploration. This well provides water to a loading facility where water is hauled to the well sites.

**Miscellaneous Industrial Water Use.** The SEO issued five permits totaling 560 gpm of water rights. The water is mainly for agricultural purposes such as mixing of liquid fertilizer and pesticides, washing equipment, and some irrigation. Wyoming Ethanol LLC has three permits totaling 765 gpm. The water is used for boiler feed and process water at an ethanol production facility. This facility recently closed.

#### Industrial Water Use in the Upper Laramie Subbasin

Within the Upper Laramie Subbasin, a new groundwater right was filed for aggregate industrial purposes. As shown on **Figure 3.4.1**, this permit was filed for a well located north of Laramie. Details on the individual permit referenced are included in **Appendix 3-D**, Table 1.

**Aggregate, Cement, and Concrete Production.** One new permit was issued to Pete Lien & Sons, Inc. at a production rate of 500 gpm. The well is used at a batch plant for aggregate crushing, concrete and asphalt production, dust abatement, and domestic purposes.

### Lower Laramie Subbasin Industrial Water Use

Within the Lower Laramie Subbasin, new groundwater rights were filed for oil development, power generation, and miscellaneous industrial purposes. As shown on **Figures 3.4.1 and 3.4.2**, these permits were filed for wells located in and around Wheatland. Details on the individual permits referenced are included in **Appendix 3-D**, Tables 1 and 2.

**Oil Exploration, Refining, and Reclamation.** The SEO issued three new permits for wells for oil and gas industrial development, which included a total of 485 gpm. The main use of the water is for the construction of drill sites, dust abatement, and oil and gas exploration. Secondary uses include stock watering and domestic use.

**Power Generation.** Basin Electric Power Cooperative added one well with a permitted water right of 950 gpm for use at the Laramie River Station, a steam power electric generation plant. The water is used for cooling water, process water, and fire protection.

**Aggregate, Cement, and Concrete Production.** One well permit with a production rate of 50 gpm was issued for use at a concrete batch plant.

**Miscellaneous Industrial Use.** Flying H Land and Cattle was issued one well permit for 100 gpm for a 6,000 head feed lot. Another permit was issued for 100 gpm for stock and irrigation purposes.

### Horse Creek Subbasin Industrial Water Use

Within the Horse Creek Subbasin, a few new groundwater rights were filed for oil development and miscellaneous industrial purposes. As shown on **Figures 3.4.1 and 3.4.2**, these permits were filed for wells located primarily near Yoder. Details on the individual permits referenced are included in **Appendix 3-D**, Tables 1 and 2.

**Oil Exploration, Refining, and Reclamation.** The SEO issued two new well permits with a total permitted yield of 200 gpm for oil exploration. Both wells are for loading facilities where water is hauled to the well sites.

**Miscellaneous Industrial Use.** One permit was issued for a commercial feedlot. The well is permitted for 85 gpm.

### Industrial Water Use in the South Platte Subbasin

Within the South Platte Subbasin, new groundwater rights were filed for oil development, power generation, and miscellaneous industrial purposes. As shown on **Figures 3.4.1 and 3.4.2**, these permits were filed for wells located primarily near Cheyenne. Details on the individual permits referenced are included in **Appendix 3-D**, Tables 1 and 2.

**Oil Exploration, Refining, and Reclamation.** Ten new permits for water wells were issued for oil and gas exploration. One of the wells was an enlargement where the water was used for hydrostatic testing of a 16-inch diameter crude oil pipeline. The largest permit was issued to Texas American Resources Co. at a production rate of 2,500 gpm. A total 5,215 gpm was permitted for oil exploration operations.

**Road and Bridge Construction and Maintenance.** Two permits were issued for WYDOT highway construction projects. Both wells were permitted for 50 gpm.

**Power Generation.** Generation Development Company, LLC was issued a permit for a production rate of 400 gpm for use at the Cheyenne Prairie Generating Station. The water is used as an alternate supply for make-up water for the cooling tower which cools water from the circulating water system. Coolant water is primarily obtained from the nearby Dry Creek Wastewater Reclamation Facility.

**Aggregate, Cement, and Concrete Production.** Three permits were issued for dust control and for crushing and screening operations. Two of the sources are wells while the other source is an open pit. Two 200 gpm permits were issued to Jebco Inc. for domestic, sanitary facilities, washing, landscaping, and steam production to feed boilers at an asphalt plant. New permits for aggregate and batch plants totaled 650 gpm.

**Miscellaneous Industrial Water Use.** One new permit was issued to Cheyenne-Laramie County Corp for Economic Development at the Swan Ranch facility south of Cheyenne. The water is used for landscaping, potable, sanitary and construction purposes.

Burnett Land & Livestock LTD LLLP was issued three well permits each at 60 gpm for a total 180 gpm. These wells are used to provide stock water for a dairy operation near Carpenter.

### 3.4.7 Industrial Water Use Summary in the Platte River Basin

Since 2004, the types of industrial water use have not changed appreciably in the Platte River Basin. The principal industrial users continue to include oil and gas, coal and uranium as well as power generation, aggregate mining, cement production, chemical processing and ethanol production. Overall, annual industrial water use is estimated to be approximately 147,950 acre-feet in the Platte River Basin as indicated in **Table 3.4.3**. Increases in industrial water use were limited to a few areas. As summarized in **Table 3.4.3**, the Pathfinder to Guernsey Subbasin experienced the most robust increase in industrial water use with additional groundwater production to serve the oil and gas industry near Douglas and uranium mining near Glenrock. This activity increased the subbasin’s percentage of total water use in the Platte River Basin from 36.4% to 38.0%. The South Platte Subbasin also witnessed an increase in industrial water use with the addition of a new power plant, dairy, and oil and gas development. This industrial activity raised the subbasin’s percentage of total water use from 6.1% to 7.2%.

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## 3.5 RECREATIONAL AND ENVIRONMENTAL USE

### 3.5.1 Introduction

This section provides detailed information and mapping related to the E&R water uses in the Platte Basin of Wyoming. Although this work is part of a larger effort to update the original Platte River Basin Plan that was completed in 2006, the methodology used for this particular task is considerably different from the original plan memorandum and resultant demand estimates. Further, this section presents specifics as to how the new methodology was utilized in developing current water use patterns for E&R water use and the relationship between current use and traditional, permitted uses. It also provides a detailed analysis of the current uses and how they interact with those permitted uses in each of the subbasins. Within this framework, the appropriate E&R uses will be included in the current and future demand projections, while other uses will be discussed but not included in projections. The methodology for developing these data is discussed below.

### 3.5.2 Development of the New Methodology

After completing River Basin Plans for the seven Basins in Wyoming, the WWDC desired a more uniform methodology for non-consumptive E&R water uses. HE and Hinckley Consulting were engaged to develop a new methodology that would more accurately explain how the water for these non-consumptive uses related to traditional, permitted uses. The resulting work began with an overview of approaches from the existing Basin plans and identification of the inconsistencies and perceived shortcomings of those plans as related to non-consumptive water use. The HE team, in coordination with WWDC, developed a new methodology and a Handbook for implementing that methodology, the basics of which are described below. The complete study can be found at: http://library.wrds.uwyo.edu/wwdcrept/Wyoming/Wyoming-Environmental_and_Recreational_Water_Use_Study-Final_Report-2012.html.

The initial steps of the process outlined in the Handbook and utilized for this update are:

- Identification and mapping of E&R water uses
- Locating traditional, divertible uses
- Categorization of recreational and environmental uses (described below)
- Assimilation of recreational and environmental uses

The categorization of the E&R water uses places them in context relative to traditional uses. This allows planners to more fully understand the role of these non-consumptive uses under existing conditions and their relative vulnerability in the future. The following categories were developed for the Handbook and have been applied to existing E&R uses in the Platte Basin in this report:

1) ***Protected water uses*** – These are water uses which are both recognized and protected in some way from incursions by traditional water uses. The obvious example is an instream flow water right. However, protected wetlands, protected bypass flows, or any environmental water uses protected by Federal agencies through permit or water right, fall into the protected category. In addition, protected water uses may have a senior traditional water use diverter in a location which ensures the continuation of that non-divertible use.

   *Example*: If the most senior water right downstream is larger than or equal to the recreational or environmental water use immediately above that senior water diversion in the stream system, that recreational water use is protected and should be recognized as such in the Basin planning process.

2) ***Complementary water uses*** – These E&R water uses exist without explicit protection, but exist and will continue to exist typically by virtue of their location or linkage with a traditional water use. For instance, environmental water uses are often located at the highest reaches within a watershed, and intervening uses are very unlikely to occur. Environmental water uses which occur at high elevations or in a forest high in the watershed are unlikely to be disturbed by water users below. Without future intervening water uses, those complementary water uses are likely to continue and should be recognized as such in the river basin planning process.

   Another example or sub-category of complementary water use stems from the incidental linkage of certain environmental or recreation water uses to traditional uses. For example, fisheries and spawning habitat may be supported by subsurface irrigation return flows, which would be lost if irrigation stops or the method is changed. These incidentally linked water uses are without explicit protection and will expand or contract with the linked traditional use.

3) ***Competing uses*** – Competing uses are those environmental or recreational water uses which are in a location where other traditional water use diverters may constrain or eliminate the environmental or recreational use at any point in time. These water uses are incidental and subject to elimination. These uses should also be recognized in the Basin planning process, but with the explicit understanding that such water uses can and will disappear when future appropriators step forward.

Readers should note that this methodology does not include divertible E&R water demands, as recommended in the Handbook. Where diversions exist for a golf course, ski area, hot springs, wetlands or other permitted E&R diversion, those uses have been identified in specific terms and are aggregated as sub-elements of other uses. For example, golf course diversions may be classified as agricultural, municipal or recreational water by the SEO, and are included in the divertible demands for the appropriate category.

### 3.5.3 GIS Sources

Mapping for this work was provided by Wenck Associates. Geographic Information Systems (GIS) layers were combined to reveal the relationship between E&R water uses and traditional diversions. All diversions of 10 or more cfs which are extremely senior water rights were noted by Wenck if available. **Table 3.5.1** provides a list of sources used. Layers were acquired in late 2014 and early 2015.

#### Unique Characteristics of the Platte Basin

The Platte Basin is the most populous of all the Wyoming basins and has fully appropriated water rights. Further, water leaving the Basin is governed by the North Platte Decree and 2001 Modified Decree, which govern the amount of water from the Platte Basin that can be diverted for agriculture. The details of these Decrees as they apply to the Platte Basin, its water uses and diversions are discussed in other parts of the updated Basin Plan. The Compact and fully appropriated water rights within the Basin tend to limit or to some extent, impact, future water development prospects for the Basin. Current water uses can be changed with the appropriate approvals and as a result the situation is not static. However, changes are complicated by the various decrees and rules that govern the Basin and required mitigation, making such changes expensive, time consuming and thus relatively uncommon.

The Platte River Basin encompasses 22,000 square miles, or about a quarter of the state, and covers a wide variety of landscapes (Wyoming Historical Society). The eastern part of the Basin is relatively flat, sparsely populated and well-suited to agriculture. To the west, the Laramie Mountains provide many recreational opportunities and environmental habitat. The North Platte River traverses the northern part of the Basin and provides a rich environment for fishing and other recreational activities. The close proximity of this Basin to Northern Colorado and its large population base, make it an attractive destination and likely puts additional pressure on recreational and environmental water uses.

The Platte River Basin encompasses many vital aspects of the Wyoming economy and culture. However, it is also the location of many important E&R uses, most notably along the North Platte River and its reservoirs, which provides a wealth of recreational opportunities and wildlife habitat, while providing irrigation waters to Basin farmers. This report will put these varied uses in the context of E&R water use to provide greater understanding for future planning efforts.

**Table 3.5. 1: GIS Data Sources for Environmental and Recreational Mapping in the Platte River Basin**

| Name | Source |
|---|---|
| Aquatic Habitat Priority Areas | Wyoming Game and Fish |
| Critical Streams Corridors | Wyoming Game and Fish |
| Elk Feed Grounds | Wyoming Game and Fish |
| Fishing Spots | WyGISC |
| Game and Fish Stream Classifications | Wyoming Game and Fish |
| Golf Courses | WyGISC |
| Instream Flows | WWDO, SEO, Wyoming Game and Fish |
| Lakes | WSGS |
| Landownership | BLM |
| Model Demand Nodes | WWDO |
| National Wetlands Inventory | Fish and Wildlife Service |
| Nature Conservancy Easements | The Nature Conservancy |
| Non-Nature Conservancy Easements | The Nature Conservancy |
| Scenic Highways and Byways | WyGISC and ESRI |
| Ski Areas | WyGISC |
| Streams | WSGS |
| Trout Unlimited Projects | Trout Unlimited |
| Wild and Scenic Rivers | WyGISC and SEO |
| Wilderness Areas | WyGISC |

### 3.5.4 Section Organization and Maps

This report first considers E&R water uses that fit within the Handbook framework and that will be included in the current water demand profile and demand projections for the Basin update. Specific E&R uses are mapped and discussed on a subbasin level.

Each subbasin is discussed individually in the following order:

- Above Pathfinder Dam
- Pathfinder to Guernsey
- Guernsey to State Line
- Upper Laramie
- Lower Laramie
- Horse Creek
- South Platte

For each subbasin, two maps were prepared for the analysis and categorization of water uses. That first map includes existing E&R water uses, along with traditional diversion locations, which are identified by their permitted cfs allocation. The second map includes dry land information, such as land ownership, campgrounds, electric generating facilities, etc. This land-use map provides context to the water-use map, separated to facilitate interpretation. Electronic versions of these maps will be available that will allow users to select map layers to view any combination of these elements as desired. As the Above Pathfinder Dam Subbasin is quite large and has many relevant uses to map, that subbasin was divided into two maps to improve readability, east and west, and thus there are four maps for this subbasin. The categorization of the E&R water uses is also analyzed separately for the east and west sections.

Wetlands are discussed for each subbasin, but not included on the maps to improve the readability of the maps. A more general discussion of wetlands and a Basin-wide map are provided after the subbasin analyses in a later section of this report. A map of all irrigated lands is also provided following the wetlands map.

There are some topics that are related, but less directly, to E&R use that do not lend themselves to the Handbook methodology because of their broad geographic reach and non-specific water use characteristics. These topics include threatened and endangered species and hunting, which are discussed generally; Basin-wide maps have been provided, following the subbasin analyses.

### Water Use Maps

Water use maps are provided for each subbasin. Traditional, permitted water uses are included on these maps, and the marker for each indicates the size of the allocation. As discussed above, the relationship between these water uses and E&R is the basis for this analysis. These maps also include existing E&R water uses, which were located using the GIS data layers discussed above. An effort was also made to acquire any unique Platte Basin uses. Legends for each subbasin map only include those items that are relevant to that subbasin. Recreational topics include:

- Fishing access points
- Whitewater rafting
- Trout streams - mapped by their classification, which is determined by the estimated total pounds of trout per mile (WGF, 2006): [1]
    - Blue Ribbon Streams – National importance, > 600 pounds per mile
    - Red Ribbon Streams – Statewide importance, 300 to 600 pounds per mile
    - Yellow Ribbon Streams – Regional importance, 50-300 pounds per mile

Mapped environmental elements include:

- Instream Flow Segments
- Crucial Stream Corridors
- Trout Unlimited Projects
- Aquatic Enhancement Priority Areas
- Designated or Protected Wetlands

### Land Use Maps

For each subbasin, a land use map follows the water use map. Mapped recreational elements include:

- Campgrounds

[1] Green Ribbon streams are of local importance <50 pounds per mile and include 63% of all stream miles in the state and are not included because of the large number and relative lack of importance.



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- Natural Landmarks
- Scenic Highways and Byways
- National Historic and Scenic Trails

Mapped environmental elements include:

- Wilderness and Roadless Areas
- U.S. Forest Service Lands
- Other Land Ownership

NOTE: The GIS databases used in this mapping and analysis include:

1) WyGISC
2) SEO Water Rights Database
3) USFS Natural Resource Database
4) 2006 Platte River Basin Plan Database
5) American Whitewater Association Database

### 3.5.5 Subbasins

The seven subbasins of the Platte Basin are shown in **Figure 3.5.1** which also includes the approximate elevations.

#### Above Pathfinder Dam Subbasin

This is the largest of the Platte Basin subbasins with many recreational opportunities and varied landscapes. The entire subbasin is first described as a whole, but for the mapping analysis, this subbasin will be discussed in two sections.  First is Above Pathfinder Dam Subbasin (East).  Second is the area below Pathfinder Reservoir and Above Pathfinder Dam Subbasin (West), the area including and to the west of Pathfinder Reservoir. The East portion of the subbasin encompasses much of Carbon County, about 20% of Albany County and a very small portion of southern Converse County. The West portion includes the northwest area of Carbon County, southwest corner of Niobrara County, across the southern part of Freemont County and small portion of eastern Sublette County.

This mostly rural subbasin offers many opportunities for recreation including a long stretch of the North Platte River, the Sweetwater River and two major reservoirs. It is also home to much of the Medicine Bow National Forest and extensive environmentally sensitive areas.

The subbasin includes the highest elevations in the Basin, ranging from about 6,400 to more than 13,000 feet. About 23% of the Basin's irrigated lands are in this subbasin, mainly in the East Pathfinder Subbasin. However, since 2006, irrigated acreage has declined 18% with about 123,500 irrigated acres remaining as of 2012.

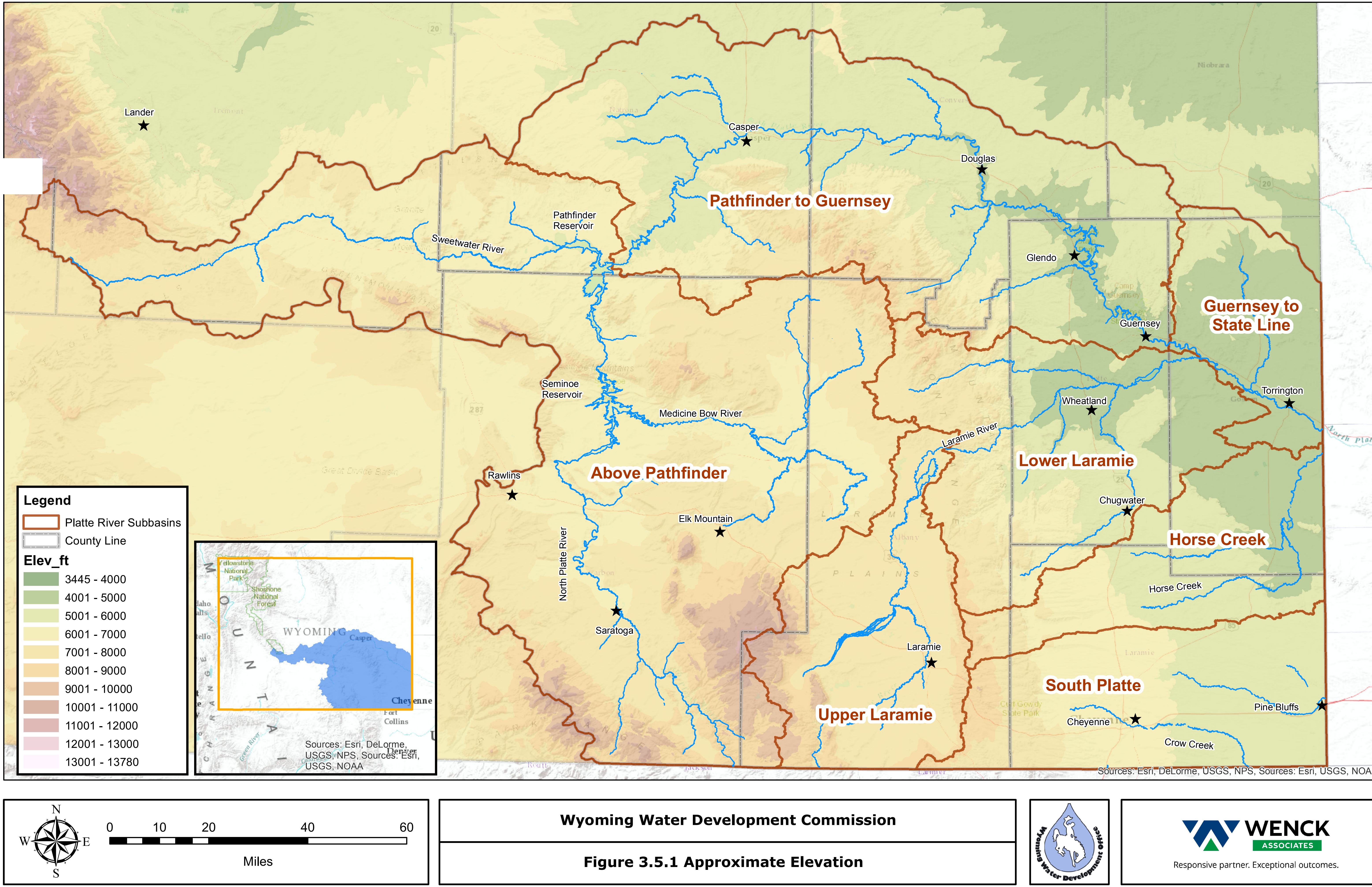


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**Figure 3.5.1 Approximate Elevation**

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## Major Recreational Opportunities in the Above Pathfinder Dam Subbasin

**Seminoe Reservoir and State Park.** Seminoe State Park was established in 1965, and construction of Seminoe Dam was completed in 1939. Seminoe Dam is located on the North Platte River approximately 72 miles southwest of Casper and 34 miles north of Sinclair in Carbon County. The reservoir has an adjudicated capacity of 1,026,360 acre-feet. The Wyoming Department of State Parks and Cultural Resources manages the recreational facilities at Seminoe Dam for the USBR. Campgrounds and boat-launching facilities are provided to the public on a fee basis. The Morgan Creek drainage is located near the north end of the reservoir. This approximately 4,700-acre area has been designated by the Wyoming Game and Fish Department (WGFD) as winter range for elk and bighorn sheep.

**Kortes Reservoir / Miracle Mile Area.** This area is located in a narrow North Platte River canyon downstream of Seminoe Dam in Carbon County. The USBR manages Kortes Reservoir and the North Platte River reach below the dam known as the "Miracle Mile." No fish are stocked in Kortes, but rainbow trout are stocked annually in the Miracle Mile (USBR – Kortes, 2015). The dam was completed in 1951 primarily as a hydroelectric power generation project. The reservoir has an adjudicated capacity of 4,640 acre-feet. Due to frequent surges of water from Seminoe Dam, there are no boat facilities providing access to Kortes Reservoir. The Miracle Mile area extends approximately 5.5 miles downstream from the Kortes Dam to the southern management unit of the Pathfinder National Wildlife Refuge. Primitive camping areas are located in the Miracle Mile area. No fees are collected for recreational utilization of this area.

**Pathfinder Reservoir.** Pathfinder Reservoir is located on the North Platte River 47 miles southwest of Casper in Carbon and Natrona Counties. The reservoir was completed in 1909 and the adjudicated amount of water allotted to the reservoir is 1,070,000 acre-feet. The U.S. Bureau of Land Management (BLM) and the Natrona County Roads, Bridges and Parks Department manage the recreational facilities at Pathfinder Reservoir for the USBR. Camping and boat launching facilities are present at the site as well as an interpretive center and trail. The facilities are free to the public with the exception of a fee to utilize the campgrounds. Portions of the reservoir are included in the Pathfinder National Wildlife Refuge, which consists of 16,807 acres and 117 miles of shoreline. At low reservoir levels much of the refuge is a bare mud flat with some marsh adjacent to tributary stream inlets.

State Park visitor data for Seminoe State Park are shown in **Table 3.5.2**.

**Table 3.5.2: State Park Visitor Days, Five Year Average and 2014**

| State Park | Five Year Average (2009-2013) | 2014 |
|---|---|---|
| Seminoe | 22,329 | 24,466 |
| **Total** | | **24,466** |
| Source: Wyoming Division of State Parks, Historic Sites and Trails, Department of State Parks & Cultural Resources, *Visitor Use Program, 2014*. | | |

**Fishing.** Almost 170,000 angler days are estimated for this subbasin each year. Many trout species, including rainbow, brown and cutthroat, along with walleye can be found in the reservoirs and other locations. **Table 3.5.3** provides angler days for various locations throughout the subbasin.

**Table 3.5.3: Angler Days for the Above Pathfinder Dam Subbasin**

| Above Pathfinder Subbasin | Angler Days/Year |
|---|---|
| Kortes Reservoir, Miracle Mile, Pathfinder Reservoir | 46,827 |
| Seminoe Reservoir and Big Ditch Drainage | 33,200 |
| Platte River, North Seminoe to CO | 18,547 |
| Encampment River Drainage | 16,258 |
| Lake, Cedar, Elk Hollow Drainages | 14,191 |
| Upper Medicine Bow River Drainage | 10,465 |
| Seminoe and Ferris Mountains | 9,180 |
| Lower Medicine Bow River Drainage | 5,879 |
| Sweetwater River Drainage | NA |
| Jack and Spring Creeks | 3,975 |
| Beaver Creek and Big Creek Drainages | 3,292 |
| Pass Creek Drainage | 3,062 |
| Shirley Mountains | 1,157 |
| **Total** | **166,033** |

**Note:** Some of these data have not been updated in several years, but these are the latest available figures.
Source: Al Conder, Casper Regional Fisheries Supervisor, WGFD, December 2014 and Mike Snigg, Laramie Regional Fisheries Supervisor, WGFD, January 2015.

## Notable Environmental Factors in the Above Pathfinder Dam Subbasin

**Critical Habitat Areas.** The main stem of the North Platte River, and its tributaries, from the Colorado border to Sage Creek has been designated a Crucial Aquatic Habitat Area. The value of this habitat includes supporting wild trout fisheries and providing wetland habitat for amphibians. Residential and energy development are potential threats due to fragmentation of habitat. The boreal toad, beaver, brown trout, rainbow trout and brook trout are the focus of restorative action. Proposed solutions include conservation easements, creation of wetland habitats, fish passage and screening at irrigation diversions, and promotion of livestock grazing management practices to restore riparian habitat (WGF – Upper North Platte, 2014).

The North Platte River from Seminoe Reservoir to Pathfinder Reservoir, including the Miracle Mile blue ribbon fishery, has also been classified as a Crucial Habitat Area. This designated area continues to Alcova Dam in the Pathfinder to Guernsey Subbasin. This area received this designation due to its superior sport fisheries and wetlands. Brown trout, rainbow trout and walleye are species of concern. Proposed actions include enhancement of spawning habitat, working with USBR on minimum pool requirements and control of invasive species (WGF – Upper North Platte Reservoirs, 2014).

**Sweetwater Aquatic Enhancement Area.** This area has riparian habitat, aspen, true mountain mahogany and big sagebrush plant communities that have been degraded due to overgrazing, lack of beaver, trampled stream banks, stream bank erosion, channel degradations, sedimentation, reduced floodplain connectivity, low riparian woody plant regeneration, and conifer encroachment and lacks diversity. Remediation efforts are focused on rainbow trout, brown trout, cutthroat trout, brook trout, native non-game fish species and the Great Basin Spadefoot (toad). Proposed actions to improve this habitat include fencing, restoration of the beaver population, upgrades to road and culvert crossings that are detrimental to fish habitat and promotion of best management practices (WGF – Sweetwater, 2014).

**Trout Unlimited Project.** Encampment River Watershed Restoration Plan seeks to restore a segment of the Encampment River, which has degraded due to channelization, mine dredging and diversions, leaving the river banks highly unstable. It is also wide and shallow which warms the water causing stress to fish. The project is a partnership between WGF and the Wyoming Wildlife and Natural Resource Trust Fund, and the land owner. Many other groups have contributed funding. The project will narrow the channel to increase sediment flow, keep the water cool and reduce algae. A wetland area has also been created which will benefit the fishery by providing off-channel rearing habitat for young fish. (TU, 2015)

**Pathfinder National Wildlife Refuge.** This wildlife refuge was established in 1909, although its boundaries have been changed several times. It is generally located on the lands around Pathfinder Reservoir and is jointly managed by U.S. Fish and Wildlife Service (USFWS), the USBR, the WGFD, the BLM, and Natrona County Parks. Pathfinder Reservoir is attractive to water birds and the refuge provides open water wetlands, shrub and grasslands and alkali flats that support a diversity of wildlife. (USFWS, 2014)

**Minimum Release Reservoirs.** The only minimum release flow reservoir in this subbasin is located at the Kortes Dam. Authorized by Congress, a minimum flow of 500 cfs is maintained in the North Platte between Kortes and the normal headwater of Pathfinder Reservoir permits maintenance of the fishery in the Miracle Mile, discussed above. Details are provided in **Table 3.5.4.**

**Table 3.5.4: Minimum Release Reservoir in the Above Pathfinder Dam Subbasin**

| Structure | Owner | Minimum Release | Regulation |
|---|---|---|---|
| Kortes Dam | USBR | 500 cfs | U.S. Public Law 92-146 (85 Statute 414), Missouri Basin project |
| Source: USBR Annual Operating Plan, North Platte River Area, 2013-2014. | | | |

### Classification of Recreational and Environmental Water Uses in the Above Pathfinder Dam (East) Subbasin

As described in Section 3.5.1, an analysis of recreational and environmental water uses was performed utilizing GIS data and maps in order to categorize those uses. **Table 3.5.5** provides a listing or recreational and environmental sites within the subbasin.

**Table 3.5.5: Recreational and Environmental Water Uses within the Above Pathfinder Dam Subbasin**

| **Recreation Sites** | |
|---|---|
| Fishing Access | 20 |
| Whitewater Rafting | 8 |
| Trout Streams | |
| *Blue* | 4 |
| *Red* | 6 |
| *Yellow* | Numerous |
| Campgrounds | 22 |
| Natural Landmarks | 1 |
| Scenic Highways and Byways | 2 |
| National Historic and Scenic Trails | 0 |
| **Environmental Uses** | |
| Wilderness/Roadless Areas | Yes |
| US Forest Service Lands | Yes |
| Instream Flow Segments | 6 |
| Crucial Stream Corridors | 1 |
| Aquatic Crucial Priority Areas | 4 |
| Wetland Area | Yes |
| Source: GIS sources are provided in the Introduction. | |

Maps of these data are provided following the analysis.

### Categorization of Recreational and Environmental Water Uses in the Above Pathfinder Dam (East) Subbasin

As shown on **Figure 3.5.2**, the fishing and whitewater activity south of Saratoga in the southwest corner of the subbasin are located within U.S. Forest Service (USFS) lands. As a result, these uses are considered protected. They are also within the Encampment River Watershed aquatic enhancement area, although this designation does not provide explicit protection. The southeastern portion of the subbasin is also within USFS lands and thus the fishing and whitewater rafting there are also protected. The Encampment River Watershed and Douglas Creek aquatic enhancement areas in the subbasin are within USFS lands which affords these areas protected status and facilitate proposed improvement activities. The Trout Unlimited Project is located along an instream flow segment which affords this environmental project protection.

Between these two tracts of USFS lands, there is one red ribbon trout stream. The upper portion of this stream is complementary to existing diversions. Downstream of the diversion and continuing as the red ribbon designation becomes yellow, there are numerous small diversions which provide a complementary status to this stream segment.

The North Platte River crosses the border from Colorado into this subbasin within USFS wilderness land. After it leaves that protected area, the area around the River is within the North Platte Crucial Stream Corridor. There is a long section of the River that has been designated Blue Ribbon Trout Stream that is complementary to downstream diversions south of Saratoga. After those diversion, where the Encampment River flows into the North Platte, the river flows to Seminoe Reservoir and there are no sizable diversions that would complement the bluE&Red ribbon stream segments. However, due to minimum release flows at Kortes Dam, the Cooperative Agreement and reservoir operating plans, it is unlikely that any new diversions could disrupt the recreational activities on the this stretch of the North Platte. Therefore, these uses should be considered complementary. As described above, minimum flow requirements between Kortes Dam and Pathfinder Reservoir provide explicit protection to the blue ribbon stream segment known as the Miracle Mile.

In the Elk Mountain area, an instream flow segment provides protected status to a whitewater rafting area and yellow ribbon stream. Elsewhere in the area surrounding Elk Mountain, fishing and whitewater rafting can be classified as complementary due to various irrigation diversions. To the east of the North Platte, several yellow ribbon streams are complemented by numerous small diversions and several large diversions. The Pathfinder National Wildlife Refuge is protected by its wildlife refuge status.

The determination for the Above Pathfinder Dam (East) subbasin is that all E&R uses are either protected or complementary and that there are no competing uses that should be eliminated from the water demand calculations. **Table 3.5.6** provides a summary of the classified uses in Above Pathfinder Dam (East) subbasin.

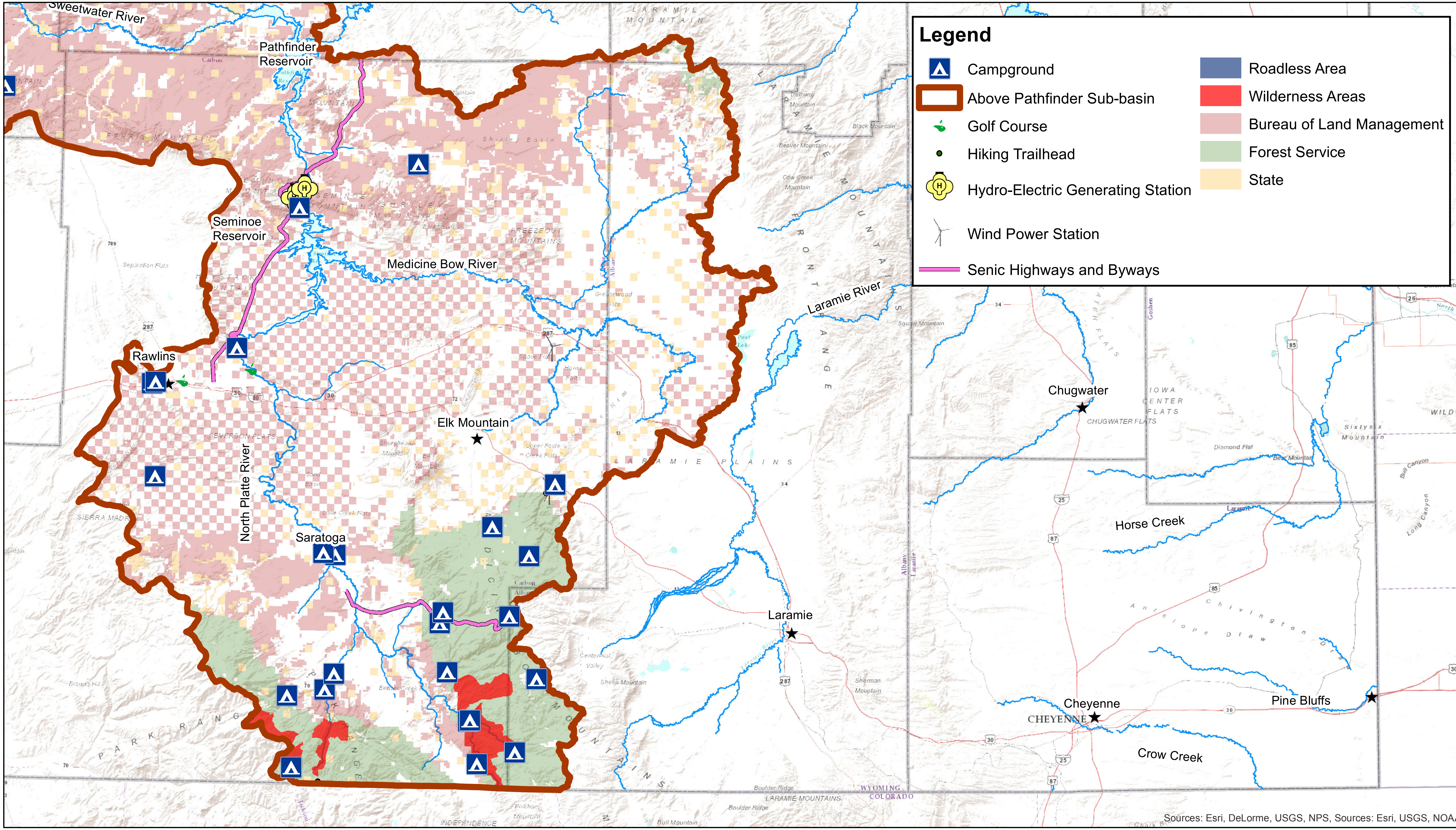


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**Figure 3.5.2 Land Use - Above Pathfinder East**

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**Table 3.5.6: Categorization of E&R Uses in the Above Pathfinder Dam (East) Subbasin**

| Status | Location and Uses |
|---|---|
| Protected | All activities on U.S. Forest Service lands, ISF segments, Miracle Mile blue ribbon stream, whitewater rafting and yellow ribbon segment upstream of an ISF near Elk Mountain, Pathfinder National Wildlife Refuge, aquatic enhancement areas |
| Complementary | Red and yellow segments between U.S. Forest Service lands, blue ribbon segment to Kortes Dam, whitewater rafting east of Elk Mountain, yellow ribbon segments in the northeast area of the subbasin |
| Competing | NA |

Maps of these resources are provided in **Figure 3.5.2 and Figure 3.5.3**.

#### Categorization of Recreational and Environmental Water Uses in the Above Pathfinder Dam (West) Subbasin

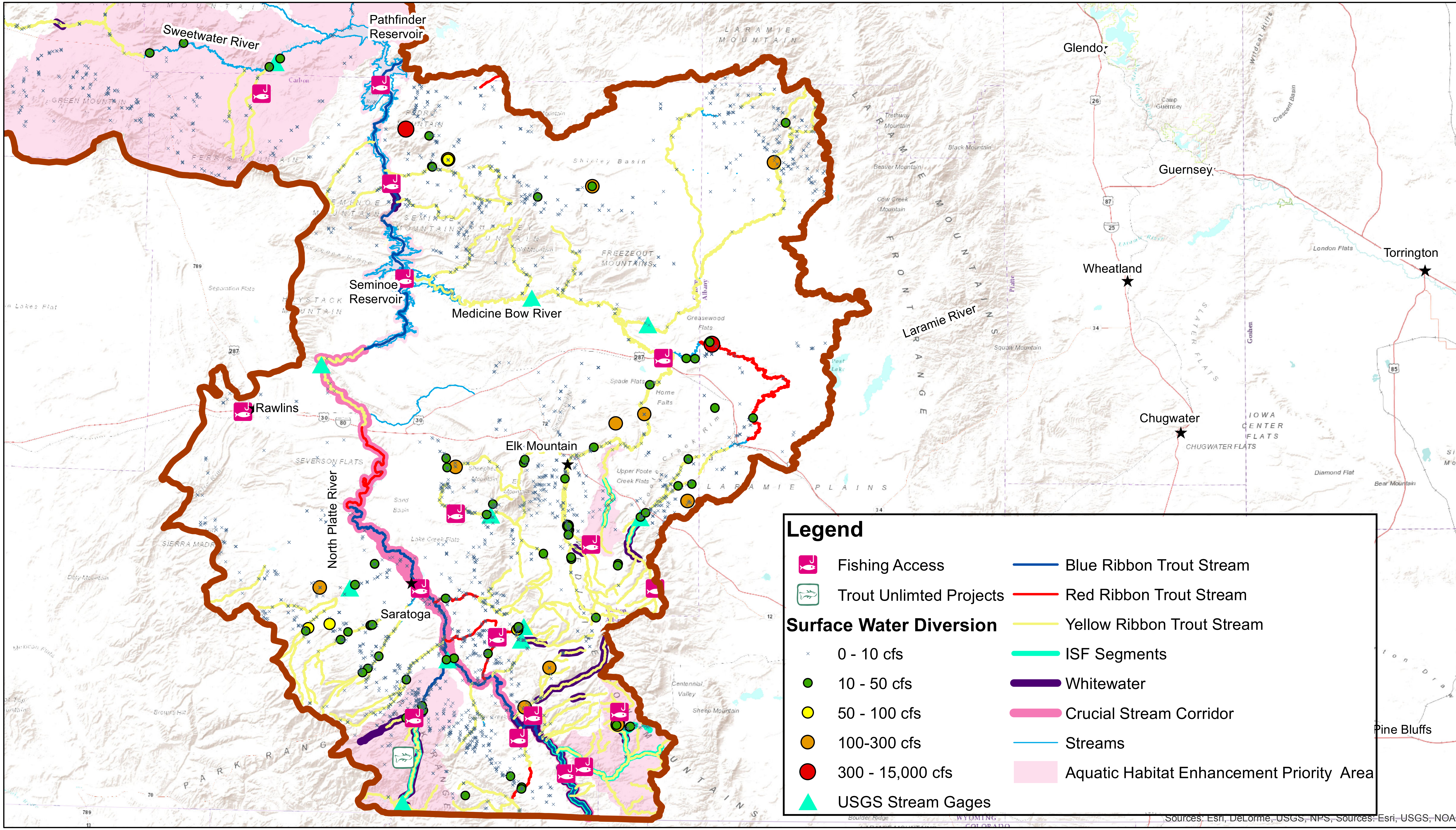
Most of the area in the west portion of this subbasin is BLM land, with some state and USFS lands. Privately owned land is very limited. Much of the Sweetwater River and its tributaries are designated as yellow ribbon streams as they flow out of the Wind River Range. Fishing and whitewater rafting are protected by an ISF along one segment of the River. Segments at the higher elevations are protected by geography and complementary to downstream diversions. A designated fishing access point to the northeast at Carmody Lake is unprotected and subject to drought conditions. A second, small rafting location in the Granite Mountains is protected by its mountainous location and complemented by downstream diversions. Yellow ribbon streams that feed into the Sweetwater from the Granite Mountains are complemented by several large downstream diversions and the operating requirements of Pathfinder Reservoir, where the Sweetwater joins the North Platte. A third fishing access point in the Ferris Mountains is protected by that mountainous location.

The determination for the Above Pathfinder Dam (West) subbasin is that all E&R uses are either protected or complementary, with the exception of fishing access at Carmody Lake. **Table 3.5.7** provides a summary of the classified uses in the Above Pathfinder Dam (West) subbasin.

**Table 3.5.7: Categorization of E&R Uses in the Above Pathfinder Dam (West) Subbasin**

| Status | Location and Uses |
|---|---|
| Protected | Fishing and whitewater rafting upstream and contiguous with an ISF, yellow ribbon segments at high elevations, fishing access point in the Ferris Mountains, fishing at Pathfinder Reservoir |
| Complementary | Whitewater rafting in the Granite Mountains, yellow ribbon segments that feed into the Sweetwater River |
| Competing | Fishing access point at Carmody Lake |

Maps of these resources are provided in **Figures 3.5.4 and 3.5.5**.




N
W E
S
0 5 10 20 30 40
Miles

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**Figure 3.5.3 Surface Water Uses - Above Pathfinder (East)**

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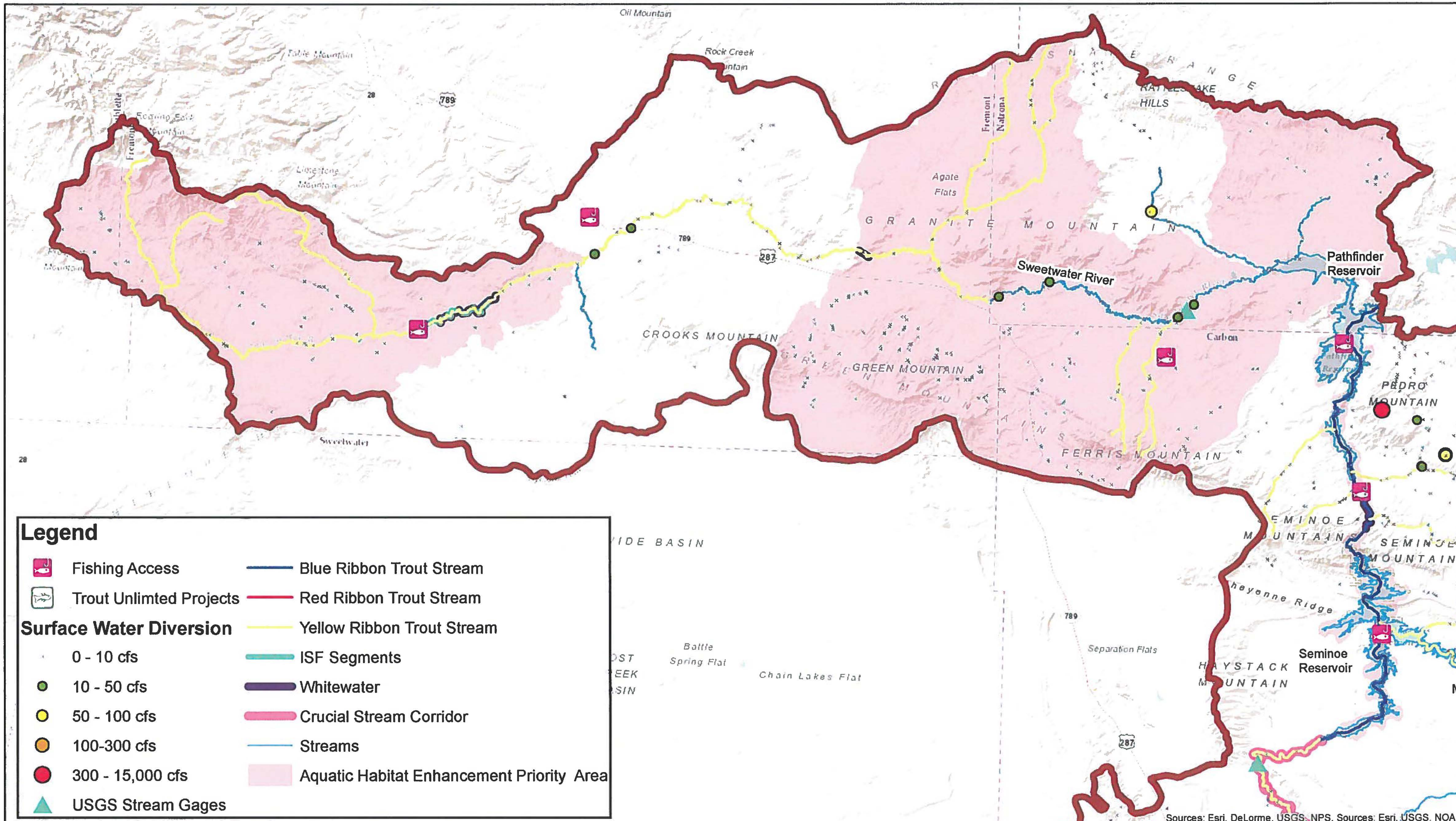


N W E S

0 2.5 5 10 15 20 25

Miles

**Wyoming Water Development Commission**

**Figure 3.5.4 Surface Water Uses - Above Pathfinder (West)**

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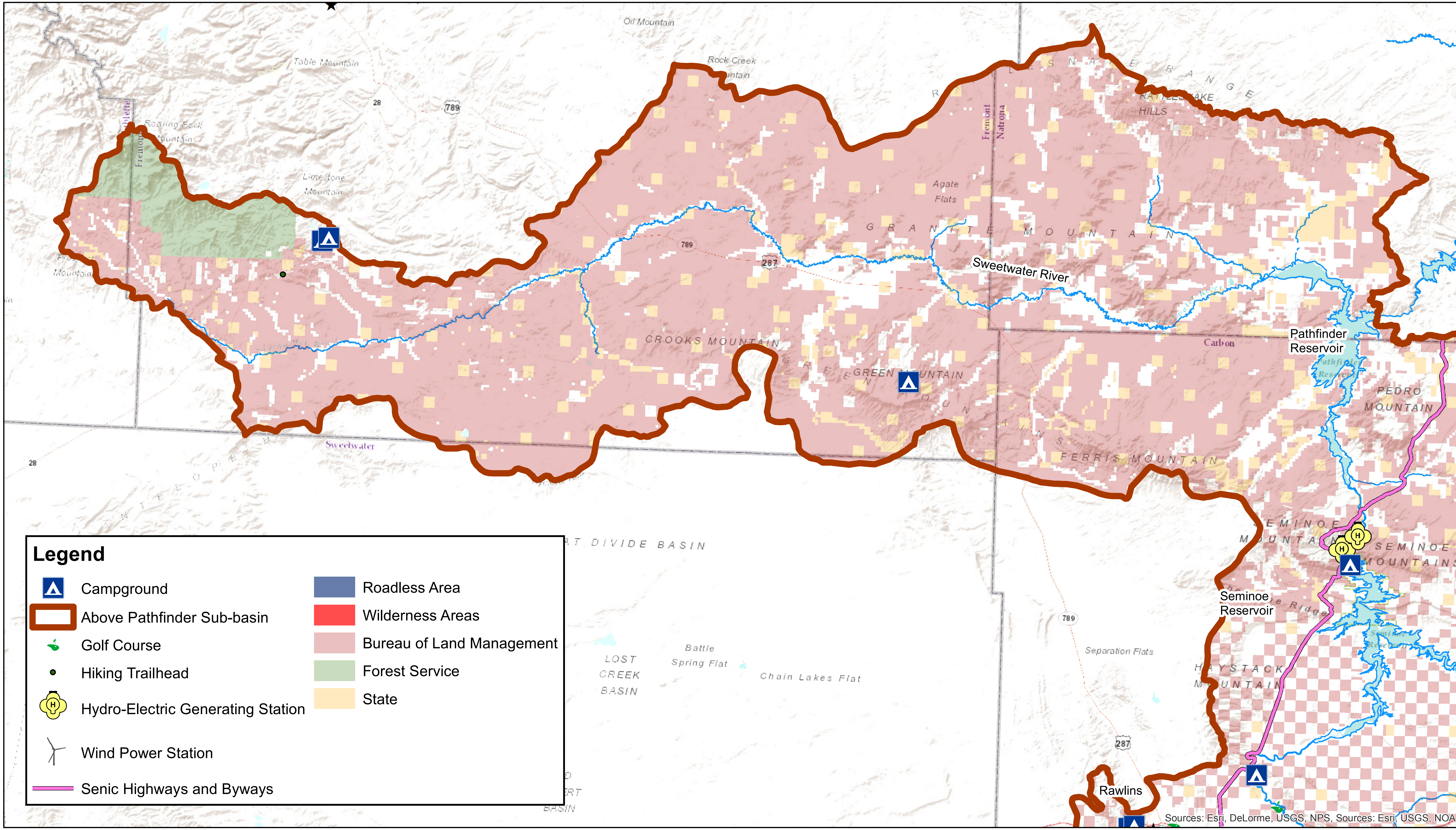


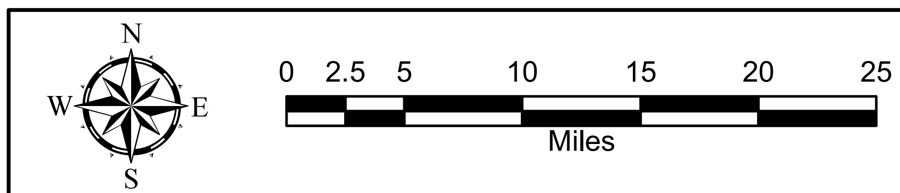


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**Figure 3.5.5 Land Use - Above Pathfinder (West)**

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### Pathfinder to Guernsey Subbasin

This subbasin is rich in recreational opportunities with its long reach of the North Platte River and three reservoirs, two of which are associated with state parks, and offers a wide variety of recreational opportunities. The Laramie and Granite Mountains provide numerous E&R benefits. Casper, the second largest city in the state, is also located here. As of 2012, there were about 65,000 irrigated acres in the subbasin, down almost 30% since 2006. About 12% of the total Basin irrigated acreage is located in this subbasin.

The elevation of this subbasin ranges from about 4,000 to 8,400 feet providing a variety of landscapes well suited to agriculture, recreational pursuits and environmental habitat.

#### Major Recreational Opportunities in the Pathfinder to Guernsey Subbasin

**Alcova Reservoir.** Alcova Reservoir is located on the North Platte River approximately 30 miles southwest of Casper, in Natrona County. The dam was completed in 1938 and has an adjudicated capacity of 184,295 acre-feet of water. The Natrona County Roads, Bridges and Parks Department manages recreational facilities at Alcova Reservoir for the USBR. Alcova Reservoir is unique in that it serves many facets of water use. The dam serves as a diversion dam for the Casper Irrigation Canal and as a forebay for the Alcova Power Plant. These uses, in addition to recreational use, make this reservoir an important basin feature. Campgrounds, boat ramps, an interpretive trail, and a marina concession are available at the site. A dinosaur interpretive trail is located near Cottonwood Creek Beach. In 2010, there were more than 100,000 visitor days at the lake; visitor days are projected to grow to more than 130,000 by 2030 (USBR, 2013).

**Edness K. Wilkins State Park.** This state park is located 6 miles east of Casper near Interstate 25 in Natrona County. The site covers 315 acres of what was once a rock quarry. As a result of a master reclamation plan to construct an attractive and functional park for all visitors, the site was transformed into a handicapped accessible facility with picnic tables, playgrounds, and a launching ramp for canoes and rafts. Lake water at the park is groundwater that has percolated from the subsurface. The property was purchased by the State of Wyoming in 1981 and is managed by the Wyoming Department of State Parks and Cultural Resources.

**Glendo Reservoir and State Park.** Glendo Reservoir is located on the North Platte River 6 miles southeast of the town of Glendo in Platte County. Construction on the dam was started in 1954 and completed in 1957. The power plant was completed in 1958. The adjudicated water right of Glendo Reservoir is 800,000 acre-feet. The Wyoming Department of State Parks and Cultural Resources manages recreational facilities at Glendo Reservoir for the USBR. Glendo State Park provides

campgrounds, boat ramps, and a marina concession. Three interpretive trails, including the Glendo Dam Wetlands Trail, Muddy Bay Wetlands Interpretive Trail, and the Glendo Dam Overlook Trail, provide recreational opportunities for those who desire to learn about the area. An entrance fee and a campground fee are assessed to users of Glendo State Park.

**Guernsey Reservoir and State Park.** Guernsey Reservoir is located on the North Platte River 2 miles west of the town of Guernsey in Platte County. A dam was built between 1925 and 1927 by the USBR to create Lake Guernsey. Guernsey Reservoir has an adjudicated water right for 71,040 acre-feet. The Civilian Conservation Corps completed approximately 85% of the construction of Guernsey State Park between 1933 and 1936. The Wyoming Department of State Parks and Cultural Resources manages the recreational facilities at Guernsey Reservoir for the USBR. Guernsey State Park provides campgrounds and boat ramps for public use. Fees are collected from the public to utilize campgrounds and to enter Guernsey State Park.

The Guernsey Reservoir water level is typically lowered twice each year for a relatively brief period in order to provide annual "silt runs." The "silt runs" are USBR operations which provides silt-laden irrigation water to the Goshen, Gering-Fort Laramie, and Pathfinder Irrigation Districts by decreasing Glendo Reservoir outflow, thereby reducing the Guernsey Reservoir water level; then increasing Glendo Reservoir discharge into and through Guernsey Reservoir, thereby flushing silt from Guernsey Reservoir and re-filling Guernsey Reservoir. This practice is thought to affect the Guernsey Reservoir fishery and the ways in which the public utilizes the park and reservoir for recreational purposes during periods of low water.

**Trappers Route Special Recreation Management Area.** This is a newer recreational area, managed by BLM, developed since the original Basin Plan. The area is operated under an adaptive management approach, which is more flexible than traditional resource management but requires monitoring of management actions to measure site-specific actions for potential extrapolation to a larger area. The recreation area consists of several recreation sites along the North Platte River between Alcova Lake and Casper. The various sites provide four-day use areas, camping, fishing, picnicking and floating opportunities. Future improvements and additional amenities are planned (BLM, 2014).

State Park visitor data for the parks discussed above are shown in **Table 3.5.8**.

**Table 3.5.8: State Park Visitor Days, Five Year Average and 2014**

| State Park | Five Year Average (2009-2013) | 2014 |
|---|---|---|
| Edness K. Wilkins | 60,983 | 85,593 |
| Glendo | 219,845 | 300,801 |
| Guernsey | 64,323 | 77,613 |
| **Total** | | **462,007** |
| Source: Wyoming Division of State Parks, Historic Sites and Trails, Department of State Parks & Cultural Resources, *Visitor Use Program, 2014*. | | |

**Fishing.** Fishing opportunities are abundant in the subbasin and are evident at all the state parks and recreational locations discussed above. Many trout species, including rainbow, brown and cutthroat, along with walleye and channel catfish can be found in the North Platte. **Table 3.5.9** provides angler days for various locations throughout the subbasin.

**Table 3.5.9: Angler Days for the Pathfinder to Guernsey Subbasin**

| Pathfinder to Guernsey Subbasin | Angler Days/Year |
|---|---|
| Dave Johnson Power Plant to Glendo Dam | 60,815 |
| Pathfinder Dam to Alcova | 94,670 |
| Alcova Dam to Dave Johnson Power Plant | 29,293 |
| North Slope Laramie Range | 7,500 |
| Sage Creek Drainage | 3,091 |
| Bates Hole | 2,365 |
| Glendo Dam to Guernsey Dam | 1,713 |
| **Total** | **199,447** |
| **Note:** Some of these data have not been updated in several years, but these are the latest available figures.<br>Source: Al Conder, Casper Regional Fisheries Supervisor, WGFD, December 2014. | |

### Notable Environmental Factors in the Pathfinder to Guernsey Subbasin

**Critical Habitat Areas.** The North Platte River from Seminoe Reservoir to Alcova Dam has been classified as a Crucial Habitat Area. The area above Alcova Dam is in the Above Pathfinder Dam Subbasin. This area received this designation due to its superior sport fisheries and wetlands. Brown trout, rainbow trout and walleye are species of concern. Proposed actions include enhancement of spawning habitat, working with USBR on minimum pool requirements and control of invasive species (WGF – Upper North Platte Reservoirs, 2014).

The area along the North Platte River from Seminoe Reservoir to Glendo Reservoir is also designated as an Aquatic Crucial Habitat Area. It is divided into two sections, North Platte Corridor and Middle with somewhat differing values and species of interest. The habitat values for the North Platte Corridor include sport fishery, cottonwood gallery forest, and riparian wetlands. The habitat narrative calls for efforts to maintain or enhance this economically significant fishery. Primary species in the area include brown and rainbow trout, walleye, bald eagles, white-faced ibis and many more. Water temperature and USBR water management are critical elements in this area (WGF North Platte, 2014).

***The Middle North Platte*** – Glendo Reservoir habitat values include sport fishery, existing and potential native sport fish habitat, riparian cottonwood habitat and wetlands that should be maintained or enhanced. Primary species include black crappie, brown trout, channel catfish, rainbow trout and more. Issues in the area include USBR water management, barriers to fish migration and degraded riparian habitat (WGF Glendo, 2014).

These areas do not receive specific protection due to this designation, but management efforts in these areas are designed to improve conditions.

**Minimum Release Reservoirs.** There are three minimum release flow reservoirs in this subbasin, each owned and operated by the USBR. Only releases at Gray Reef, a regulating reservoir downstream of Alcova Dam, are mandated by law. USBR voluntarily maintains releases at Pathfinder and Glendo Dams to improve fisheries, wetlands and wildlife habitat. Details on the minimum release flows are provided in **Table 3.5.10.**

**Table 3.5.10: Minimum Release Reservoirs in the Pathfinder to Guernsey Subbasin**

| Structure | Owner | Minimum Release | Regulation |
|---|---|---|---|
| Pathfinder Dam | USBR | 75 cfs | Voluntary low flow release for trout fisheries |
| Gray Reef Dam | USBR | 300 cfs | U.S. Public Law 85,695, Missouri Basin Project |
| Glendo Dam | USBR | 25 cfs | Voluntary release for wetlands and associated fish and wildlife benefits |
| Source: USBR Annual Operating Plan, North Platte River Area, 2013-2014. | | | |

### Classification of Recreational and Environmental Water Uses in the Pathfinder to Guernsey Subbasin

An analysis of recreational and environmental water uses was performed utilizing GIS data and maps in order to categorize those uses. **Table 3.5.11** provides a listing or recreational and environmental sites within the subbasin.

**Table 3.5.11: Recreational and Environmental Water Uses within the Pathfinder to Guernsey Subbasin**

| **Recreation Sites** | |
|---|---|
| Fishing Access | 5 |
| Whitewater Rafting | 3 |
| Trout Streams | |
| *Blue* | 2 |
| *Red* | 6 |
| *Yellow* | Numerous |
| Campgrounds | 14 |
| Natural Landmarks | 1 |
| Scenic Highways and Byways | 2 |
| National Historic and Scenic Trails | 1 |
| **Environmental Uses** | |
| Wilderness/Roadless Areas | Yes |
| US Forest Service Lands | Yes |
| Instream Flow Segments | 1 |
| Crucial Stream Corridors | 1 |
| Aquatic Crucial Priority Areas | 2 |
| Wetland Area | Yes |
| Source:GIS sources are provided in the Introduction. | |

**Categorization of E&R Water Uses in the Pathfinder to Guernsey Subbasin**

Many of the E&R water uses in this subbasin appear to be protected or complementary to the traditional diversions. The North Platte is somewhat different than other rivers because of the 1945 North Platte Decree and 2001 Modified Decree, which limits diversion for agriculture in this subbasin. In addition, the economic importance and quality of life value of the recreation associated with the North Platte make it highly unlikely that flows would be reduced to a level that would impair these uses. An additional level of protection exists because the reservoirs along the Platte, discussed above, ensure that water is released to the river. All uses directly associated with existing reservoirs are categorized as protected for this analysis.

The North Platte River is a prime recreational resource in the subbasin. In addition to the designated fishing access points, there are many fishing spots all along the Platte that offer opportunities to catch rainbow, brown and cutthroat trout, channel catfish and walleye (BLM, 2015). Much of the North Platte in this subbasin has been designated as a blue ribbon trout stream by WGFD. Most of the land area along the banks of the Platte in this subbasin has been designated as an Aquatic Enhancement Priority Area by WGFD, because of its high value as a fishery. However, there are no specific protections associated with this designation (WGF, 2009).

As the Platte leaves the Pathfinder Reservoir, there are several recreational water uses, including a whitewater rafting segment, a yellow ribbon trout stream and a fishing access point. Just downstream of these activity areas are two surface water diversion points, including a large diversion for power generation at Alcova Reservoir, a USBR project. The locations of these diversions complement the recreational uses and as long as those diversions are in place, the recreational uses upstream of them will be protected. It is likely that the power generation at Alcova will remain in place for the long term and thus these upstream uses should be considered protected.

North of Casper is a short rafting segment that is complemented by several large downstream diversions. West of Natrona County in Converse County, there is an important stream segment with a whitewater segment, red ribbon trout stream, and an instream flow segment. As the instream flow segment is protected by a water right, the trout stream and whitewater segment above it are thus protected. However, the whitewater segment below it and the yellow ribbon trout stream should be considered competing. Although there are numerous small diversions downstream, any changes to those diversions could allow for additional upstream diversions. Just to the east is another whitewater stream segment and yellow ribbon trout stream. These uses are complementary to several, large downstream diversions.

There are numerous yellow ribbon and a few red ribbon stream segments originating in the Laramie Mountains. Some of these are within the bounds of the Medicine Bow National Forest and are at high elevations. As a result, these uses can be considered protected, even though the segments outside of the national forest would not have explicit protection. Their location within the landscape provides the required protection. The red ribbon stream west of Douglas lacks sufficient complementary uses and should be considered competing.

There is a fishing access point in the northwest portion of the subbasin that should be considered competing as there is no evidence of protection from other uses. This is also true of the fishing access point that is south of Douglas. No apparent protection exists and it should be considered competing.

**Table 3.5.12** provides a summary of the classified uses in the subbasin.

**Table 3.5.12: Categorization of E&R Uses in the Pathfinder to Guernsey Subbasin**

| Status | Location and Uses |
|---|---|
| Protected | Uses at reservoirs, North Platte activities between Pathfinder and Alcova Reservoir, remaining stretch of the North Platte to Glendo, instream flow segments and associated upstream uses, uses originating in the upper reaches of the Laramie Mountains |
| Complementary | Whitewater rafting north of Casper, and rafting and yellow ribbon segment west of Douglas |
| Competing | Fishing access points in the northwest area of the subbasin and south of Douglas, whitewater and yellow stream segment below the ISF in Converse County, red ribbon stream west of Douglas |

Maps of these resources are provided in **Figures 5.3.6 and 5.3.7**.

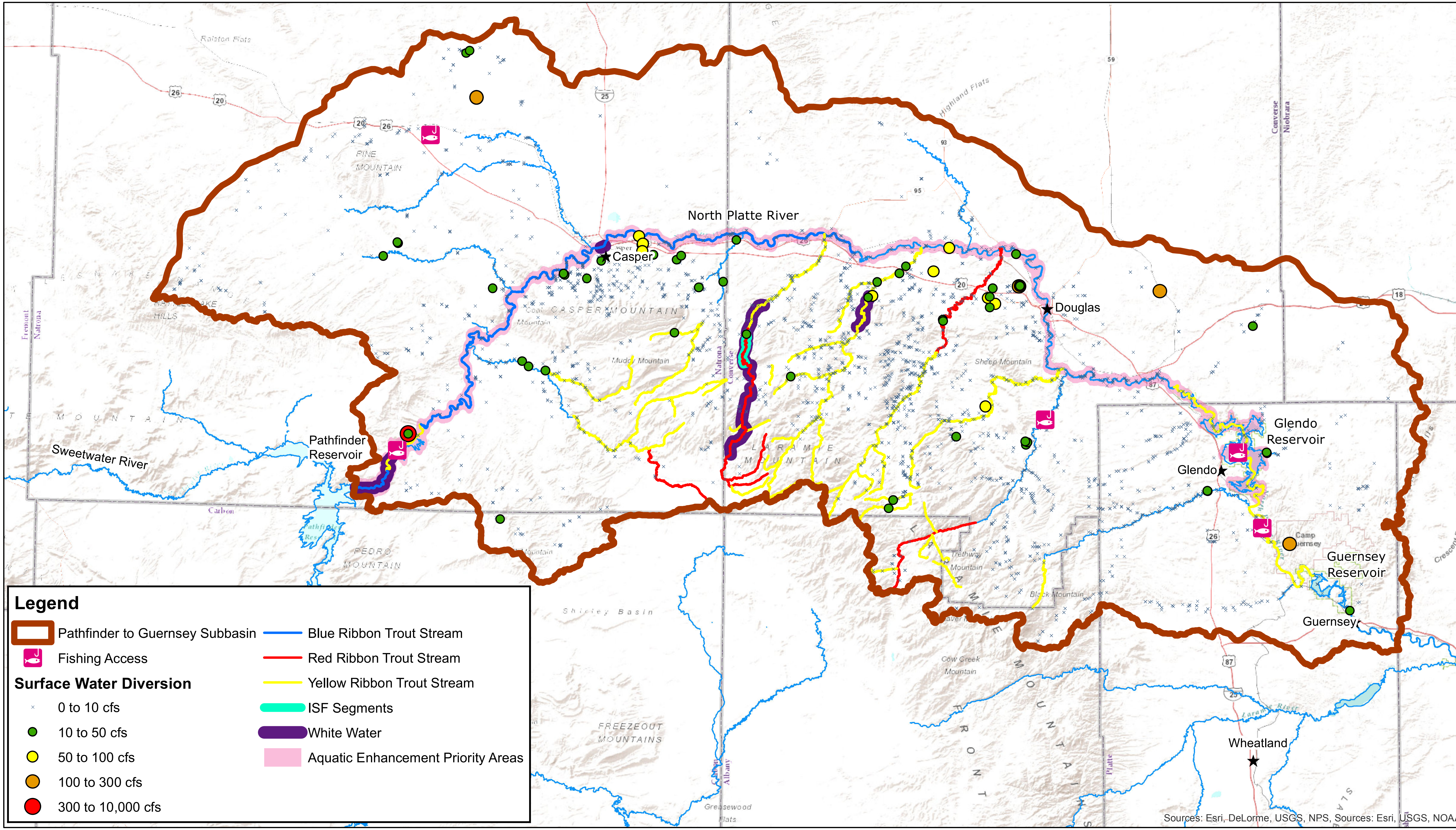
### Guernsey to State Line Subbasin

This subbasin is home to the Goshen County seat of Torrington, which has a population of about 6,800. The remainder of the subbasin is sparsely populated. The area of the subbasin is predominately in Goshen County with a small area in Niobrara County and a very small area of Platte County. There is little recreational or environmental activity in the subbasin. As of 2012, there were about 81,700 irrigated acres in the subbasin, down from 90,980 in 2006, for a reduction in irrigated acres of about 10%. More than 15% of the Basin's total irrigated acreage is located here, much of it in the vicinity of Torrington.

The land here is relatively flat and well suited for agriculture. The elevation of this subbasin ranges from about 4,000 to 5,500 feet.

### Major Recreational Opportunities

Recreational opportunities in this subbasin are limited. There are no designated fishing access points or other recreational locations in the subbasin. The water used for the Torrington golf course will be included in the municipal demands.



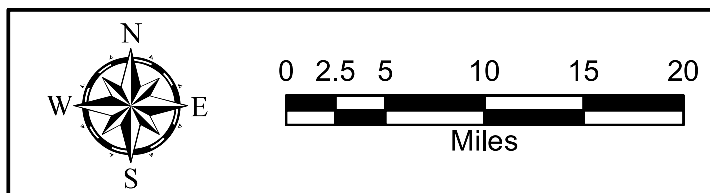




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**Figure 3.5.6 Surface Water Uses - Pathfinder to Guernsey**

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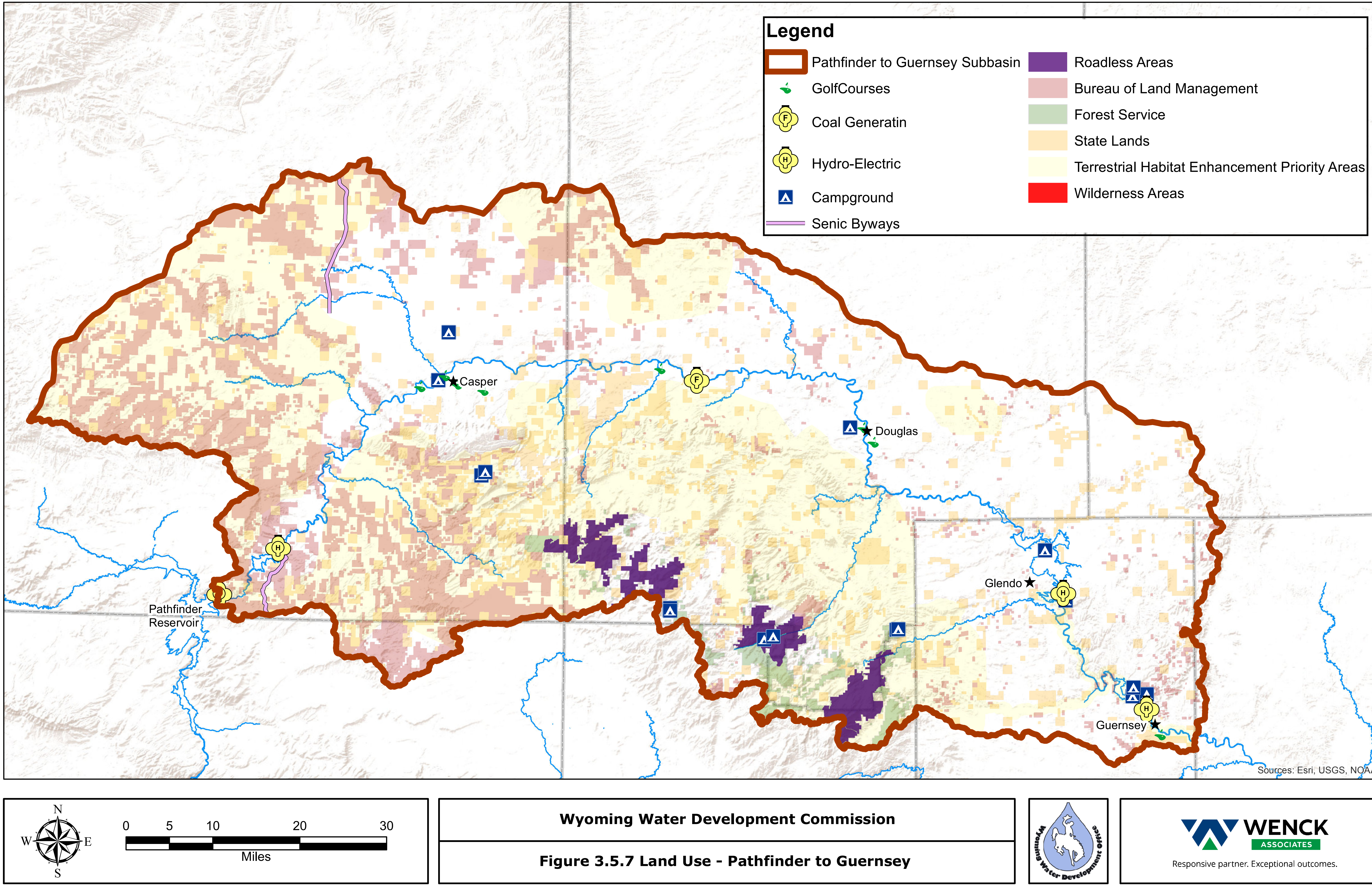


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**Figure 3.5.7 Land Use - Pathfinder to Guernsey**

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### Notable Environmental Factors in the Guernsey to State Line Subbasin

**Wetlands.** The Goshen Hole Complex, located in Southern Goshen County, is one of nine high priority wetland areas, as designated by the Wyoming Joint Ventures Steering Committee. Much of this wetland area has been created by and is sustained by irrigation activities. These wetlands are an important migration corridor for and provides habitat for waterfowl and attracts diverse species. This wetlands complex is the most important waterfowl hunting area in the state. A large number of acres of both wetlands and upland buffers are in private ownership and are enrolled in management agreements. This wetlands complex occupies about 491 square miles and includes about 7,000 acres of wetlands (Wyoming Joint Ventures Steering Committee, 2010).

**Critical Habitat Areas.** The Niobrara Critical Aquatic Area is mostly located north, and outside of Platte Basin. However, small sections of it cross over into the Guernsey to State Line Subbasin. WGF has identified the important habitat value here to be for native fish assemblage. The primary species of importance are the finescale dace, northern pearl dace and plains topminnow. Impacts from cultivated land, including nutrient and sediment inputs, and barriers to migration are issues here. Landowner awareness, conservation easements and stream surveys are some of the proposed actions for this area (WGF – Niobrara, 2014).

**Minimum Release Reservoirs.** There are no minimum release reservoirs in the subbasin.

### Classification of Recreational and Environmental Water Uses in the Guernsey to Stateline Subbasin

An analysis of recreational and environmental water uses was performed utilizing GIS data and maps in order to categorize those uses. **Table 3.5.13** provides a listing or recreational and environmental sites within the subbasin.

**Table 3.5.13: Recreational and Environmental Water Uses within the Guernsey to State Line Subbasin**

| **Recreation Sites** | |
|---|---|
| Fishing Access | 0 |
| Whitewater Rafting | 0 |
| Trout Streams | |
| *Blue* | 0 |
| *Red* | 0 |
| *Yellow* | 0 |
| Campgrounds | 0 |
| Natural Landmarks | 0 |
| Scenic Highways and Byways | 0 |
| National Historic and Scenic Trails | 0 |
| **Environmental Uses** | |
| Wilderness/Roadless Areas | 0 |
| US Forest Service Lands | 0 |
| Instream Flow Segments | 0 |
| Crucial Stream Corridors | 0 |
| Aquatic Crucial Priority Areas | 1 |
| Wetland Area | Yes |
| Source: GIS sources are provided in the Introduction. | |

### Categorization of Recreational and Environmental Water Uses

The only water use that meets the mapping standards for this analysis are those for irrigated agriculture and the small area of the Niobrara Critical Aquatic Area. However, as the large majority of the area is outside the subbasin, it is assumed that any impactful activities will take place there. In addition, there are no explicit protections associated with this classification.

Land and water use maps for the subbasin are presented in **Figures 3.5.8 and 3.5.9**.

### Upper Laramie Subbasin

This subbasin is home to Laramie. It is mostly within Albany County, but does extend into a small area of Carbon County. The Laramie River, several small lakes and reservoirs and the Medicine Bow National Forest provide ample opportunity for recreation. This subbasin is the only one in the Platte Basin that has seen an increase in irrigated acres since 2006. As of 2012, there were about 104,400 irrigated acres, up 13% from 92,250. This represents more than 18% of irrigated acres within the Basin. The elevation of this subbasin ranges from about 7,000 to 11,000 feet.

#### Major Recreational Opportunities in the Upper Laramie Subbasin

**Lake Hattie Reservoir.** Lake Hattie is located 15 miles west of Laramie near the foothills of the Medicine Bow Mountains in Albany County. The dam was originally constructed in 1912 and modified in 1990. The reservoir has an adjudicated water right to store 65,260 acre-feet of water. Lake Hattie contains 2,239 acres of land. The Lake Hattie Irrigation District owns the lake, and the WGFD manages the recreational facilities. Camping and picnic facilities are undeveloped, potable water is not available, and there are no fees to use the park. A boat launch is available.

**Rob Roy Reservoir.** Rob Roy Reservoir and campground is located in the Medicine Bow National Forest approximately 40 miles southwest of Laramie in Albany County. The reservoir has an adjudicated water right and a storage capacity of 35,434 acre-feet.

Construction of the dam and reservoir was completed in 1963 and modified in 1985. Rob Roy Reservoir is the largest and deepest of a series of five reservoirs in the Cheyenne public water supply system, including Hog Park Reservoir in the Sierra Madre Mountains; Rob Roy Reservoir and Lake Owen (Berg Reservoir) in the Medicine Bow Range; and Crystal Lake and Granite Springs Reservoir in the Laramie Range. Rob Roy contains 79% of Cheyenne's surface water storage capacity. Rob Roy is the only lake in the series that stores only runoff from its watershed and receives no inflow from other reservoirs. The reservoir campground is developed and includes picnic tables and potable water. The reservoir is managed by Cheyenne, and the nearby recreational facilities are administered by the USFS.

**Fishing.** Fishing opportunities are good in the subbasin, which has several red ribbon trout streams and numerous yellow ribbon streams. Rainbow, brown, brook, and cutthroat trout can be found in the streams and lakes. Angler days for the subbasin are provided in **Table 3.5.14**.

**Table 3.5.14: Angler Days for the Upper Laramie Subbasin**

| Upper Laramie Subbasin | Angler Days / Year |
|---|---|
| Upper Big Laramie | 24,975 |
| Little Laramie River and Drainages | 12,513 |
| **Total** | **37,488** |

**Note:** Some of these data have not been updated in several years, but these are the latest available figures.
Source: Mike Snigg, Laramie Regional Fisheries Supervisor, WGFD, January 2015.

There are no state parks in the subbasin.

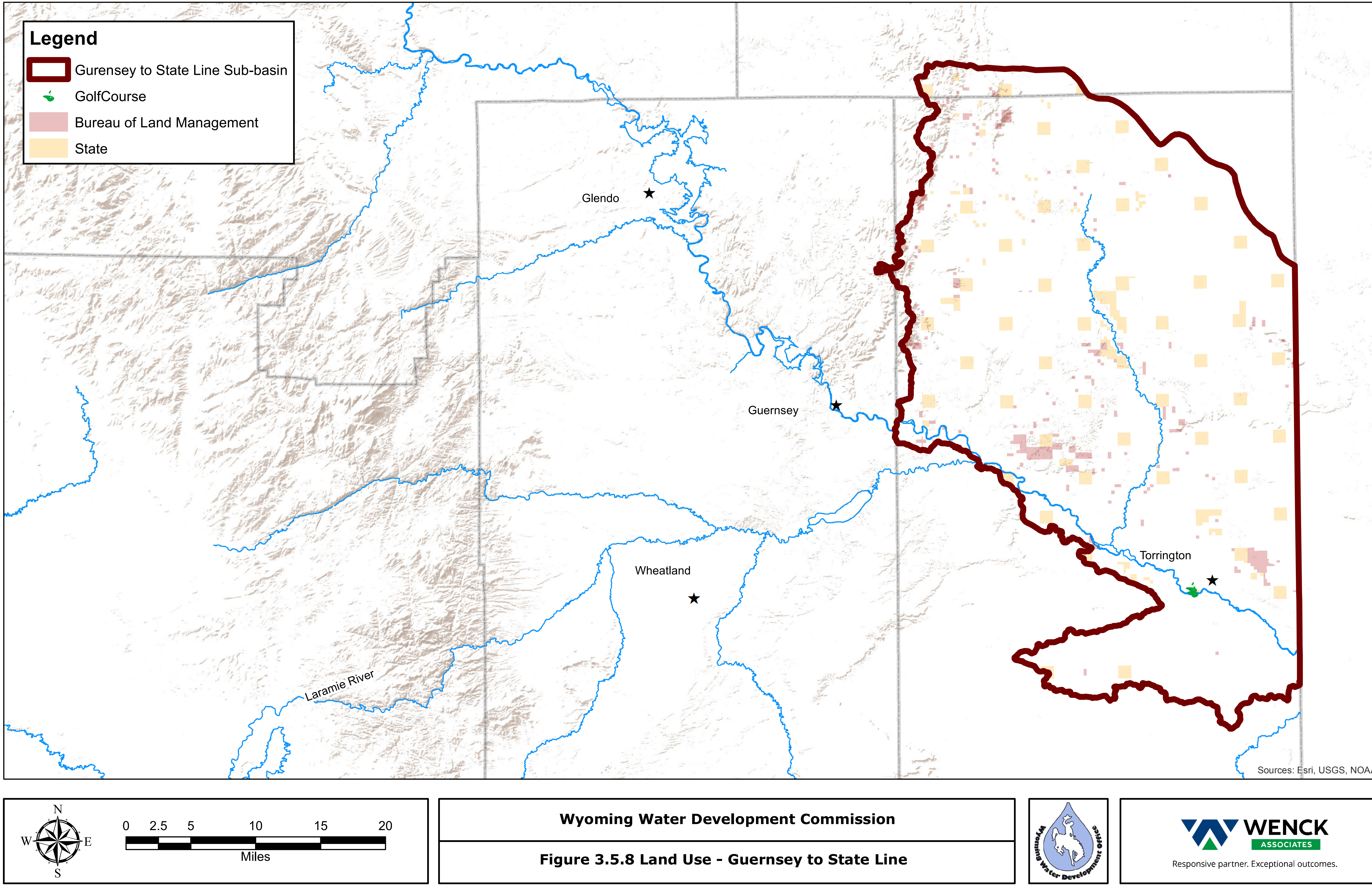


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**Figure 3.5.8 Land Use - Guernsey to State Line**

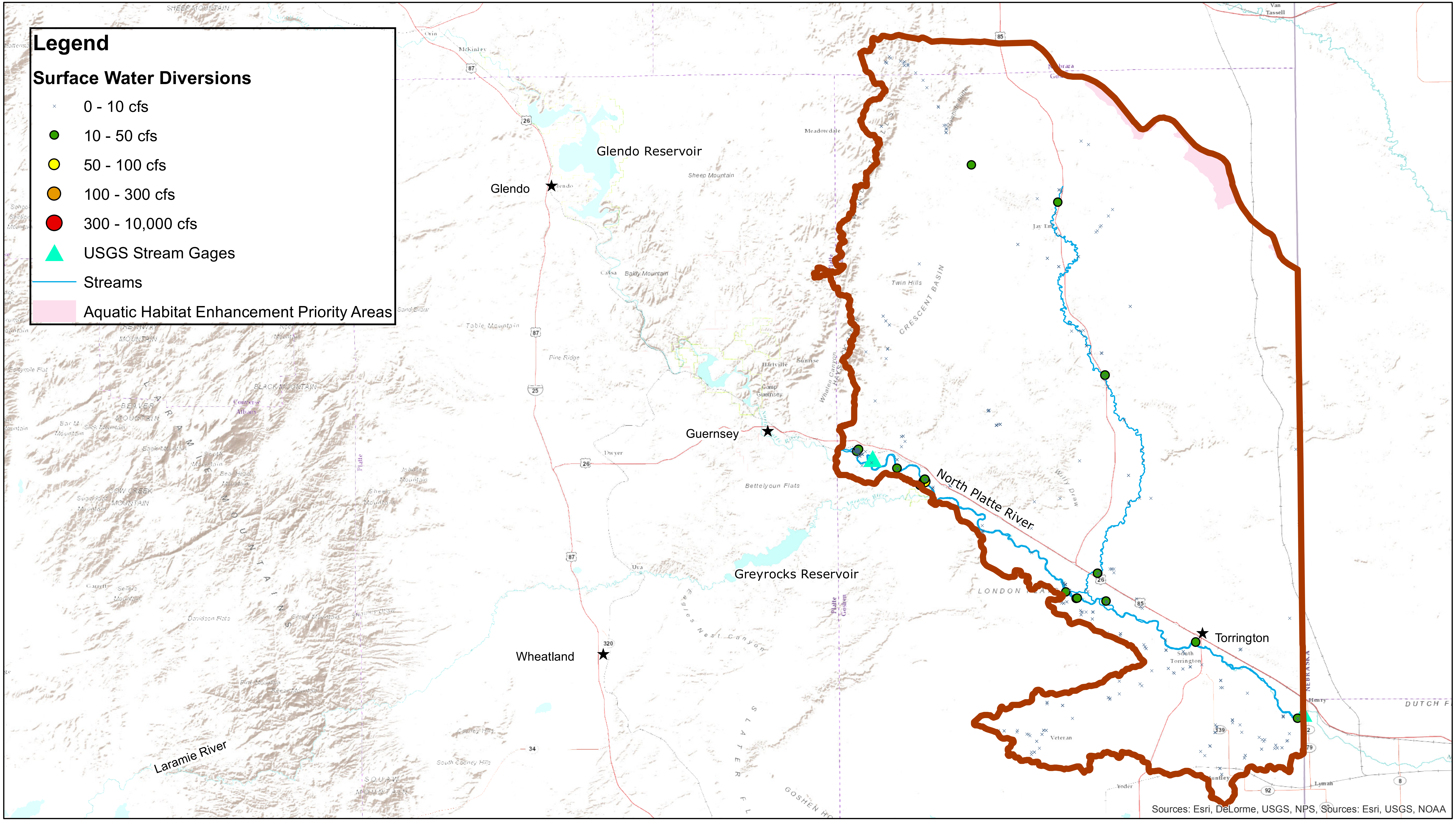


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**Figure 3.5.9 Surface Water Uses - Guernsey to State Line**

### Notable Environmental Factors in the Upper Laramie Subbasin

**Aquatic Habitat Enhancement Priority Area.** The Laramie River/Spring Creek aquatic enhancement area was adopted to improve brown and rainbow trout habitat that has been degraded due to stream channelization, streambank erosion, urbanization and willow removal. The creation of this cooperative project should improve habitat and improve upstream fishing opportunities.

**Trout Unlimited Project.** Trout Unlimited contributed funding to this National Resources Conservation Service project for channel restoration on Holland Ranch/ Laramie River. This project was completed in 2015.

**Permitted Instream Flow.** This 3.94 mile segment on the Laramie River was issued in 2012, with a priority date of December 15, 1989. The permitted cfs is a minimum of 50 and maximum of 100.

**Laramie Plains Wetlands Complex.** This large wetlands encompasses about 1,480 square miles in Albany and Carbon Counties. The dominant land use within the area is agriculture, including both irrigated and non-irrigated crops and native rangeland. Flood irrigation has contributed to the wetlands and snowmelt from the surrounding mountains reaches the wetlands through irrigation ditches and irrigation. Recreational activities in the Complex are not currently an issue, but that could change as population increases in the southeastern part of the state (WGF - Regional Wetland Conservation Plan, 2014).

### Classification of Recreational and Environmental Water Uses in the Upper Laramie Subbasin

As described in Section 3.5.3, an analysis of recreational and environmental water uses was performed utilizing GIS data and maps in order to categorize those uses. **Table 3.5.15** provides a listing or recreational and environmental sites within the subbasin.

**Table 3.5.15: Recreational and Environmental Water Uses within the Upper Laramie Subbasin**

| **Recreation Sites** | |
|---|---|
| Fishing Access | 7 |
| Whitewater Rafting | 4 |
| Trout Streams | |
| *Blue* | 0 |
| *Red* | 3 |
| *Yellow* | Numerous |
| Campgrounds | 6 |
| Natural Landmarks | 0 |
| Scenic Highways and Byways | 1 |
| National Historic and Scenic Trails | 0 |
| **Environmental Uses** | |
| Wilderness/Roadless Areas | Yes |
| US Forest Service Lands | Yes |
| Instream Flow Segments | 1 |
| Crucial Stream Corridors | 0 |
| Aquatic Crucial Priority Areas | 2 |
| Wetland Area | Yes |
| Source: GIS sources are provided in the Introduction. | |

**Categorization of Recreational and Environmental Water Uses in the Upper Laramie Subbasin**

There are seven public access fishing locations on the map, the first being on the Laramie River just north of Colorado and upstream of the Trout Unlimited Project and the only permitted instream flow in this subbasin. It is recognized as protected due to its proximity to an instream flow segment as well as numerous senior downstream diverters. Just to the east of the Medicine Bow Range are four fishing locations at small lakes and reservoirs which are protected due to their location. This is also true of the fishing access point located at Wheatland Reservoir 3 on the northwest side of the subbasin. The final public fishing access point on the Laramie River has a single, close downstream diverter but is protected by the downstream irrigation rights of the Wheatland Irrigation District.

There are three red ribbon trout streams in this subbasin. The first is on the Laramie River beginning at the Colorado border. Much of this stretch is upstream of a permitted in-stream flow, and all of it is upstream to numerous senior diverters, providing it a protected status. Coming out of the Medicine Bow National Forest is a second lengthy red ribbon segment. Its location upstream of numerous senior downstream diverters affords this stretch of fishing a complementary use status. The final red ribbon stream is a short stretch high in the Medicine Bow Mountains which is protected by its location but is also complementary to numerous senior downstream diverters.

There are five whitewater rafting locations in the subbasin. The first is just north of Laramie on the Laramie River. This stretch of the river is also a yellow-ribbon trout stream, and is within the aquatic enhancement area discussed above. There are several senior traditional diversions downstream of this location associated with the Wheatland Irrigation District. Although its location in a priority area does not afford official protection, this river reach is considered complementary because the Laramie River has many downstream diverters which necessitate bypassing water through this segment. The WGF's goal is to improve the segments habitat and it is unlikely that flow would be curtailed. In the northern area of the subbasin, is another whitewater stretch, also a yellow-ribbon trout stream, which is complementary to one large senior downstream and several smaller diversions in the Lower Laramie Subbasin.

There are two whitewater stream segments coming out of the higher reaches of the Medicine Bow Mountains. Their location on USFS lands provides a protected status to these recreation areas. Just north of the Colorado border is a fifth whitewater rafting area on the Laramie River. This relatively short stretch is just upstream of an instream flow segment, which provides a protected status to this stream segment. **Table 3.5.16** provides a summary of the classified uses in the subbasin.

**Table 3.5.16: Categorization of E&R Uses in the Upper Laramie Subbasin**

| Status | Location and Uses |
|---|---|
| Protected | Fishing access locations, whitewater segments and a red ribbon stream in the Medicine Bow National forest, the ISF segment and whitewater rafting and red ribbon stream segment upstream of it |
| Complementary | Whitewater rafting and yellow ribbon stream segment north of Laramie, long red ribbon segment after it leaves the Medicine Bow Forest |
| Competing | NA |

Maps of these data are provided in **Figures 3.5.10 and 3.5.11**.

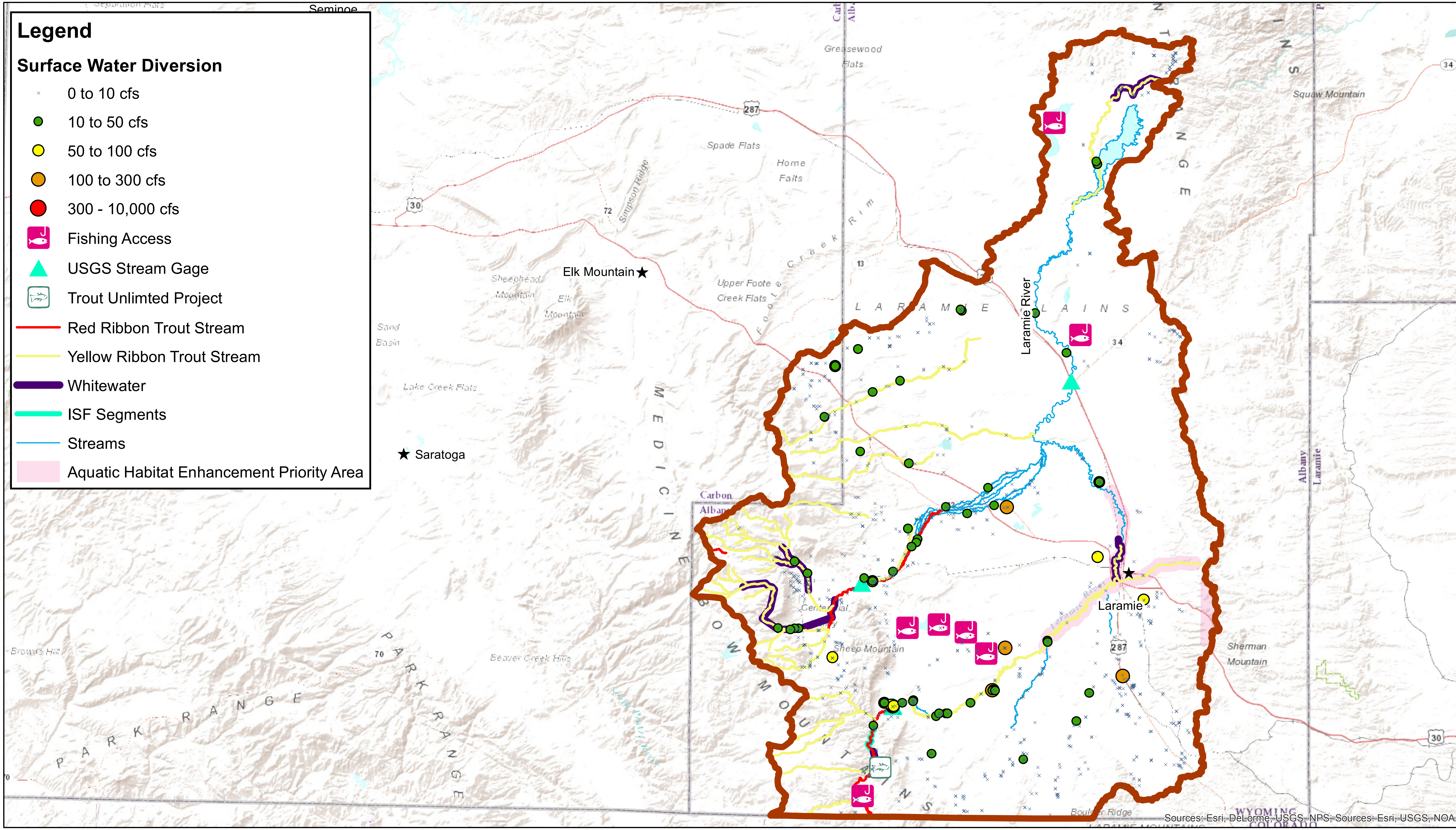


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**Figure 3.5.10 Surface Water Uses - Upper Laramie**

Wyoming Water Development Office

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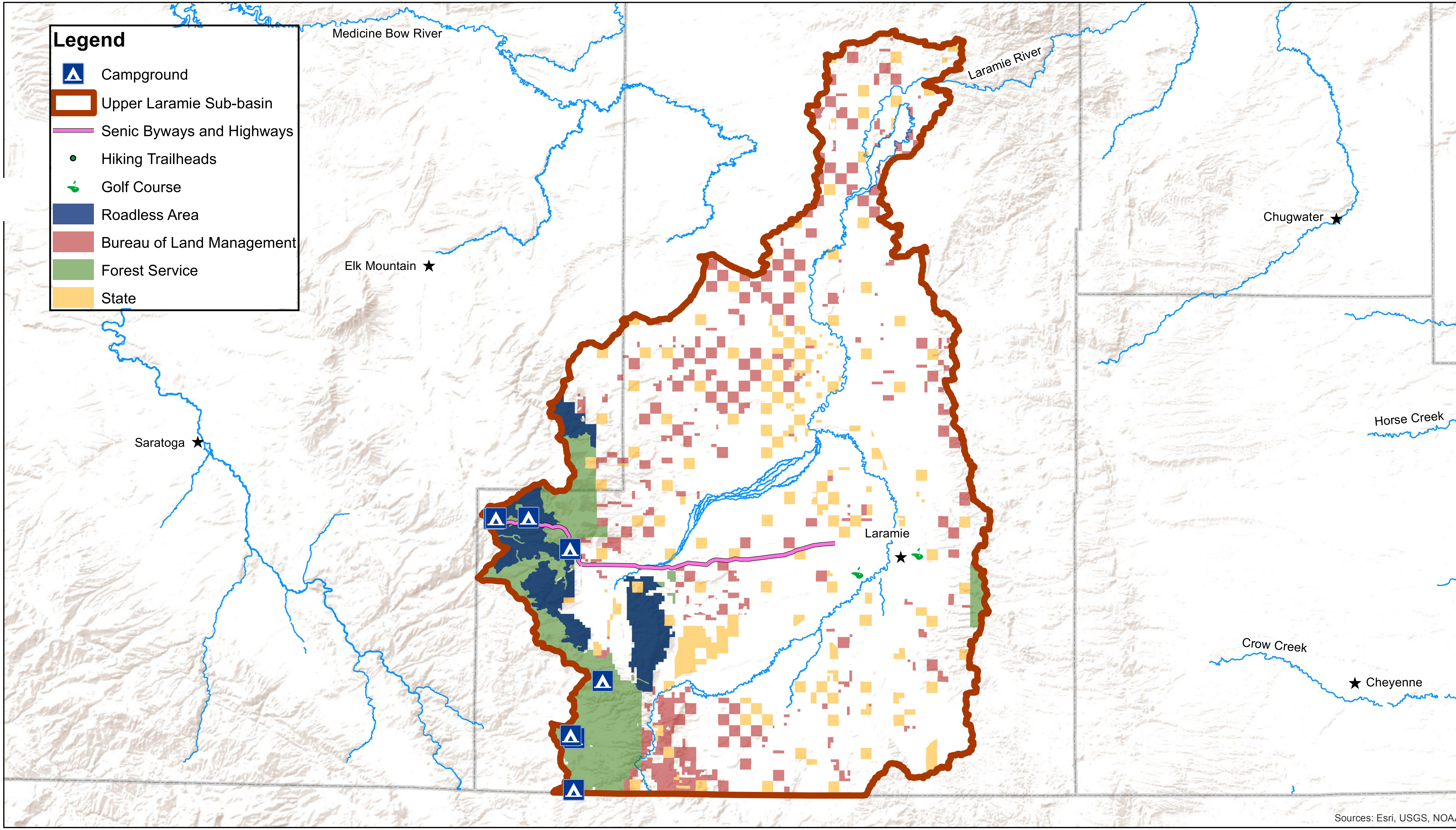




**Wyoming Water Development Commission**

**Figure 3.5.11 Land Use - Upper Laramie**

### Lower Laramie Subbasin

This subbasin is home to Wheatland and encompasses parts of four counties, Albany, Platte, Laramie and Goshen. The Laramie River continues its course through the subbasin flowing out of the Upper Laramie Subbasin and providing many recreational opportunities. In addition, the Laramie Mountains provide excellent fishing and rafting locations. The area around Wheatland includes a heavy presence of irrigated agriculture, which has diminished about 27% since 2007. As of 2012, there were about 66,600 irrigated acres, including the Wheatland Irrigation District. The elevation of this subbasin ranges from about 4,000 to 8,000 feet, much of it at the lower elevations that are suitable for agriculture.

#### Major Recreational Opportunities

**Grayrocks Reservoir.** Grayrocks Reservoir is located on the Laramie River about 11 miles east of the Laramie River electrical power generating station. The reservoir lies at an elevation of approximately 4,000 feet in Platte County. The reservoir is about 8 miles long, has an adjudicated storage capacity of 104,109.60 acre-feet, and includes recreational facilities. The reservoir, which is owned by the Basin Electric Power Cooperative, is the primary source of steam production and cooling water for the power station. In addition, the reservoir and surrounding areas are managed by the WGF as a wildlife habitat management area. WGF stocks the reservoir with several species of game fish, and the reservoir contains largemouth bass, smallmouth bass, walleye, tiger muskie, channel catfish, crappie, pumpkinseed, and bluegill.

**Fishing.** There is one blue, several red, and numerous yellow ribbon streams in the subbasin. In addition to Grayrocks Reservoir, stream fishing opportunities exist for walleye, channel catfish, yellow perch, largemouth bass, black bullhead, and rainbow trout. Angler days are provided in **Table 3.5.17**.

**Table 3.5.17: Angler Days for the Lower Laramie Subbasin**

| Lower Laramie Subbasin | Angler Days/Year |
|---|---|
| North Laramie River and Drainages and Grayrocks Reservoir | 5,813 |
| Chugwater and Wheatland Creeks | 3,432 |
| Grayrocks Reservoir | 17,000 |
| **Total** | **26,245** |
| **Note:** Some of these data have not been updated in several years, but these are the latest available figures.<br>Source: Mike Snigg, Laramie Regional Fisheries Supervisor, WGFD, January 2015. | |

There are no state parks in the subbasin.

#### Notable Environmental Factors in the Lower Laramie subbasin

**Aquatic Enhancement Priority Areas.** A segment of the Laramie River as it exits the canyon in the Laramie Range to Grayrocks Reservoir has been designated an Aquatic Habitat Enhancement area. Irrigation diversions, livestock grazing and invasive plant species have caused degradation of the stream segment. Many fish species may benefit from an improved habitat and include bigmouth shiner, common shiner, hornyhead chub, Iowa darter, plains topminnow and many more. Potential actions include fish passage/screening projects, cottonwood regeneration, removal of invasive plants and conservation easements (WGF – Laramie River, Wheatland, 2008).

**Minimum Reservoir Releases.** There is one minimum release flow reservoir at the Grayrocks Dam, which is owned by the Basin Electric Power Cooperative. The minimums released are governed by the Modified North Platte Decree and are dependent on flows measured at the Grayrocks Reservoir and at the Fort Laramie Gauge. Details are provided in **Table 3.5.18** and in the italicized text below the table.

**Table 3.5.18: Minimum Release Reservoir in the Lower Laramie Subbasin**

| Structure | Owner | Minimum Release | Regulation |
|---|---|---|---|
| Grayrocks Dam | Basin Electric Power Cooperative | See notes below | 1978 Agreement of Settlement and Compromise and the Modified North Platte Decree |
| Source: 1978 Agreement of Settlement and Compromise and the Modified North Platte Decree. | | | |

*The operation of the Grayrocks is complicated. Natural flow is measured at the gage above the Reservoir. Senior rights downstream of the Reservoir total 24.69 cfs. Minimum release flows are dependent on storage at the Reservoir and time of year and are measured at the gage below Grayrocks (Below GR) and at the Ft. Laramie Gauge (FLG)*

*When storage is at least 50,000 AF:*

*October 1 to March 31 – 40 cfs at both GR and FLG*
*April 1 to April 30 – 50 cfs at both GR and FLG*
*May 1 – September 30 – minimum flow of whichever is greater: 40 cfs or 75% of natural flow at the gage above Grayrocks Reservoir, after all rights have been filled except the Grayrocks Reservoir storage right and the direct flow right for the Laramie River Station power plant; release rates are not to exceed 200 cubic feet per second – at both GR and FLG*

*When storage is at below 50,000 AF:*

*No minimum releases at GR*
*October 1 to March 31 – 20 cfs at FLG*
*April 1 to April 30 – 40 cfs at FLG*

### Classification of Recreational and Environmental Water Uses in the Lower Laramie Subbasin

As described in Section 3.5.3, an analysis of recreational and environmental water uses was performed utilizing GIS data and maps in order to categorize those uses. **Table 3.5.19** provides a listing or recreational and environmental sites within the subbasin.

### Categorization of Recreational and Environmental Water Uses in the Lower Laramie Subbasin

Fishing in the subbasin is excellent as evidenced by the number of red and yellow ribbon streams and one blue ribbon stream. The lone blue-ribbon stream is at the end of a long stretch of red ribbon through the Laramie Mountains. Although there are no traditional diversions downstream that would seem to protect these uses, their high mountain location makes it unlikely that they will be disturbed and are therefore recognized as protected. Just to the east is another red ribbon segment that is complementary to large, senior diversions at its end point. The red ribbon segments in the northern area of the subbasin appear to exist by virtue of their location and should be considered protected. This is also true of the yellow ribbon streams in the Laramie Mountains. The yellow ribbon streams in the eastern part of the subbasin however, lack the same level of protection. There are several yellow ribbon streams in the Chugwater area that are likely subject to frequent low flows under existing conditions. These streams should be considered competing.

**Table 3.5.19: Recreational and Environmental Water Uses within the Lower Laramie Subbasin**

| **Recreation Sites** | |
|---|---|
| Fishing Access | 3 |
| Whitewater Rafting | 2 |
| Trout Streams | |
| *Blue* | 1 |
| *Red* | 6 |
| *Yellow* | Numerous |
| Campgrounds | 6 |
| Natural Landmarks | 0 |
| Scenic Highways and Byways | 0 |
| National Historic and Scenic Trails | 0 |
| **Environmental Uses** | |
| Wilderness/Roadless Areas | Yes |
| US Forest Service Lands | Yes |
| Instream Flow Segments | 0 |
| Crucial Stream Corridors | 0 |
| Aquatic Crucial Priority Areas | 1 |
| Wetland Area | Yes |
| Source: GIS sources are provided in 3.5.3. | |

The fishing location at Grayrocks Reservoir is protected due to its location. A second fishing access point west of Grayrocks on the Laramie River is complementary to two large downstream diversions and minimum flow requirements at Grayrocks. A third fishing access location is at the Wheatland Reservoir #1, which has storage rights and should be considered protected.

There are two whitewater rafting segments within the subbasin. The first begins at the western border on the Laramie River, high in the Laramie Mountain Range. A very large, senior diversion complements the early reach of this rafting segment. As the river crosses into Platte County, it is part of the aquatic enhancement area discussed above. In addition to large, senior downstream diversions, the mountainous location of this stretch provides protection for this stretch of the river. Directly south of this segment is the second whitewater area. This stretch comes out of the mountains, which is the source of this segment's protection as there are no large diverters downstream. These rafting segments are all classified as protected due to location, but in some cases, are further enhanced by complementary, large downstream diversions.

The aquatic enhancement area along the Laramie River does not receive explicit protection due to this status. However, it is likely that projects will be undertaken to maintain or improve this stretch of the River. Its proximity to Grayrocks Reservoir also provides some level of protection due to the required minimum release flows.

**Table 3.5.20** provides a summary of the classified uses in the subbasin.

**Table 3.5.20: Categorization of E&R Uses in the Lower Laramie Subbasin**

| Status | Location and Uses |
|---|---|
| Protected | All red, yellow and the single ribbon segments high in the Laramie Mountains, whitewater rafting segments, fishing access points at Grayrocks Reservoir and Wheatland Reservoir #1 |
| Complementary | Fishing access point west of Grayrocks on the Laramie River |
| Competing | Yellow ribbon streams in the Chugwater area |

Maps of these resources are provided in **Figure 3.5.12 and 3.5.13**.

### Horse Creek Subbasin

This subbasin is sparsely populated with two small incorporated towns, Yoder and LaGrange. The area of the subbasin is predominately in Goshen and Laramie Counties, with small areas in Platte and Albany Counties. Fishing is the primary recreational activity here. There are several creeks that offer fishing opportunities and a variety of recreational activities are available at Hawk Springs Reservoir and State Park. There are no significant environmental water uses in this subbasin. As of 2012, there were about 41,700 irrigated acres in the subbasin, down from 61,500 in 2006, for a reduction in irrigated acres of 32%. The elevation of this subbasin ranges from about 4,000 to 8,000, much of it the lower range.

### Major Recreational Opportunities in the Horse Creek Subbasin

**Hawk Springs Reservoir and State Park.** Hawk Springs Reservoir is located approximately 20 miles south of Torrington in Goshen County. The site was named a state recreation area in 1987. The dam was originally constructed in 1925 and modified in 1985. The adjudicated storage capacity of the reservoir is 16,735 acre-feet of water (WWDC - Hawk Springs, 2013). The Horse Creek Conservation District owns the reservoir and surrounding area. The Wyoming Department of State Parks and Cultural Resources manages and maintains the recreational area around the reservoir while the WGF regulates recreational use of the water and stocks the reservoir with fish. Walleye, largemouth bass, brown trout, yellow perch, largemouth and smallmouth bass, and channel catfish are found in the reservoir. Hawk Springs State Park includes a blue heron rookery, home to blue-winged and green-winged teal, gadwall, pintail wood duck and great horned owls. Amenities at the park include a beach, boat ramp, playground, picnic area and campsites.

State Park visitor data are shown in **Table 3.5.21**.

**Table 3.5.21: State Park Visitor Days, Five Year Average and 2014**

| State Park | Five Year Average (2009-2013) | 2014 |
|---|---|---|
| **Hawk Springs** | 17,704 | 20,692 |
| **Total** | | **20,692** |
| Source: Wyoming Division of State Parks, Historic Sites and Trails, Department of State Parks & Cultural Resources, *Visitor Use Program, 2014*. | | |

**Fishing.** Opportunities for fishing are limited in this subbasin, but there are some creek locations that provide prospects for fishermen. Angler days for the subbasin are shown in **Table 3.5.22**.

**Table 3.5.22: Angler Days for the Horse Creek Subbasin**

| Horse Creek Subbasin | Angler Days/Year |
|---|---|
| Horse, Bear, Cherry and Deer Creeks | 3,663 |
| Hawk Springs Reservoir | 1,536 |
| **Total** | **5,199** |
| **Note:** Some of these data have not been updated in several years, but these are the latest available figures.<br>Source: Mike Snigg, Laramie Regional Fisheries Supervisor, WGFD, January 2015. | |

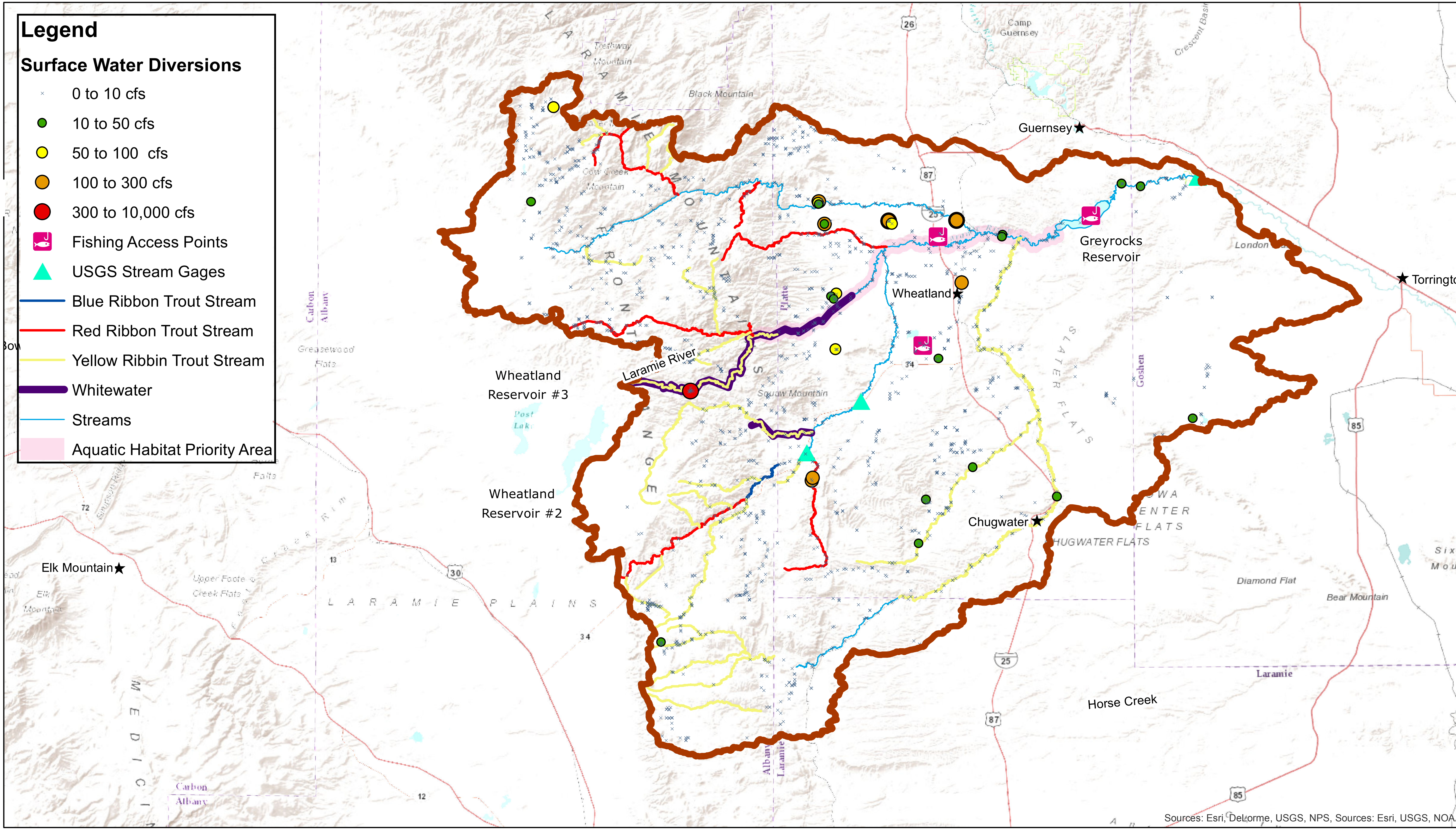


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**Figure 3.5.12 Surface Water Uses - Lower Laramie**

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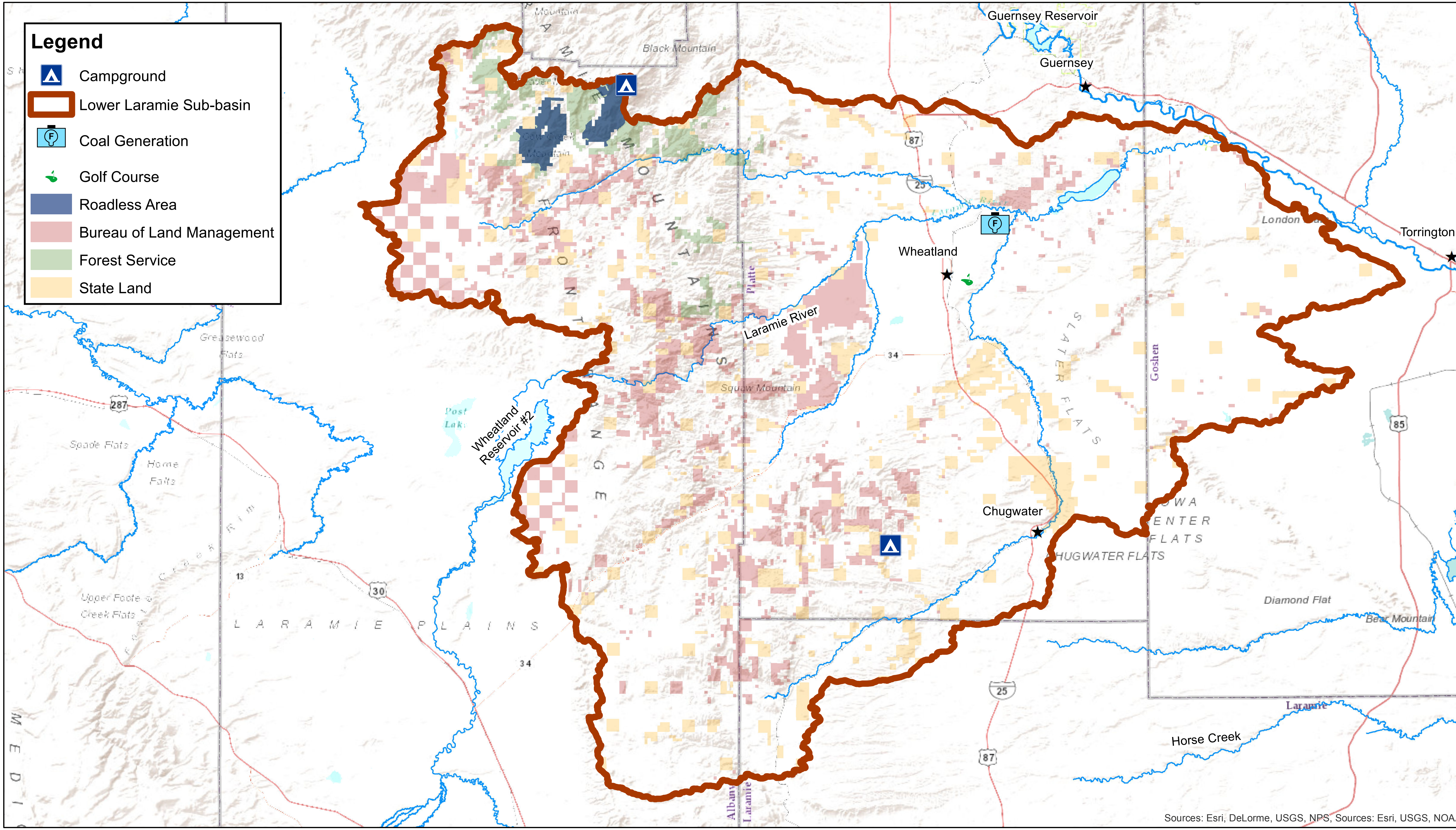


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**Figure 3.5.13 Land Use - Lower Laramie**

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**Notable Environmental Factors**

There are no notable environmental areas within this subbasin.

**Classification of Recreational and Environmental Water Uses in the Horse Creek Subbasin**

As described in Section 3.5.3, an analysis of recreational and environmental water uses was performed utilizing GIS data and maps in order to categorize those uses. **Table 3.5.23** provides a listing or recreational and environmental sites within the subbasin.

**Categorization of Recreational and Environmental Water Uses in Horse Creek Subbasin**

Recreational and environmental water uses within this subbasin are minimal. The fishing location at Hawk Springs Reservoir is considered protected. The yellow ribbon stream segment in the western part of the subbasin is at a high elevation and likely protected by its location. The other two yellow ribbon segments north and south of Horse Creek eventually come together and flow into Hawk Springs Reservoir, which has storage rights. However, those rights are junior to other upstream diverters and these stream segments are over-appropriated. Thus, these segments are classified as competing. The fishing location at Packer Lake near the state line is classified as competing. This lake is rarely accruing water due to low flows and upstream diversions. **Table 3.5.24** provides a summary of the classified uses in the subbasin.

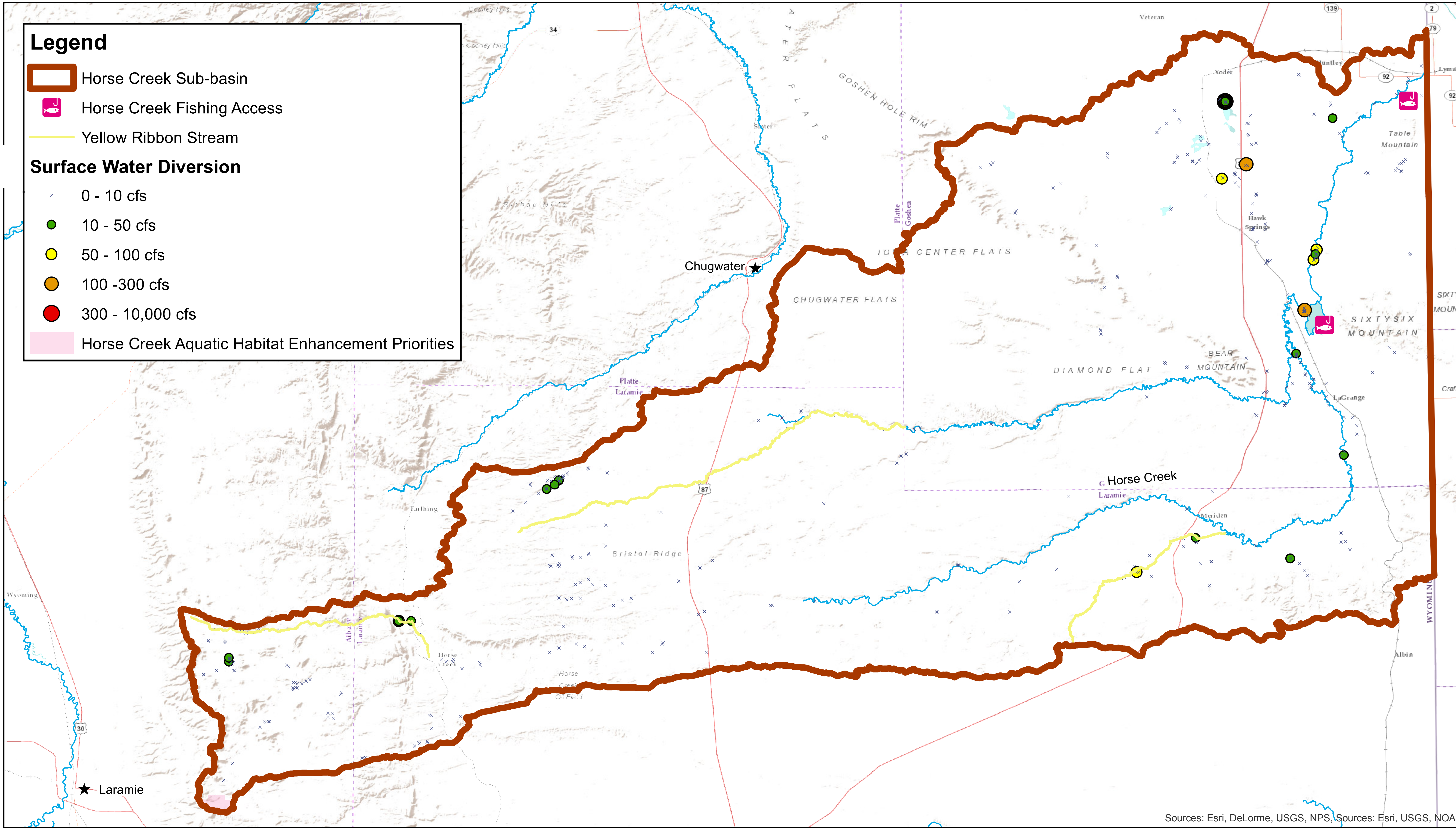
**Table 3.5.23: Recreational and Environmental Water Uses within the Horse Creek Subbasin**

| **Recreation Sites** | |
|---|---|
| Fishing Access | 2 |
| Whitewater Rafting | 1 |
| Trout Streams | |
| *Blue* | 0 |
| *Red* | 0 |
| *Yellow* | 3 |
| Campgrounds | 1 |
| Scenic Highways and Byways | 0 |
| National Historic and Scenic Trails | 0 |
| **Environmental Uses** | |
| Wilderness/Roadless Areas | 0 |
| US Forest Service Lands | 0 |
| Instream Flow Segments | 0 |
| Crucial Stream Corridors | 0 |
| Aquatic Crucial Priority Areas | 0 |
| Wetland Area | Yes |
| Source: GIS sources are provided in 3.5.3. | |

**Table 3.5.24: Categorization of E&R Uses in the Horse Creek Subbasin**

| Status | Location and Uses |
|---|---|
| Protected | Fishing access point at Hawk Springs Reservoir, yellow ribbon segment at high elevations |
| Complementary | NA |
| Competing | Yellow ribbon segments flowing to Hawk Springs Reservoir, fishing access point at Packer Lake |

Maps of these resources are provided in **Figures 3.5.14 and 3.5.15.**



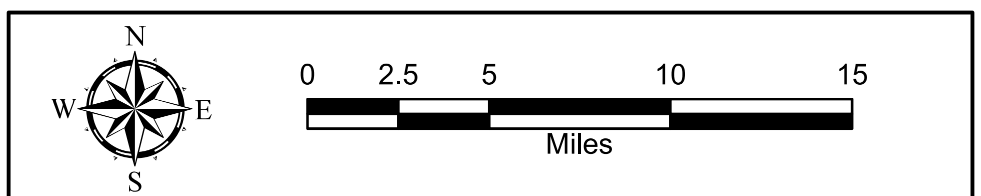




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**Figure 3.5.14 Surface Water Uses - Horse Creek**

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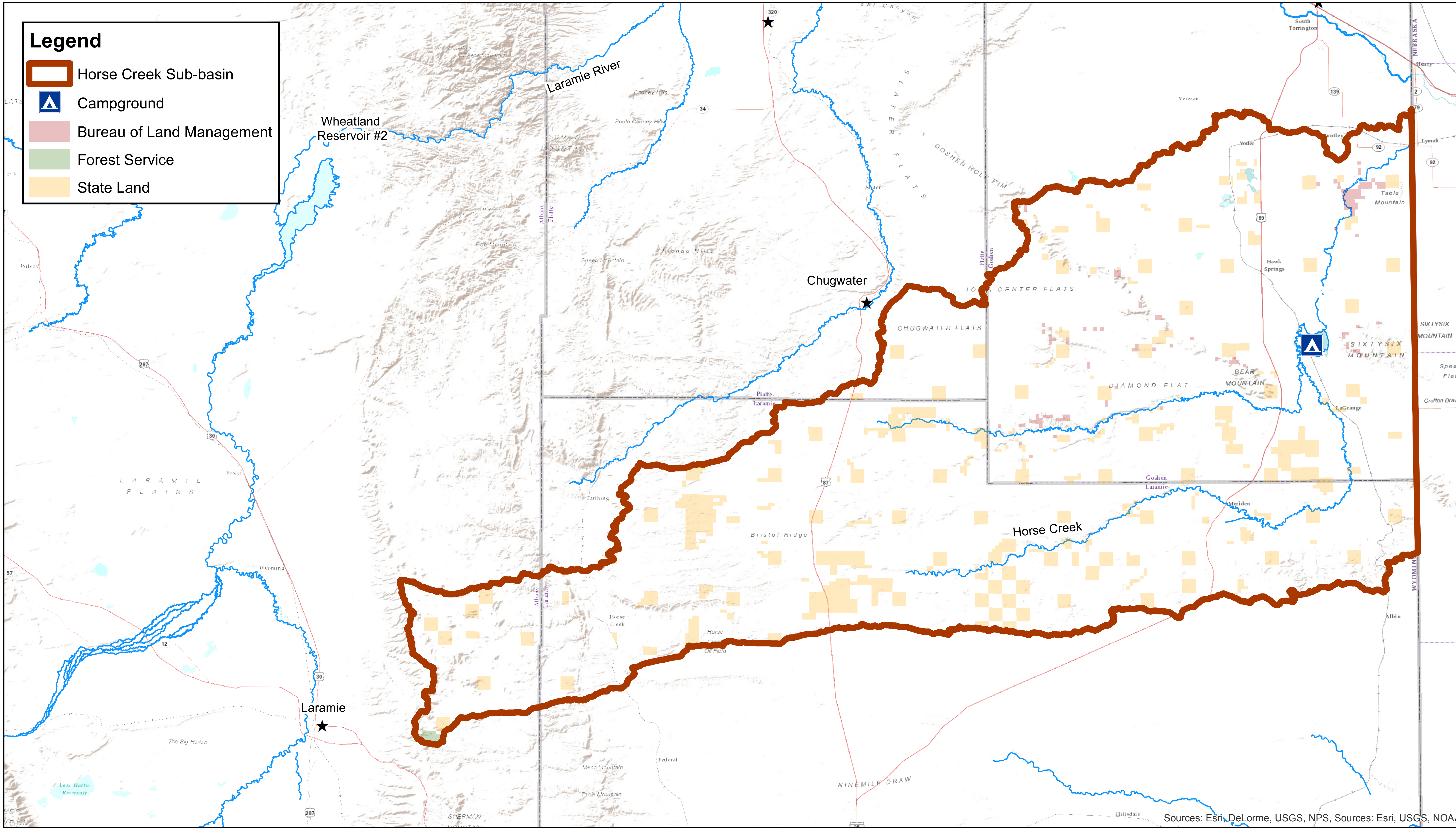


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**Figure 3.5.15 Land Use - Horse Creek**

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### South Platte Subbasin

This subbasin is home to Cheyenne, the state capital and most populous city in Wyoming. The western area of the subbasin provides the most recreational opportunities, with its many streams flowing out of the Medicine Bow National Forest. In general, irrigated agriculture is located in the plains of the eastern part of the subbasin. As of 2012, there were about 43,300 irrigated acres in the subbasin, down over 5% since 2006. The elevation of this subbasin ranges from about 4,500 to 8,000 feet.

#### Major Recreational Opportunities in the South Platte Subbasin

**Curt Gowdy State Park**. Curt Gowdy State Park is located 24 miles west of Cheyenne, 23 miles east of Laramie, and 12 miles north of the Colorado border. The park was established in 1971 through a lease with the City of Cheyenne and the Cheyenne Boy Scouts. The Wyoming State Parks and Cultural Resources Department administers the park. Crystal and Granite Reservoirs are located within the park. Crystal Lake Dam was constructed in 1922 and modified in 1987. The adjudicated water right for Crystal Reservoir is for 4,513 acre-feet. Granite Reservoir was constructed in 1904, and the dam was modified in 1987. The adjudicated water right of Granite Reservoir is 7,367 acre-feet. Motorized boating is allowed on Crystal Reservoir but not on Granite Reservoir. Other water activities are allowed at both reservoirs. The park has over 100 developed campsites available. Hynds Lodge was built in 1922-23 and has since received a listing on the National Register for historical sites. Hynds Lodge is managed by the Wyoming Department of State Parks. State Park visitor data are shown in **Table 3.5.25**.

**Table 3.5.25: State Park Visitor Days, Five Year Average and 2014**

| State Park | Five Year Average (2009-2013) | 2014 |
|---|---|---|
| Curt Gowdy | 116,931 | 149,756 |
| **Total** | | **149,756** |
| Source: Wyoming Division of State Parks, Historic Sites and Trails, Department of State Parks & Cultural Resources, *Visitor Use Program*, *2014*. | | |

**Fishing.** Although there are only three fishing access points in the subbasin, there are a relatively large number of angler days. This is likely due to the proximity of locations to Cheyenne and larger population centers in Colorado. Angler days for the subbasin are shown in **Table 3.5.26**.

**Table 3.5.26: Angler Days for the South Platte Subbasin**

| South Platte Subbasin | Angler Days/Year |
|---|---|
| Crow Creek, North Crow Creek, Granite and Crystal Reservoirs | 34,954 |
| **Total** | **34,954** |
| Source: Mike Snigg, Laramie Regional Fisheries Supervisor, WGFD, January 2015. | |

#### Notable Environmental Factors

**Aquatic Crucial Areas.** There are two crucial aquatic areas in the subbasin. Although there are no explicit legal protections associated with this designation, these areas have been identified as important to habitat. The Pole Mountain Watersheds in the western part of the subbasin are located on Medicine Bow National Forest lands. They received this designation due to the importance of the headwater streams that feed the streams in the Eastern Plains of Wyoming. The primary species within the area are the northern leopard frog, boreal chorus frog, beaver and brook trout. Potential remedial actions include grazing management, aspen restoration, management of beaver population and control of invasive plants (WGF – Pole Mountain, 2014).

In the central and eastern area of the subbasin, the Lower Lodgepole and Muddy Creeks received this designation due to high density of native fishes including, bigmouth shiner, common shiner, Iowa darter, orangethroat darter, plains topminnow and central stoneroller and others. The goal is to seek opportunities for conservation easements and to reduce impediments to habitat (WGF – Lower Lodgepole and Muddy Creeks, 2014).

**Classification of Recreational and Environmental Water Uses in the South Platte Subbasin**

As described in Section 3.5.3, an analysis of recreational and environmental water uses was performed utilizing GIS data and maps in order to categorize those uses. **Table 3.5.27** provides a listing or recreational and environmental sites within the subbasin.

**Categorization of Recreational and Environmental Water Uses in the South Platte Subbasin**

The major recreational activity in this subbasin is fishing. Two of the three fishing access areas are at the Crystal and Granite Reservoirs and as such have adjudicated water rights associated with them and are protected uses. The third location is within the Medicine Bow National Forest which provides a protected status to this location.

**Table 3.5.27: Recreational and Environmental Water Uses within the South Platte Subbasin**

| **Recreation Sites** | |
|---|---|
| Fishing Access | 3 |
| Whitewater Rafting | 1 |
| Trout Streams | |
| *Blue* | 0 |
| *Red* | 2 |
| *Yellow* | Numerous |
| Campgrounds | 10 |
| Natural Landmarks | 1 |
| Scenic Highways and Byways | 0 |
| National Historic and Scenic Trails | 0 |
| **Environmental Uses** | |
| Wilderness/Roadless Areas | 0 |
| US Forest Service Lands | Yes |
| Instream Flow Segments | 0 |
| Crucial Stream Corridors | 0 |
| Aquatic Crucial Priority Areas | 3 |
| Wetland Area | Yes |
| Source: GIS sources are provided in 3.5.3. | |

There are two red ribbon streams in the subbasin, the first is Middle Crow Creek flowing through Curt Gowdy State Park, through the two reservoirs. The 1-mile segment of this stream that is between the two reservoirs should be considered protected due to the water rights associated with Crystal, the downstream reservoir. Downstream of Crystal, this segment becomes a complementary use to the numerous small traditional diversions. Before reaching Cheyenne, the stream becomes a yellow-ribbon stream. This segment is complementary to several large and numerous small downstream diversions. A second red ribbon stream, in the southern part of the subbasin, is complementary to many small diversions and one very large downstream diversion and is categorized as complementary.

There are numerous yellow ribbon streams in the Medicine Bow National Forest whose location, both in the national forest and at high elevations, makes future disturbance of these uses unlikely and they should be considered protected. All other yellow ribbon segments in the subbasin lack sufficient protection from traditional uses and should be considered competing.

There is one whitewater rafting segment on Middle Crow Creek, the red ribbon stream between Granite and Crystal Reservoirs. This 1 mile stretch is complementary to the two reservoirs which store water for Cheyenne, and thus provide protection to the stream.

**Table 3.5.28** provides a summary of the classified uses in the subbasin.

**Table 3.5.28: Categorization of E&R Uses in the South Platte Subbasin**

| Status | Location and Uses |
|---|---|
| Protected | Fishing access points, red ribbon and whitewater segment upstream of Crystal Reservoir, yellow ribbon streams in Medicine Bow National Forest |
| Complementary | Red and yellow ribbon segment downstream of Crystal Reservoir, red ribbon segment southwest of Cheyenne |
| Competing | Yellow ribbon segments southeast of Cheyenne |

Maps of these resources are provided **Figure 3.5.16 and Figure 3.5.17**.

**Other Topics Related to E&R Water Use**

**Endangered Species.** The presence of endangered species in the Basin is related to environmental water usE&Recreational activity, but it cannot be analyzed in the same fashion as utilized in subbasin analyses above. In addition, the data are only available at the county level. Therefore, **Table 3.5.29** provides threatened and endangered species by county, but the data are not included in the maps.

**Table 3.5.29: Endangered, Threatened, CandidatE&Recovering Species in the Platte Basin, by County**

| | County | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Species | Albany | Carbon | Converse | Fremont | Goshen | Laramie | Natrona | Niobrara | Platte |
| **Endangered** | | | | | | | | | |
| Wyoming toad | √ | | | | | | | | |
| Blowout penstemon | | √ | | | √ | | | | |
| Black-footed ferret | √ | √ | | √ | | | √ | | |
| **Threatened** | | | | | | | | | |
| Yellow-billed cuckoo | | √ | | √ | | | | | |
| Colorado butterfly plant | | | | | √ | √ | | | √ |
| Desert yellowhead | | | | √ | | | | | |
| Ute ladies'-treses | √ | √ | √ | √ | √ | √ | √ | √ | √ |
| Grizzly bear | | | | √ | | | | | |
| Canada lynx | √ | √ | | √ | | | | | |
| Preble's meadow jumping mouse | √ | | √ | | √ | √ | | | √ |
| **Candidate** | | | | | | | | | |
| Greater sage-grouse | √ | √ | √ | √ | | √ | √ | √ | √ |
| Whitebark pine | | | | √ | | | | | |
| Fremont County rockcress | | | | √ | | | | | |
| **Recovery** | | | | | | | | | |
| Bald eagle | √ | √ | √ | √ | √ | √ | √ | √ | √ |
| Gray wolf | √ | √ | √ | √ | √ | √ | √ | √ | √ |
| Source: USFS, http://www.ws.gov/endangered/ | | | | | | | | | |

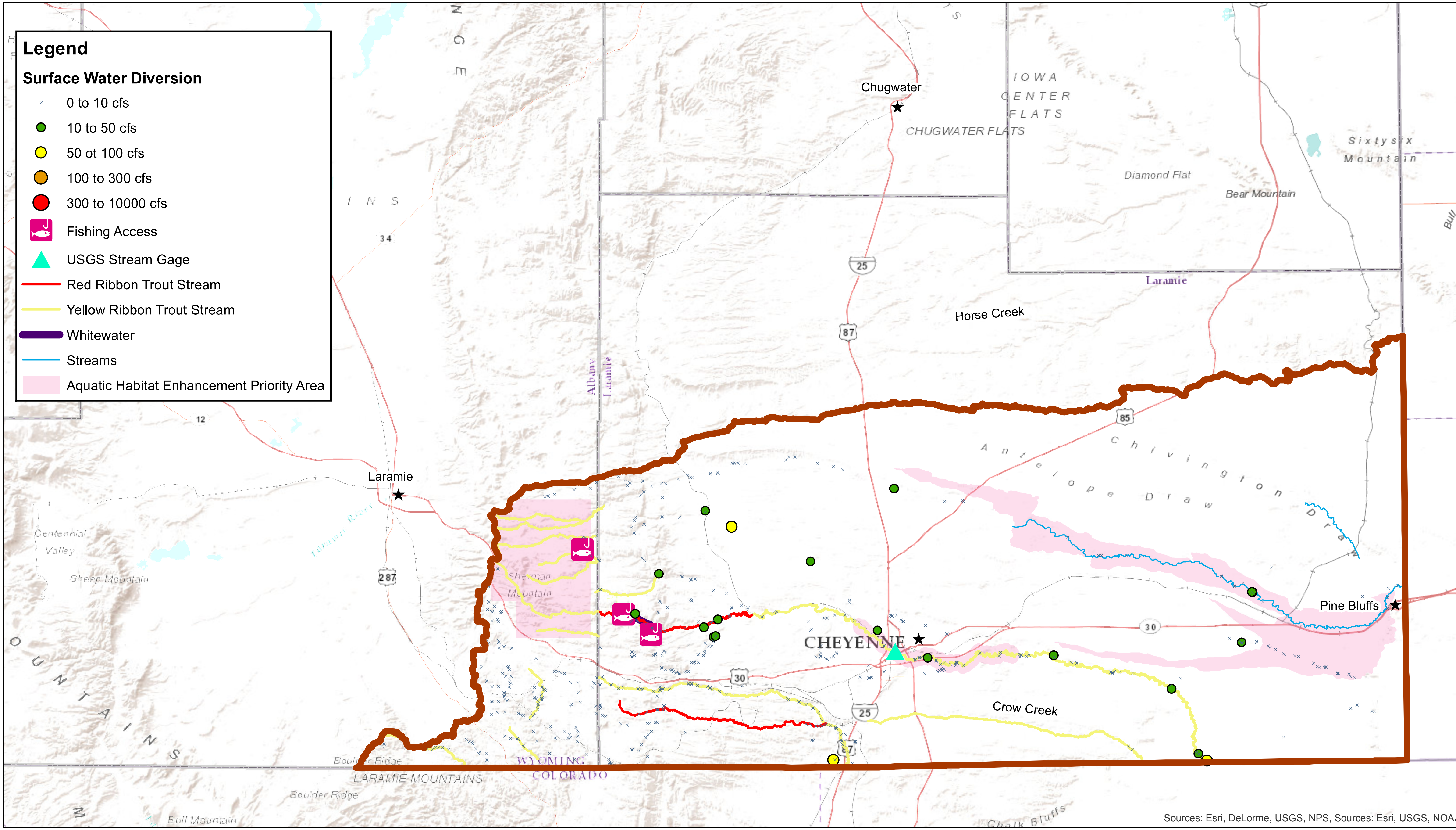


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**Figure 3.5.16 Surface Water Uses - South Platte**

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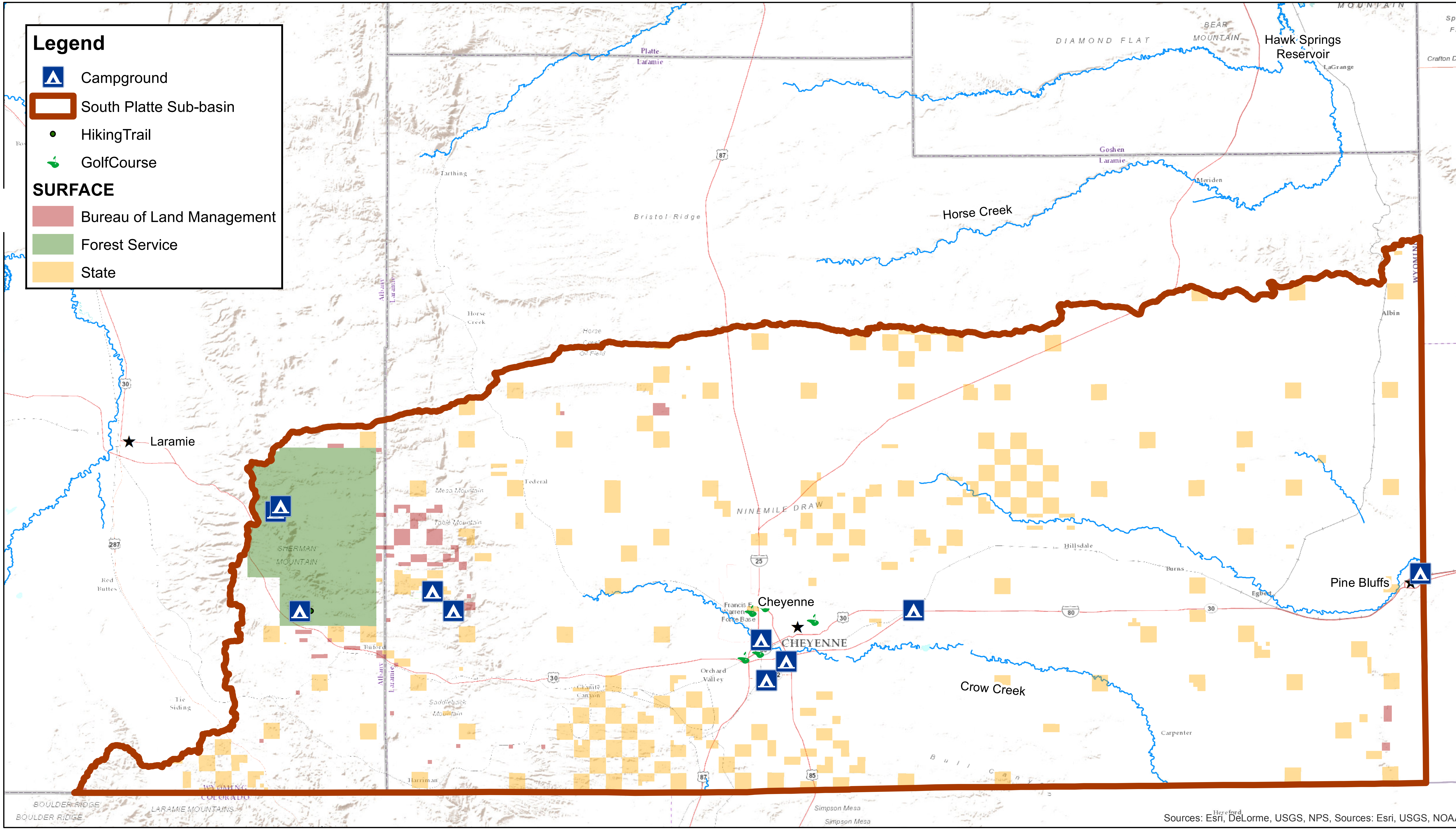


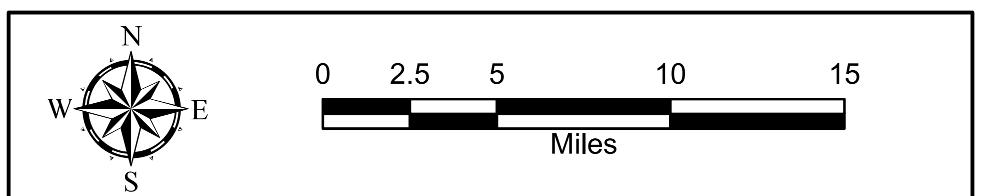


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**Figure 3.5.17 Land Use - South Platte**

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**Instream Flows.** Instream flows represent a permitted and thus protected water environmental water use. There are 13 instream flow segments in the Basin that have been permitted by the Wyoming State Engineer's Office totaling almost 90 miles. All have been permitted since 2007 and there are no current applications for new permits. Each of the permitted stream segments has been displayed on the appropriate subbasin water use map. SEO instream flow permits are shown in **Table 3.5.30**.

**Table 3.5.30: SEO Permitted Instream Flows within the Platte Basin**

| Permit No. | Stream Segment | Priority Date | Stream Length (mi) | CFS (min-max) | Water Division/District |
|---|---|---|---|---|---|
| 88 IF | S Fork Grand Encampment River | 10/08/93 | 13.60 | 54 | 1/7 |
| P29608D | Carlin Springs | 03/11/91 | 0.25 | 1.31 | 1/9 |
| 84 IF | Wagonhound Creek | 03/11/91 | 8.50 | 1.2-545 | 1/9 |
| 103 IF | Rock Creek IF | 03/11/91 | 3.9 | 13-60 | 1/9 |
| 87 IF | Sweetwater River | 06/21/91 | 10.20 | 16-80 | 1/12 |
| 86 IF | Deer Creek | 06/21/91 | 5.00 | 10-30 | 1/15-5 |
| 66 IF | North Platte River | 06/21/91 | 16.00 | 163* | 1/17 |
| 67 IF | Lake Creek | 06/21/91 | 5.80 | 0.5 | 1/17 |
| 61 IF | Horse Creek | 06/21/91 | 0.10 | 0.2 | 1/17 |
| 62 IF | Nugget Gulch Branch | 06/21/91 | 0.10 | 0.2* | 1/17 |
| 63 IF | Beaver Creek | 12/31/91 | 1.90 | 0.35* | 1/17 |
| 64 IF | Camp Creek | 01/05/93 | 1.20 | 0.2* | 1/17 |
| 65 IF | Douglas Creek | 01/21/93 | 22.30 | 5.5 | 1/17 |
| Source: Wyoming State Engineer's Office, 2015 | | | | | |

USFS Lands also have stream segments for which minimum and peak flows have been established. Many of these are important to both recreational and environmental activities. Additional information regarding Priority Watersheds and Streams in the Medicine Bow National Forest can be found in Appendix One of the Revised Land and Resource Management Plan. **Table 3.5.31** provides flow data for the USFS bypass flow points in the Basin.

**Table 3.5.31: USFS Permitted Bypass Flow Points in the Platte Basin**

| Stream | Minimum Flow (cfs) | Peak Flows (cfs) | Bypass Point |
|---|---|---|---|
| **Above Pathfinder Subbasin** | | | |
| Nugget Gulch Creek | 020 | 3-5 days natural peak discharge | T14N R79W Sec 14 |
| Little Beaver Creek | 0.35 | 7 | T14N R79W Sec 14 |
| Camp Creek | 0.20 | 2 | T14N R79W Sec 13 |
| Horse Creek | 0.20 | NA | T14N R79W Sec 16 |
| Douglas Creek | 5.50 | 130 | T14N R79W Sec 9 |
| Hog Park Creek | 15.00 | 5 days natural peak discharge | T12N R84W Sec 5 |
| Deep Creek, below Sand Lake | 0.80 | NA | T17N R79W Sec 9 |
| **South Platte Subbasin** | | | |
| Bamford Creek/South Fork of Middle Crow Creek | NA | 1.5 (maximum release permitted) | T14N R71W Sec 27 |
| Source: Mr. David Gloss, Hydrologist, Medicine Bow/Routt National Forests, Saratoga, WY, October 2015. | | | |

**Waterfowl Hunting.** Waterfowl hunting is an important recreational activity in the Platte Basin that is dependent on available water supplies. Wetland areas, lakes, streams and other water bodies provide the necessary habitat to support waterfowl, but the benefits of water to hunting are ancillary and cannot be accounted in this analysis. Despite this, it is important to recognize that changes to water availability would have an impact on hunting, which is an important economic contributor, especially on the eastern plains. Waterfowl management areas 1C, 2A, 2B, 3A and 4D are within the Platte Basin. **Table 3.5.32** provides data on hunters, harvest and hunter days for waterfowl hunting.

**Table 3.5.32: 2013 Duck and Geese Harvest Estimates for the Platte Basin**

| Management Area | Hunters | | Harvest | | Days | |
|---|---|---|---|---|---|---|
| | **Ducks** | **Geese** | **Ducks** | **Geese** | **Ducks** | **Geese** |
| 1C Central North Platte River | 939 | 566 | 8,765 | 2,071 | 4,742 | 2,747 |
| 2A Lower Platte River | 1,222 | 1,947 | 6,438 | 15,862 | 4,768 | 9,860 |
| 2B South Platte River | 78 | 47 | 348 | 168 | 180 | 101 |
| 3A Upper North Platte River | 401 | 154 | 2,536 | 377 | 1,901 | 945 |
| 4D Sweetwater River | 7 | 2 | 17 | 11 | 9 | 4 |
| **Total Platte Basin** | **2,647** | **2,716** | **18,104** | **18,489** | **11,600** | **13,657** |
| **Total Wyoming** | **6,483** | **5,744** | **53,296** | **30,861** | **30,386** | **26,125** |
| Percent in Basin | 41 | 47 | 34 | 60 | 38 | 52 |
| Source: WGFD. Annual Report of Small Game, Upland Game, Waterfowl, Furbearer, Wild Turkey & Falconry Harvey, 2013, July 2014. | | | | | | |

As **Table 3.5.32** demonstrates, a large percentage of all Wyoming waterfowl hunting occurs in the Platte Basin, especially in the Lower Platte River Management Area, which encompasses Platte and Goshen Counties and small parts of the surrounding counties.

**Wetlands.** The State of Wyoming has identified 49 major wetland complexes in the Wyoming Wetlands Conservation Strategy (WGF, 2010). For this work, the definition adopted by the USFWS was utilized:

> *"Wetlands are lands transitional between terrestrial and aquatic systems where the water table is usually at or near the surface or the land is covered by shallow water. For purposes of this classification wetlands must have one or more of the following three attributes: (1) at least periodically, the land supports predominantly hydrophytes; (2) the substrate is predominantly undrained hydric soil; and (3) the substrate is non-soil and is saturated with water or covered by shallow water at some time during the growing season each year"* (Cowardin, 1979).

Wetlands provide wildlife habitat and the associated riparian areas provide other benefits such as flood attenuation, aquifer recharge and discharge, sediment filtering, contaminant removal, erosion control, and biomass export. Grazing, stream regulation and other human actions can cause harm to wetlands and riparian areas. As shown in **Figure 3.5.17**, there are many wetland areas in the Basin. Some of these may be temporary in nature, as a result of flood irrigation or other seasonal influences. Major wetland complexes within the Platte Basin are discussed in the appropriate subbasin sections. A map of wetlands within the Basin is presented in **Figure 3.5.17**. A map of irrigated acres within the Basin is provided in **Figure 3.5.18**.

### 3.5.6 Summary and Conclusions

This examination of E&R uses in the Platte Basin has resulted in the identification of each E&R use by respective subbasin, along with the categorization of those uses into protected, complementary, and competing categories. There are numerous and excellent water-based recreational opportunities in most subbasins, primarily flat water or stream fishing. There

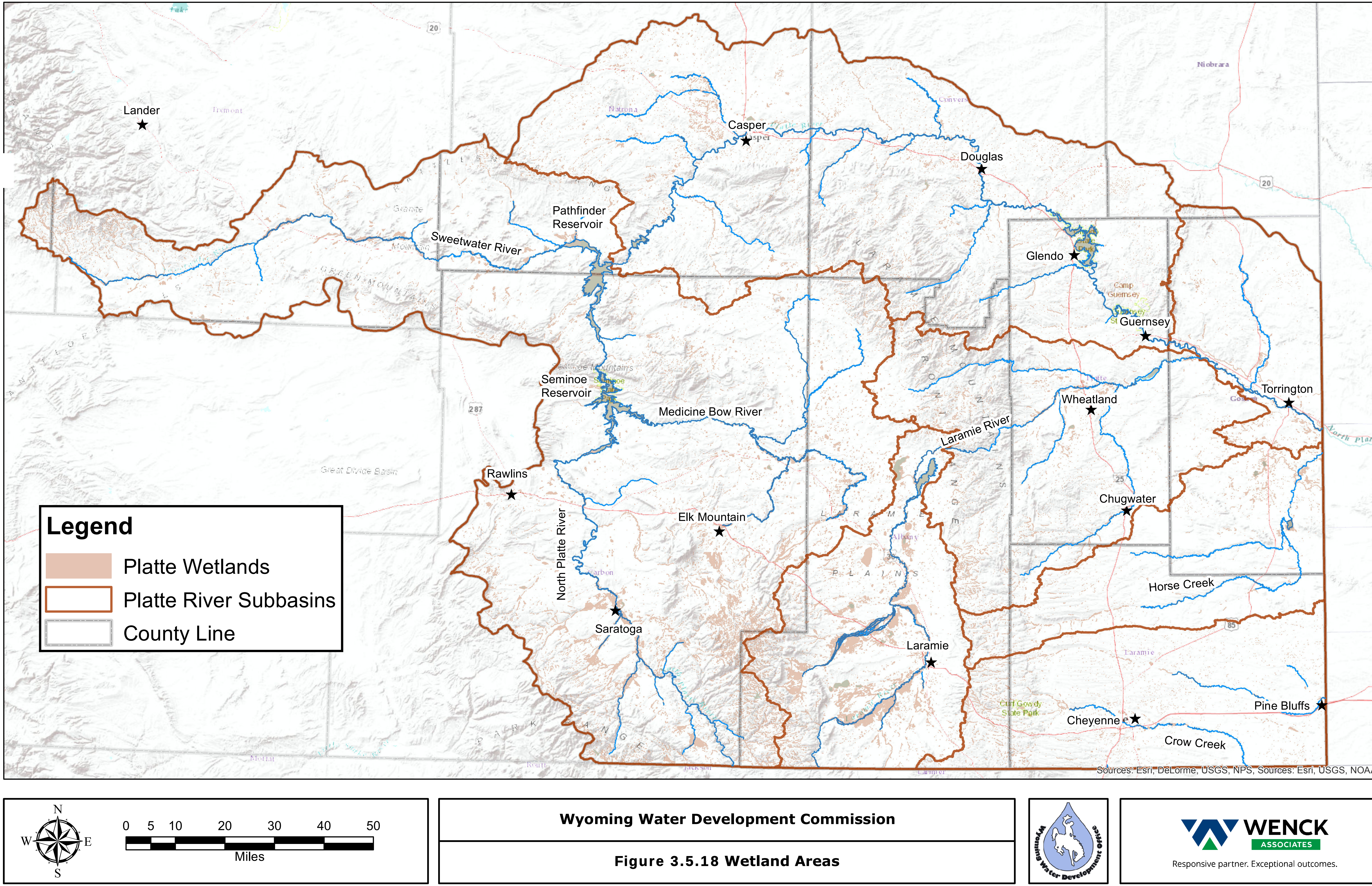


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Figure 3.5.18 Wetland Areas

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are also extensive environmental water uses, including wetland areas, crucial habitat areas and in-stream flows. Overall, almost all of the E&R uses in the Basin have been determined to be protected or complementary. Of those that are competing, most are likely already unavailable in many years due to over-appropriation of Basin water resources.

The maps and analysis provided in this section demonstrate the relative importance of E&R water use in each of the subbasins. There is a large variation in activity levels, which is generally determined by the natural landscape. Land use, especially Federal ownership, is a dominant factor in a number of subbasins. Topography related to high elevation also provides protection to some E & R uses. The interdependence between traditional consumptive water uses, such as irrigated agriculture, and E&R uses has also been demonstrated.

Unfortunately, we were unable to quantify the water amount which would fall into the three categories because of a lack of stream gauge or similar data on the tributaries in the subbasins. We do not know the water volumes associated with traditional uses or how they have changed since the original Platte Basin Plan. Ideally, in this part of the analysis, the mapping of E&R water use would be translated into a number, expressed in acre-feet, which would demonstrate how much of the Basin's water resources contribute to these important sectors. After that determination, the acre-feet that were attributed to competing uses would be subtracted from the total to establish current E&R water demand as prescribed in the Handbook methodology. Unfortunately, flow data for the Basin is very incomplete and thus such a calculation has not been possible.

The WWDC might consider future funding to gather these data. More geographically comprehensive flow data and changes in that data over time could represent a material improvement to water planning in Wyoming.

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## 3.6 WATER USE FROM STORAGE

### 3.6.1 Introduction

The objective of this section is to evaluate potential storage possibilities in irrigation reservoirs located in the Basin above Pathfinder Reservoir exclusive of Kendrick Project and Seminoe Reservoir. The previous Platte River Basin Plan (2006) identified and presented water right permit, physical and operational data on non-stock reservoirs greater than 50 acre-feet located within the entire basin. This plan presents any updated information on these reservoirs and includes information on any new reservoirs permitted or constructed since the original plan.

This planning effort reviews both non-structural and structural alternatives for optimizing the use of water supplies within the State of Wyoming. A non-structural alternative approach may be a more achievable undertaking because it involves optimizing the operation of the existing reservoirs and no new construction. Because private parties or irrigation districts own the irrigation reservoirs, any of the non-structural alternatives would require future coordination and monitoring efforts with the respective reservoir owners. A state agency or other state designated entity would need to be responsible for implementing one or more of the non-structural alternatives. A structural alternative to modify an existing reservoir or to build a new reservoir would be faced with environmental permitting and sponsorship funding requirements.

### 3.6.2 Overview

In accordance with an interstate decree settled in 1945, Wyoming is only able to accrue up to 18,000 acre-feet of water from the North Platte River and its tributaries above the Pathfinder Reservoir for irrigation purposes during any one year. Since the settlement of the decree, Wyoming has been required to track and report the storage accrual amounts on an annual basis. For this study, Wyoming's reported carryover, maximum storage, and accrual data from 1951 to the present was analyzed. An analysis of the maximum storage and accrual data collected since 2003 for the 11 largest irrigation reservoirs was conducted.

Based on recent Wyoming reports there are approximately 55 smaller active irrigation reservoirs with 8 in the Sweetwater drainage, 16 in the Medicine Bow drainage, and 31 within tributaries of the North Platte River in the Saratoga area. The largest reservoirs had water measurement devices installed in the last 10 years. Therefore, accurate continuous records are being collected. The combined total storage capacity of the largest reservoirs is equal to 15,930 acre-feet which represents over 55% of the estimated storage capacity of all the private irrigation reservoirs located above Pathfinder Reservoir. Since 1951 the average annual accrual amount for all these reservoirs is 12,038 acre-feet and the average carryover is 5,380 acre-feet. The average accrual amount for the 11 largest reservoirs since 2003 is 8,015 acre-feet and the average carryover is 4,167. A number of irrigation reservoirs located above Pathfinder Reservoir are inactive.

Any trends in storage accruals and carryover were evaluated. The analysis revealed reservoir owners' operational decisions to conserve water during a drought period or to maintain a minimum pool serving recreational or fishery needs are factors affecting carryover quantities.

The structural and non-structural recommendations presented in this document are based on the water storage analysis performed on the reservoirs. One non-structural recommendation is to facilitate the coordination of storage accruals amongst the reservoir owners. Coordination with reservoir owners on an annual basis would allow Wyoming to maximize storage accruals occurring in Wyoming in any one year. Another non-structural recommendation is to re-describe the reservoir water rights for the actual water right purpose that is occurring on-the-ground. The beneficial use of meeting fishery or recreational needs could be formally designated for that purpose within the reservoir storage water right. A structural alternative is to construct a new reservoir or the enlargement of an existing irrigation reservoir in the Basin Above Pathfinder Reservoir.

The implementation of one or more of the non-structural alternatives and the structural alternative provides feasible opportunities for Wyoming to maximize its annual accrual quantities for irrigation purposes on an annual basis.

### 3.6.3 Background

The focus of this section is irrigation reservoirs that fall under compliance activities of the Modified North Platte Decree. The U.S. Supreme Court handed down a 1945 Decree to Wyoming and Nebraska that contained the provision that the State of Wyoming was enjoined from storing[2] more than 18,000 acre-feet of water from the North Platte River and its tributaries above the Pathfinder Reservoir for irrigation purposes during any one year. In 1986 Nebraska filed a lawsuit in U.S. Supreme Court alleging that Wyoming had violated certain aspects of the 1945 decree. One of Nebraska's claims questioned the accuracy of the procedures Wyoming followed to collect and report water stored above Pathfinder for irrigation purposes. The U.S. Supreme Court approved the Final Settlement Stipulation and entered the Modified Decree on November 13, 2001. The storage accrual cap of 18,000 acre-feet in any one year remained unchanged in the Modified Decree.

The headwaters of the North Platte River above Pathfinder Reservoir are in north-central Colorado and south-central Wyoming and the headwaters of the Sweetwater River are in the southern tip of the Wind River Mountains. Various tributaries flow into the North Platte River fed by snowmelt and springs flowing from the two primary mountain ranges. The Snowy Range and Sierra Madre Mountains are the two ranges which receive the most snow in the watershed. The Encampment River, Medicine Bow River, and Sweetwater River are the largest tributary water sources.

The overall climate varies significantly within this region of Wyoming varying from arid to semi-arid primarily affected by changes in elevation. All of the reservoirs affected by the Decree requirement are depicted in **Figure 3.6.1.** The reported annual precipitation at Saratoga which lies within the Decree compliance area is 9.8 inches. Precipitation mainly occurs in the form of snow and rain. On average the wettest months are April and May. The majority of the precipitation occurs between April and October.

The annual precipitation in the form of rain and snow in each subbasin affects carryover and accrual within the reservoirs. The irrigated lands and reservoirs in the above Pathfinder Reservoir basin vary in elevation from about 5,800 to 8,500 feet msl. The primary crop is native hay and most ranchers only perform one harvest cutting per year. Portions of the irrigated lands are not cultivated and only serve as pasture for livestock. Most ranchers rely on flood irrigation practices although some center pivots and siderolls are present within the Saratoga area. The overall runoff and active irrigation can be relatively short for the tributary areas due to the short period of high runoff which primarily occurs in the spring and early summer months. The storage water held in the reservoirs provides for mid to late season irrigation supplies; thereby, extending the irrigation seasons for irrigated lands.

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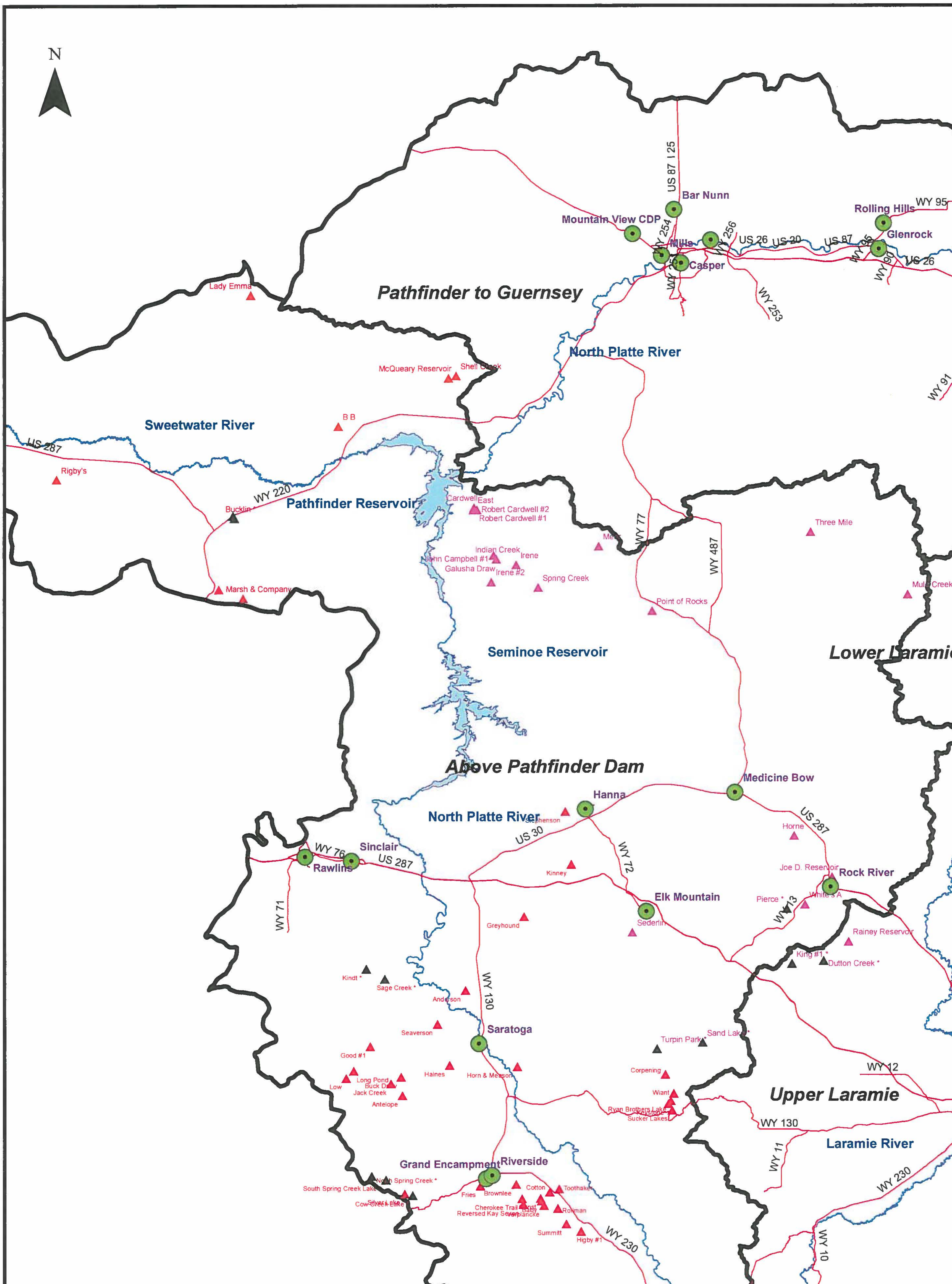
[2] The 1945 Decree reference to "storing" is actually referring to the amount of accrual in storage that is allowed in the above Pathfinder Reservoir basin each Water Year.




## Legend

- Municipality

**Reservoirs**

- Largest 11 Reservoirs
- Basin Boundaries
- WyDOT_Highways

**Figure 3.6.1 Irrigation Reservoirs above Pathfinder Reservoir**

Platte River Basin Plan Update Level 1 Study
Irrigation Reservoirs above Pathfinder Reservoir
Feb. 2016

0 5 10 20 30 40 Miles

HDR Engineering
1720 Carey Avenue Suite 612
Cheyenne, Wyoming
307.778.9500

Surface water supplies in the North Platte River basin are considered to be fully appropriated. Any new water supplies for a new large water need are typically only available through the transfer of existing water rights, transbasin diversion, or the development of non-hydrologically connected groundwater.

The primary purpose of four federal reservoirs in the Basin is to provide agricultural water supplies to various Federal projects. Pathfinder and Guernsey Reservoirs serve the North Platte Project which was authorized by Congress in 1903. Seminoe and Alcoa Reservoirs which were completed in 1939 serve the Kendrick Project. The Glendo Unit, which includes Glendo Reservoir, is considered a multiple-purpose natural resource development that provides for up to 40,000 acre-feet of irrigation water annually to irrigation lands in Wyoming and Nebraska. The federal reservoir system is allowed flexible operations in accordance with the Modified Decree and Wyoming Water Laws. The filling and re-regulation operations allow for exchanges of ownership between the various federal reservoirs to provide for maximum capacity and to enhance operations.

The overall population is small and most of the human activities are related to hay production, ranching and livestock grazing as well as recreation. A significant amount of public lands is present in the drainage with the majority of federal lands owned by either the BLM or the USFS. The remaining lands are private and State owned lands. The private ranchers hold allotments on BLM lands and leases on State Lands for livestock grazing purposes. The BLM and others have sought to improve the management of livestock and address various environmental issues such as riparian conditions, erosion problems, wildlife/fisheries habitat, and noxious weeds. The management practices include changes to the season, duration or type of livestock use as well as herding, fencing, water development, and vegetation treatments (BLM 2005).

### 3.6.4 Irrigation Water Storage above Pathfinder Reservoir

For the overall compliance activities, Wyoming, through the SEO, is tracking and reporting storage accruals on an annual basis for 69 active reservoirs listed in **Appendix 3-C,** Table 1 and illustrated in **Figure 3.6.2**. The tracking and reporting of storage is contained within three different subbasins. Within the SEO reporting, the subbasins are referred to as Saratoga, Medicine Bow River, and Sweetwater River and illustrated within each respective subbasin in **Figures 3.6.2, 3.6.3, and 3.6.4**. The total storage accrual data is available from 1951 to the present and is contained within **Appendix 3-C,** Table 3.

In accordance with the Modified Decree requirements, Wyoming has installed measuring devices at 11 of the largest irrigation reservoirs to improve the accuracy of measuring the annual accruals in each reservoir. The Wenck Team reviewed Wyoming's water storage reporting for Decree compliance with particular emphasis on reporting since 2003 for the largest reservoirs that had new measuring equipment installed. The largest storage facilities represent the primary opportunities for maximizing the annual storage quantities.

#### Wyoming's Field Checking and Reporting

SEO field staff typically visit each reservoir two times each year. The reservoirs are field checked in late spring or early summer when storage levels are the highest and during the fall following the irrigation season when water levels are at the lowest. The fall visit occurs as close to the first of October as possible. The fall water level measurement is considered the carry-over quantity in the reservoir at the beginning of the water year. Many of the irrigation reservoirs were permitted and built within the Decree compliance area prior to the mid 1950's. The field staff refers to various maps and capacity tables to convert the water level measurements to a reservoir capacity. For the many small reservoirs, SEO field staff refers to maps and capacity tables prepared in the 1950's by J.A. Cole, Special Assistant

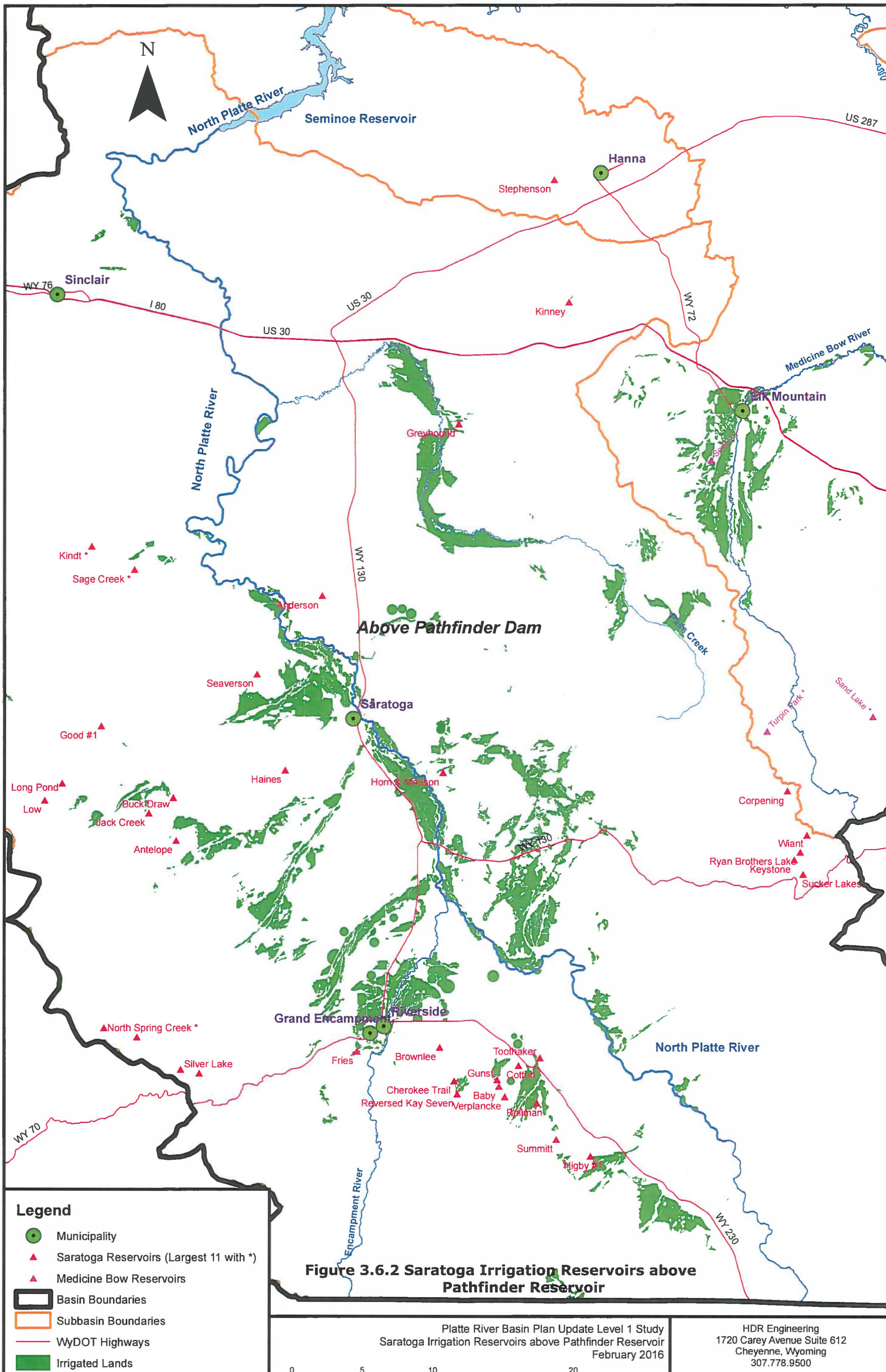



**Figure 3.6.2 Saratoga Irrigation Reservoirs above Pathfinder Reservoir**

Platte River Basin Plan Update Level 1 Study
Saratoga Irrigation Reservoirs above Pathfinder Reservoir
February 2016

HDR Engineering
1720 Carey Avenue Suite 612
Cheyenne, Wyoming
307.778.9500

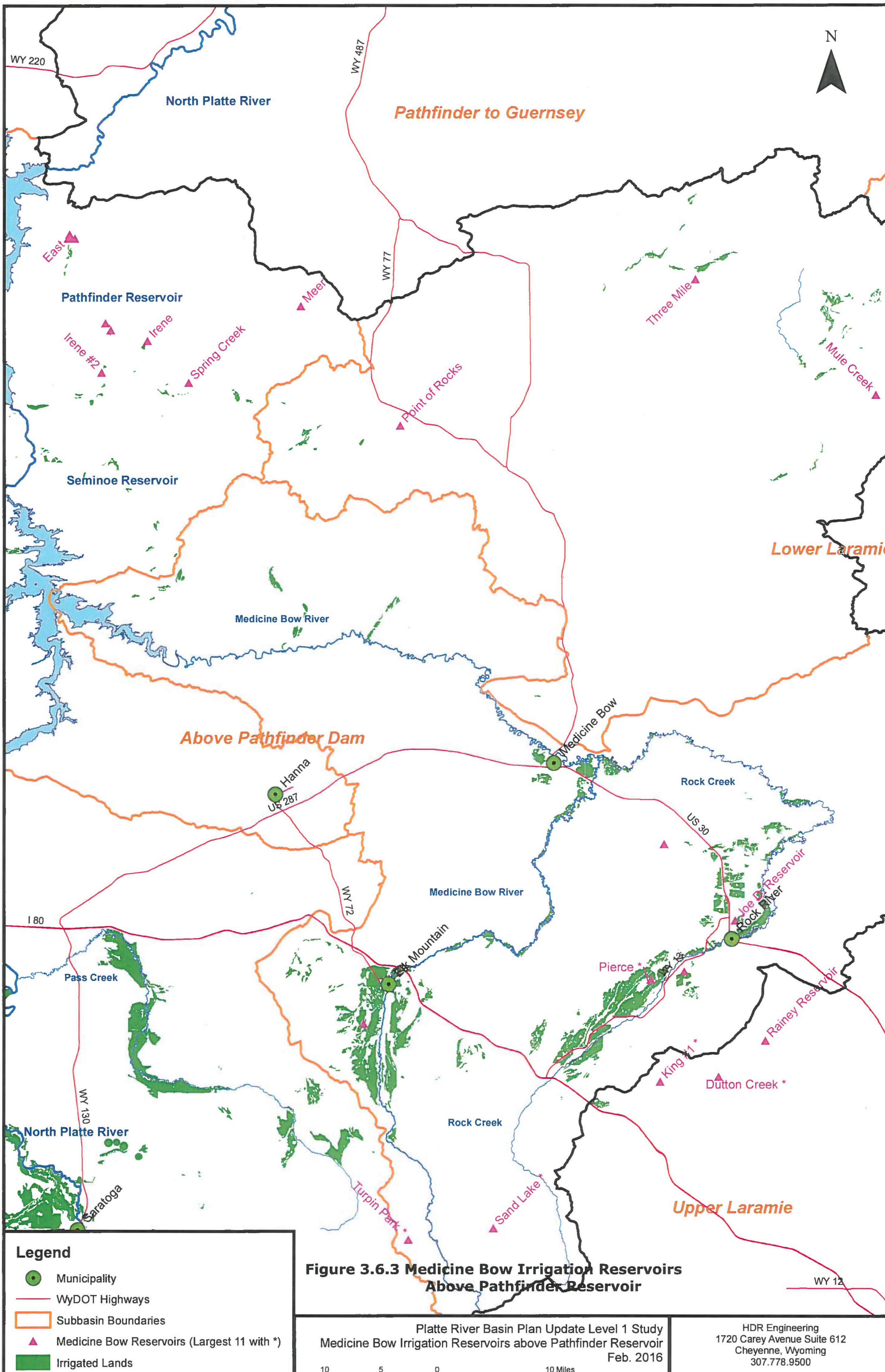



**Figure 3.6.3 Medicine Bow Irrigation Reservoirs Above Pathfinder Reservoir**

Platte River Basin Plan Update Level 1 Study
Medicine Bow Irrigation Reservoirs above Pathfinder Reservoir
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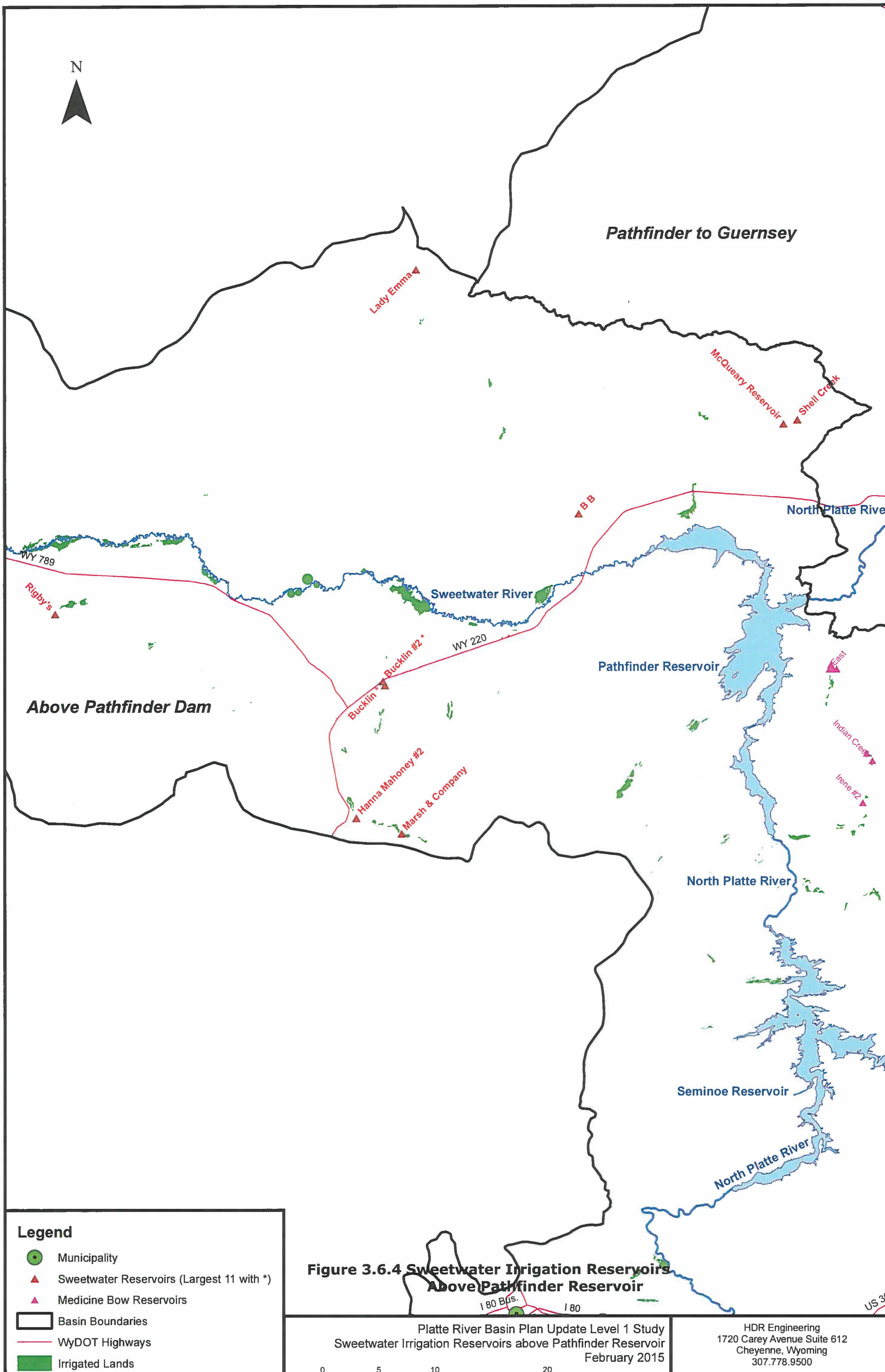


**Figure 3.6.4 Sweetwater Irrigation Reservoirs Above Pathfinder Reservoir**

Platte River Basin Plan Update Level 1 Study
Sweetwater Irrigation Reservoirs above Pathfinder Reservoir
February 2015

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307.778.9500

State Engineer. Over 90% of the existing reservoirs were physically surveyed at that time. Following the issuance of the Modified Decree in 2001, the 11 largest reservoirs were re-surveyed and new capacities tables were developed.

State West Water Resources, subsequently acquired by Wenck Associates, Inc., oversaw and completed the survey and capacity table calculations as well as completing the design and contractor administration for the installation of measuring devices. The State of Wyoming through the SEO financed the project and completed the coordination between the reservoir owners, engineering firm, and contractor. SEO field personnel rely on the new capacity tables for the largest reservoirs and the measuring devices collect and record data on a frequent basis, typically every 15 minutes. The reservoir water level elevations are measured continuously on a year-round basis. The reservoir water level data for the largest reservoirs is telemetered via the GOES system and served to the public on nearly a real-time basis with the AQUARIUS WebPortal hosted on SEO's website.

**Overall Reporting Versus Compliance**

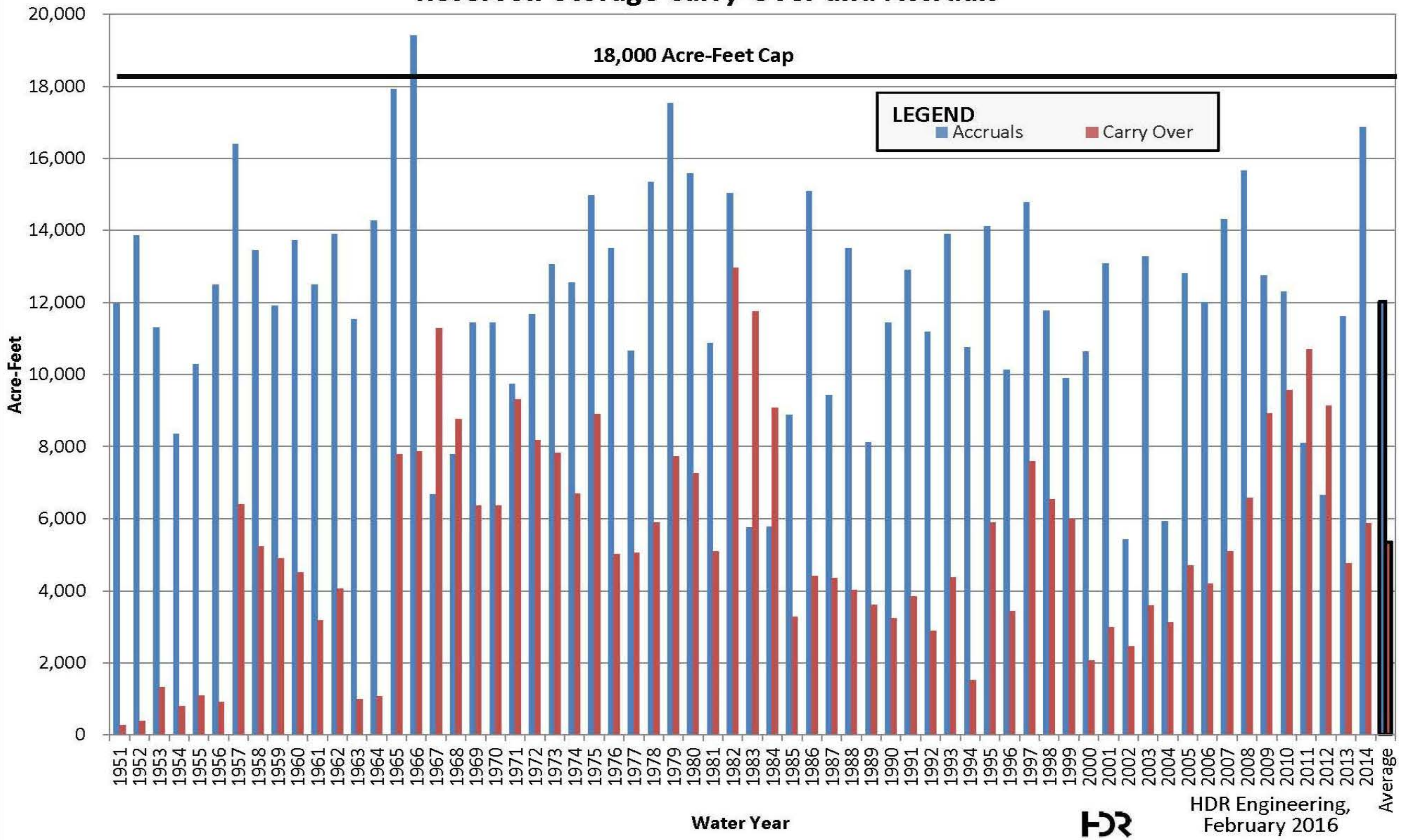
The SEO prepares a report at the end of each water year that contains the water storage accrual amounts. Presently the reports are submitted by the Wyoming State Engineer to the North Platte Decree Committee (NPDC) prior to the end of February each year. The NPDC was established by the States of Nebraska, Wyoming, and Colorado, and the United States of America through the USBR to assist in monitoring, administering, and implementing the Modified North Platte Decree and the Final Settlement Stipulation dated March 31, 2001.

The annual carryover quantities and accrual amounts for each water year are provided in **Appendix 3-C,** Table 3 and are illustrated in **Figure 3.6.5** beginning with 1951. These amounts are the sums from the individual irrigation reservoirs that are tracked and reported by SEO field personnel. Based on all available data, Wyoming has never accrued more than 18,000 acre-feet. The State Engineer's reports in 1965, 1966, and 1967 mistakenly included the storage of Seminoe Reservoir within the total reported accrual quantity. The actual quantity reported in water year 1966 should have been 10,136 acre-feet, not the 19,435 acre-feet that was reported, so the accrual total was less than the compliance cap. The actual maximum accrual quantity as reported by the SEO is 17,552 acre-feet which occurred in 1979. Recently in water year 2014, the total combined accrual quantity reported was 16,875 acre-feet.

The average annual accrual amount since 1951 is 12,038 acre-feet. To maximize water storage for irrigation purposes for above Pathfinder Reservoir in Wyoming, the estimated additional storage accrual amount available on an average annual basis is approximately 6,000 acre-feet. All the years of reporting since 1951 were reviewed and no accrual years were removed as outliers or as being non-representative. Further analysis could be completed to eliminate specific water years from the statistical analysis, but it is unlikely the overall analysis and recommendations would be significantly affected. From the 63 years of SEO reporting, the estimated maximum quantity stored in all the reservoirs combined in any one year is 23,433 acre-feet. This storage quantity occurred in 1979, the same year as the maximum accrual quantity. Water Year 2014 represented a larger than average water storage year with 22,744 acre-feet total storage.

The estimated overall storage capacity of all the reservoirs (active and inactive reservoirs combined) is 27,525 acre-feet. The overall storage capacity was calculated based on adding the actual active capacities from the surveys of the largest 11 reservoirs to the capacities of the smaller reservoirs. Most of the small reservoirs have low-level outlets so the reservoirs are nearly completely drained at the end of the irrigation season and have very small amounts of inactive storage. Based on this estimated total physical capacity, when the

FIGURE 3.6.5 Platte River Basin Plan Update - Level 1 Study
Historical WSEO Data of Above Pathfinder
Reservoir Storage Carry-Over and Accruals



HDR Engineering,
February 2016

combined carryover quantities are larger than an estimated 9,525 acre-feet for all the reservoirs at the beginning of the water year, there would not be enough available capacity in the reservoirs to exceed the 18,000 acre-feet compliance cap. This is a rare occurrence because the 9,525 carryover amount was exceeded only 5 years in the 64 years of Wyoming's compliance reporting. The reservoirs above Pathfinder subject to Decree compliance are listed in **Appendix 3-C,** Table 1.

### Review of the Largest Reservoirs and Carry-Over and Accruals

**Largest Eleven Reservoirs.** Reporting documents for the largest 11 reservoirs with storage accruals utilizing the new measuring device equipment since about 2003 were reviewed. **Appendix 3-C**, Table 2 contains the annual carryover quantities and accrual amounts for each water year beginning in 2003 for the largest 11 reservoirs. The combined total storage capacity of the largest reservoirs is equal to 15,930 acre-feet which represents over 55% of the estimated storage capacity of all the irrigation reservoirs.

The reservoir filling operations typically occur prior to the irrigation season so senior direct flow water rights are not actively calling for and diverting water. With the exception of Kindt Reservoir, the reservoirs filled to capacity or near capacity every year. The minor occurrences of filling exceptions were North Spring Creek Reservoir in water years 2009 and 2013 and Pierce Reservoir in water year 2013. Kindt Reservoir storage and accruals are highly variable with no storage accruing in most normal or dry years. During the 12-year period since 2003, Kindt stored water in only two years, water years 2010 and 2011. Kindt can store up to an estimated capacity of 2,422 acre-feet when adequate supplies are available.

Many of the largest reservoirs filled in water year 2012 which was a record dry year in the Basin, indicating that most of the larger reservoirs under the Decree compliance cap are not limited by available water supplies or water right priority administration activities. Although, water year 2012 followed a wetter year so carryover quantities were larger in many reservoirs going into water year 2012. In addition, the reservoirs owned and operated by Wheatland Irrigation District; Sand Lake, King #1, and Dutton Creek Reservoirs appeared to fill every year if the facilities and conveyance systems were in good working order.

**Carry-Over and Accrual Quantities of all Reservoirs**. In the overall reporting of all the reservoirs since 2000, **Figure 3.6.5** illustrates increasing carry-over quantities from a low of 2,059 acre-feet in 2001 to a maximum of 10,713 acre-feet in 2011. Both water years 2002 and 2004 stand out in **Figure 3.6.5** as record dry years; with very small accruals of 5,429 and 5,922 acre-feet, respectively.

Reservoir owners of the largest reservoirs following the drought of 2002-2004 purposely conserved storage water in meeting irrigation needs and intentionally increasing carry-over quantities because of uncertainties about future water availability.

Communications with SEO staff and reservoir owners has confirmed this analysis. Another consideration is that most of the reservoir owners have irrigated lands that are served by both direct flow and storage water. The owners will rely on direct flow when it is available and will conserve storage water for the future. The owners' objective to save water and provide carry-over for water needs in future years is evident. Following 2011, the carry-over quantities have steadily decreased to a quantity similar to the long-term carry-over average of 5,380 acre-feet.

For the largest reservoirs that fill almost every year, the carry-over quantities directly affect the storage space available for accruals. The storage space limitation also affects the smaller reservoirs that make up a large percentage of the overall storage and accrual reporting.

Direct communication with SEO staff has confirmed that some of the reservoir owners operate their reservoirs to meet water needs and objectives other than the permitted irrigation uses. In addition to drought concerns, some reservoir owners are increasing carry-over amounts to serve other beneficial uses and purposes; such as the needs of the existing reservoir fisheries as well as serving recreation uses within the reservoirs.

### 3.6.5 Water Use from Storage Updates

#### New Reservoir Permits

All new reservoirs or enlargements in the Wyoming's Platte River Basin that have been permitted by the SEO since the last plan update have been identified in **Appendix 3-C**, Tables 3 through 9. In accordance with the provisions of the Scope of Service, reservoirs less than 50 acre-feet capacity were excluded. The permits in **Appendix 3-C**, Table 3 are listed together within each respective subbasin with the permitted beneficial use identified. Tables 4 through 9 are updated reservoir listings from the previous Platte River Basin Plan (2006) that identified non-federal reservoirs greater than 1,000 acre-feet in storage capacity. At the bottom of each table is a listing of any new reservoirs greater than 50 acre-feet permitted or constructed since the original plan. The reservoirs were also contained in Table 3.

Many of the newly permitted reservoirs were existing facilities. The owners merely obtained a formal water right permit by the Wyoming State Engineer's Office to make the facility a "matter of record." Two reservoirs serving irrigation purposes were constructed in the Pathfinder to Guernsey Subbasin. One of the reservoirs was supplied with a non-hydrologically connected groundwater source (Eastgate Reservoir) and the other reservoir (McMurry no. 4 Reservoir) acquired water supplies through a water right transfer process. The other reservoirs permitted throughout the Basin appear to have been built for a variety of different reasons serving various beneficial uses which included industrial treatment, recreation, wildlife, fish propagation, and flood control.

### 3.6.6 Summary

Wyoming's reported carryover, maximum storage, and accrual data from 1951 to the present was reviewed. A more detailed analysis of the maximum storage and accrual data collected from the 11 largest reservoirs since 2003 was conducted. Per the Modified 2001 North Platte Decree requirements, the largest reservoirs had measurement devices installed to improve the accuracy of reporting annual accruals. Due to their size and locations, the largest reservoirs represent the best opportunities for maximizing annual storage quantities.

The statistical results of the 63 years of reporting are summarized in **Table 3.6.1**.

**Table 3.6.1: 64-Year Statistics of Water Stored for Irrigation Purposes Above Pathfinder Reservoir in Wyoming**

| Storage Quantities | Carry-Over (acre-feet) | Max Water Stored (acre-feet) | Reported Accrual (acre-feet) |
|---|---|---|---|
| Averages | 5,380 | 17,272 | 11,908 |
| Minimums | 255 | 8,412 | 5,429 |
| Maximums | 12,956 | 23,433 | 17,552 |

The average annual accrual quantity is 11,908 acre-feet so the estimated additional storage potential on an average annual basis is approximately 6,000 acre-feet to maximize Wyoming's available allocation of 18,000 acre-feet. Various carryover factors and the actual storage quantity physically available in any one year affect the feasibility of Wyoming accruing up to 18,000 acre-feet as often as possible. Reservoir owners' operational decisions to conserve water during a drought period or to maintain a minimum pool are factors affecting carryover quantities.

### 3.6.7 Conclusions and Recommendations

The reservoirs above Pathfinder have permitted and actual active storage capacities that exceed 18,000 acre-feet so the potential exists for Wyoming to exceed the cap in any one year. The records reviewed for the largest reservoirs instrumented with new measuring devices confirmed that most reservoirs filled nearly every year except when affected by severe drought conditions or when reservoir or conveyance deficiencies prevented their physical ability to store water.

During drought periods, the reservoir owners are intentionally saving water to conserve water supplies for the following year so the storage space available for accruals the following year is physically limited. Some reservoir owners are also increasing reservoir carry-over amounts to serve other beneficial uses such as fishery or recreational purposes. HDR's structural and non-structural recommendations are based on the water storage analysis performed on the reservoirs storing for irrigation purposes above Pathfinder Reservoir exclusive of Seminoe Reservoir. The implementation of one or more of the stated alternatives could assist Wyoming in maximizing the annual accrual quantities.

#### Reservoir Owner Operating Strategies

A potential non-structural recommendation is to facilitate the coordination of storage accruals among the reservoir owners. Coordination with reservoir owners on an annual basis could occur that would allow maximizing storage accruals occurring in Wyoming in any one year. This approach requires cooperation between the SEO and the entities responsible for coordinating the individual reservoir owners. The reservoir owners of the largest reservoirs with measuring device equipment may be the most amenable to this coordination approach based on their previous coordination with the State of Wyoming. The largest reservoirs represent the most efficient entities to accomplish this cooperation alternative due to their size and the practicality of coordinating with fewer reservoir owners.

In cooperation with reservoir owners, reservoir operational plans could be developed for the largest reservoirs. The operation plans would specify a procedure and method to coordinate communications with the reservoirs owners so they are aware of the carry-over amounts and the targeted accrual quantity. The procedure would require monitoring of individual reservoir carry-over quantities each water year and estimating target accrual amounts. The target accrual amounts would be added together in the respective larger reservoirs so that operational plans can be modified to maximize Wyoming's storage quantities up to the Decree allowance of near 18,000 acre-feet in every water year.

In addition, reservoir owners with excess storage may be in a position to contract with other downstream irrigators that are deficient in direct flow water rights when natural flows decrease in the mid-summer months. This contracting process would allow the reservoir owners to enhance the use of their storage water. In addition, the improved analysis and monitoring of snow pack and estimated runoff quantities would help reservoir owners optimize their reservoirs in meeting irrigation beneficial uses as well as conserving water for future drought conditions.

The new measuring device equipment will allow for near real-time monitoring of accruals and maximum storage amounts at the largest eleven reservoirs. The reservoir owners would be capable of adjusting reservoir outlets or the bypassing of inflows so Wyoming does not exceed the 18,000 acre-feet accrual cap.

#### Reservoir Water Right Re-descriptions

Another potential non-structural alternative is to consider the reservoir storage water right and its function for serving irrigation purposes. A portion of the active reservoir storage in the larger reservoirs could be better defined and modified within a Wyoming Board of Control change of use petition process to eliminate the requirement and the need to track the storage under the Modified Decree requirements. For example, the portion of storage that is for the purposes of meeting fishery or recreation beneficial uses could be formally designated for that purpose within the reservoir storage water right. The portion of the storage water right for in-place environmental or recreation uses should not be included in the SEO reporting of storage water dedicated to meeting irrigation purposes.

This re-description of a portion of the water storage rights would allow for more certainty for Wyoming to only account for the storage water actually used to meet irrigation demands. The process of optimizing the tracking and reporting would allow for Wyoming to maximize storage accruals that need to be specifically tracked and reported under the Modified Decree. Following the petition process, the SEO field personal would be required to monitor and track the storage and accruals in accordance with the modified water right for the reservoir. A potential negative impact of this alternative is that the reservoir owner must agree to a permanent change in their reservoir water rights, which eliminates the flexibility in their reservoir operations that has occurred in the past.

#### Constructing New Reservoirs or Enlargement of Existing Reservoirs

Constructing new reservoirs or enlarging existing irrigation reservoirs are challenging projects to implement. The siting of new reservoirs would require the need to evaluate suitable reservoir sites and consider the environmental effects of each site to address the environmental permitting requirements. Water supply alternative analysis evaluations would also be a NEPA requirement for a reservoir enlargement project. The permitting process will require NEPA compliance for the issuance of federal permits or required right-of-way agreements on federal lands. Wyoming's compliance with the PRRIP and Wyoming's Depletions Plan will need to be considered for either alternative. A new irrigation reservoir would require the need for a local sponsor that could provide for a share of the overall capital costs.

To be eligible for WWDC Account III funds, new reservoirs would have to be 2,000 acre-feet or greater and reservoir enlargements would have to be 1,000 acre-feet or greater. The proposed or existing irrigation reservoirs above Pathfinder must provide irrigation to service areas greater than 2,000 acres which is an additional WWDC funding requirement. New reservoirs and enlargements to reservoirs smaller than these storage quantities could be funded through WWDC Account I funds with WWDC grant funding up to 67% of the total project costs.

Following its construction or after the enlargement of an existing reservoir, the designated sponsor would need to collaborate with State officials to implement an operational strategy to maximize storage accruals to allow Wyoming to accrue near the 18,000 acre-foot quantity on an annual basis. This alternative could be implemented in concert with the nonstructural options. A potential disadvantage of this approach is that new storage under current-day priority water rights may not accrue enough storage to fill the reservoir every year.

Personal contacts were made with SEO staff regarding the water supplies, water rights, and irrigation needs served by Pierce Reservoir, which is the largest irrigation reservoir with an existing capacity of 3,895 acre-feet. SEO indicated that irrigation shortages exist downstream along Rock River because of declining natural flows during the mid to late irrigation season months that could be addressed through an enlarged storage supply. This would require contractual arrangements between the direct flow only appropriators and the current reservoir owners or an enlargement of the current service area of the Rock Creek Ditch Company. Irrigation supply shortages may exist on other irrigated lands located downstream of small irrigation reservoirs located above Pathfinder Reservoir. Further analysis would be needed to evaluate the irrigation shortages and to evaluate the potential firm water supply yields available for a new or enlarged reservoir.

### 3.6.8 References

Wyoming Attorney General's Office - 1998, Implementation and Administration of the 1945 North Platte Decree, John Shields, Bern Hinckley, Charles Brendecke, July 1998.

Wyoming State Engineer's Office, 2015, Personal Communication with Mr. Rod Oliver, Hydrographer/Commissioner, Water Division No. 1 on February 10, 2016.

Wyoming State Engineer's Office, 2015, Personal Communication with Mr. Robert Foreman, Field Inspector, Water Division No. 1 on July 14, 2015.

Wyoming State Engineer's Office, 2014 – Water Year - Water Division No. I Hydrographers Report, Districts 6,7,16, 17, 18, 9, 10, 11, and 12, accessed online at http://seo.wyo.gov on August 27, 2015.

Wyoming State Engineer's Office, 2000 - Water Year - North Platte River Decree Area Irrigated Acres and Reservoir Storage Report, Jeffrey J. Hansen, Field Investigator, Division No. I, February 2002.

Wyoming Water Development Commission, 2006, Platte River Basin Plan Technical Memorandum 2.15 – 5.3, Volume II, Trihydro Corporation, May 2006.

## APPENDIX 3-A

Irrigation System Issues within Subbasins of the Platte River Basin

## Table 1. Irrigation System Issues within Subbasins of the Platte River Basin

| Name | 2003 Problems[1] | 2012 Problems[2] |
|---|---|---|
| | Above Pathfinder | |
| None | | |
| | Pathfinder To Guernsey | |
| LaPrele Irrigation District | Ditch improvements, dam maintenance, vandalism | Repairs to Dams and Canals needed; Backhoe, shop, pipe |
| Bates Creek Reservoir Company | Lack of water | Dry Fork of Bates Creek accurately named; Ongoing maintenance of dam & supply ditch. |
| Casper Alcova Irrigation District | Leaky ditches | High conveyance losses – 20% |
| Douglas Water Users | No response to survey | No response to survey. |
| Wagonhound Land and Livestock | No response to survey | No response to survey. |
| | Guernsey To State Line | |
| Angel Draw Irrigation District | No response to survey | No response to survey. |
| Burbank Ditch | State and Federal requirements | Inadequate water sources; dependable supply. |
| Corn Creek Irrigation District | Not listed in survey | Not listed in survey |
| Goshen Hole Water Users Association | Lake needs to be dredged, headgates and water measuring devices need to be improved | No improvements made for 40+ years, entire system needs an upgrade; Interested in help, but debt is not an option |
| Goshen Mutual Reservoir and Ditch Company | No response to survey | drought, excessive water loss, state and federal requirements |
| Hill Irrigation District | None | None |
| Lingle Water Users Association | Drought, short water | No response to survey. |
| Lucerne Canal and Power Company | No response to survey | Not listed in survey. |
| New Grattan Ditch | No response to survey | No response to survey. |
| New North Platte Irrigation & Ditch Company | Diversion from river during flows less than 500 cfs | Needed improvements, Maintenance requirements; diversion dam on river |
| Pratte-Ferris Irrigation District | No response to survey | Improvements for conveyance loss |
| Rock Ranch Ditch Company | The diversion in the North Platte | The diversion in the North Platte |
| Torrington Irrigation District | Needed improvements, maintenance through subdivisions | No response to survey. |
| Wright & Murphy Ditch Company | No response to survey | No response to survey. |
| | Upper Laramie | |
| Laramie Valley Municipal Irrigation District | Flumes, need headgates, riprap, concrete, repairs | Unpredictability of water availability to lower priority water rights holders (specifically, those of lower priority than Wheatland Irrigation District, approximately 1890); Increasing costs of ditch maintenance (measuring |

| | | |
|---|---|---|
| | | flumes, culverts, headgates; equipment costs of equipment hired for ditch cleaning services). |
| Medicine Bow Conservation District | No response to survey | No response to survey. |
| Pioneer Canal-Lake Hattie Irrigation District | Limited storage imposed by U.S. Fish and Wildlife Service | Improvements at Lake Hattie outlet structure; Major erosion control on supply canal from Big Laramie River; Minimize ditch loss on the entire system. |
| Rock Creek Ditch Company | Lack of water during drought | Not listed in survey. |
| Rock Creek Water Users Association | No response to survey | High flows trying to reroute flows away from diversion structures. |
| Toltec Watershed Improvement District | No response to survey | None |
| Lower Laramie | | |
| Gunbarrel Lateral Ditch Company | 2002 – only 0.2 ft/acre; 2003 – 0.4 ft/acre | Dirt & rubbish blows into open ditch |
| Wheatland Irrigation District | Lack of storage | Old system started in 1883; unwritten easements; subdivided lands, delivery to subdivided lands. |
| Horse Creek | | |
| Goshen Irrigation District | State and federal requirements, subdivided land, seepage, lack of adequate water measurement, system age | Canal was established in 1920's and is in need of several improvements. Seepage problems, Federal EDSA, subdivisions, deliveries to and transfers to other lands in our district; Assessments are higher due to increasing costs of materials and rising fuel prices. |
| Horse Creek Conservation District | Drought, inadequate water supply, easements access issues at Hawk Springs Reervoir with state parks and G & F | Financial burdens; Ditch repairs |
| South Platte | | |
| None | | |

Notes: [1]Problems noted in Wyoming Water Development Commission 2003 Irrigation System Survey Report
[2] Problems noted in Wyoming Water Development Commission 2012 Irrigation System Survey Report

# APPENDIX 3-B

New Municipal Wells or Enlargements Filed on Existing Municipal Wells Since January 1, 2004

Summary of Water Usage for Community Water Systems for the Subbasins of the Platte River Basin

**Table 1. New Municipal Wells or Enlargements Filed on Existing Municipal Wells Since January 1, 2004**

| Entity / Municipality | Well / Facility Name | Uses | Appropriation (GPM) | Total Depth (Ft) | Depth to Water (Ft) |
|---|---|---|---|---|---|
| ALBIN | ALBIN 04-01 NOELLE | MUN_GW | 50 | 361 | 224.1 |
| ALBIN | ALBIN 04-02 MARY | MUN_GW | 110 | 430 | 217.1 |
| TOWN OF YODER | STATE NO. 04 WELL | MUN_GW | 45 | 160 | 74.5 |
| TOWN OF PINE BLUFFS | PINE BLUFFS LANCE/FOX HILLS #1 | MUN_GW | 250 | 1,008 | 240 |
| CITY OF CHEYENNE | ENL. CHEYENNE NO. 51 (FINNERTY NO. 2) | MUN_GW | 175 | 210 | 45.48 |
| CITY OF CHEYENNE | ENL. BELL NO. 10 | IRR_GW; MUN_GW | 0 | 250 | 40 |
| TOWN OF GLENDO | ROBBENS WELL | MUN_GW | 30 | 650 | 160 |
| WYOMING WATER DEVELOPMENT COMMISSION | BELVOIR NO. 5 | MUN_GW | 700 | 272 | 82 |
| TOWN OF MILLS | ENL. MILLS NO. 9 | MUN_GW | 115 | 35 | 8 |
| TOWN OF SARATOGA | SARATOGA WELL #1 | MUN_GW | 230 | 305 | 62 |
| TOWN OF SARATOGA | SARATOGA WELL #2 | MUN_GW | 230 | 352 | 78 |
| TOWN OF SARATOGA | SARATOGA WELL #3 | MUN_GW | 230 | 390 | 98 |
| TOWN OF SARATOGA | SARATOGA WELL #4 | MUN_GW | 230 | 412 | 100 |
| TOWN OF SARATOGA | SARATOGA WELL #5 | MUN_GW | 230 | 430 | 100 |
| WYOMING WATER DEVELOPMENT COMMISSION | LONE TREE #2 | MUN_GW | 500 | - | - |
| WYOMING WATER DEVELOPMENT COMMISSION | BELVOIR NO. 6 | MUN_GW | 300 | 406 | 122 |
| TOWN OF GLENROCK | GLENROCK WELL NO. 7 | MUN_GW | 1500 | 1,233 | 173 |
| CITY OF CHEYENNE, BOARD OF PUBLIC UTILITIES | 2ND ENL. BELL # 10 | IRR_GW; MUN_GW; MIS | 75 | 250 | 40 |
| TOWN OF GLENDO | ENL ROBBENS WELL | MUN_GW | 45 | 650 | 160 |
| TOWN OF ELK MOUNTAIN | ELK MOUNTAIN WELL #4 | MUN_GW | 200 | 2,926 | 0 |
| SIERRA MADRE WATER AND SEWER JOINT POWERS BOARD | RIVERSIDE NO. 7 WELL | MIS; MUN_GW | 150 | 631 | 38 |
| TOWN OF PINE BLUFFS | PINE BLUFFS #9 | MUN_GW | 300 | 702 | 271.4 |
| TOWN OF YODER | ENL. PRODUCTION WELL NO. 2 | MUN_GW | 12 | 195 | 70 |
| TOWN OF YODER | ENL PRODUCTION WELL NO. 3 | MUN_GW | 10 | 193 | 85 |
| TOWN OF YODER | ENL STATE NO. 04 | MUN_GW | 7 | 160 | 75 |
| CITY OF DOUGLAS | LITTLE BOX ELDER WELL NO. 1 | MUN_GW | 600 | 1,170 | 0 |
| WYOMING WATER DEVELOPMENT COMMISSION | THOMAS MEMORIAL NO. 1 | MUN_GW | 200 | 537 | 33.5 |
| TOWN OF YODER | YODER PRODUCTION WELL #5 | MUN_GW | 65 | 1,110 | 65.4 |
| TOWN OF GLENROCK | ENL. GLENROCK WELL NO. 7 | MUN_GW | 185 | 1,233 | 173 |
| CITY OF CHEYENNE/BOARD OF PUBLIC UTILITIES | ENLARGEMENT BAILEY NO. 5 | MUN_GW | 160 | 317 | 84 |

**Table 2. Summary of Water Usage for Community Public Water Systems in the Above Pathfinder Dam Subbasin, Wyoming**

| | | | | 2002 WWDC Report[2] | | | | 2013 WWDC Report[3] | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Use | County | Public water system identification number[1] | Name | Population served | Water Source | Average daily use (gallons per day) | Peak daily use (gallons per day) | Population served | Water Source | Total Annual Water Use (gallons) | Average daily use (gallons per day)[4] | Peak daily use (gallons per day)[5] | Source/Remarks |
| Groundwater Use | Albany | WY5600034 | Town of Medicine Bow | 282 | 3 Casper Aquifer wells | 91,600 | 129,500 | 300 | 4 Casper Aquifer wells | 44,324,926 | 121,438 | 172,500 | WWDC, 2013; Peak estimated. |
| | Fremont | WY5600106 | Jeffrey City Water & Sewer District | 50 | 2 Arikaree Aquifer wells | 11,300 | 28,750 | 50 | 1 Split Rock Aquifer well | 23,266,150 | 63,743 | 120,000 | 609 Consulting, 2013 |
| | Carbon | WY5600065 | Town of Elk Mountain | 207 | 2 Clovery Aquifer wells | 24,000 | 80,000 | 200 | 2 Cloverly Aquifer wells | 9,000,000 | 24,658 | 60,000 | PMPC and Hinckley, 2011; WWDC, 2013 |
| | Carbon | WY5600225 | Deer Haven Mobile Home Park | 50 | 2 Quaternary Aquifer wells | 11,300 | 28,750 | 35 | 1 Quaternary Aquifer wells | 2,887,150 | 7,910 | 20,125 | Usage estimated. |
| | Carbon | WY5601332 | Sierra Madre JPB | 195 | 2 North Park Aquifer wells | 29,254 | 99,000 | 180 | 3 North Park Aquifer wells | 8,899,640 | 24,383 | 47,000 | PMPC and Hinckley, 2011; WWDC, 2013 |
| | Carbon | WY5600061 | Town of Saratoga | NA | NA | NA | NA | 1,800 | 5 North Park Aquifer wells | 175,000,000 | 479,452 | 1,200,000 | Switched to groundwater system in 2007; Hinckley, 2007; WWDC, 2013 |
| | | | **Totals** | **784** | | **167,454** | **366,000** | **2,565** | | **263,377,866** | **721,583** | **1,619,625** | |
| Surface Water Use | Carbon | WY5600025 | Town of Hanna | 1,200 | Rattlesnake Creek | 60,000 | 900,000 | 841 | Rattlesnake Creek | 84,036,000 | 230,236 | 515,000 | WWDC, 2013 |
| | Carbon | WY5600048 | Town of Rock River | 200 | Rock River | 18,000 | 22,000 | 245 | Rock River | 35,800,000 | 98,082 | 120,000 | WWDC, 2013 |
| | Carbon | WY5600060 | Town of Encampment | 443 | North Fork Encampment River | 141,279 | 332,220 | 450 | North Fork Encampment River | 22,403,000 | 61,378 | 258,750 | WWDC, 2013; Peak estimated. |
| | Carbon | WY5600061 | Town of Saratoga | 1,850 | North Platte River | 500,000 | 1,200,000 | NA | NA | NA | NA | NA | Switched to groundwater system in 2007 |
| | | | **Totals** | **3,693** | | **719,279** | **2,454,220** | **1,536** | | **142,239,000** | **389,696** | **893,750** | |
| | | | | | | | | | | | | | |
| Conjunctive Water Use | Carbon | WY5600045 | City of Rawlins Water System | 9,730 | 27 Springs, Rawlins Reservoir, North Platte River, 3 Nugget Aquifer wells | 2,251,000 | 5,243,000 | 9,006 | 3 Nugget Aquifer wells, 14 Sage Creek Basin springs, North Platte River, Atlantic Rim Reservoir, Peaking Reservoir, Rawlins Reservoir | 684,979,000 | 1,876,655 | 4,421,000 | Sells water to Sinclair; Wester-Wetstein, 2010; WWDC, 2013 |
| | 3Carbon | WY5600054 | Town of Sinclair | 500 | City of Rawlins | 50,000 | 100,000 | 433 | City of Rawlins | 45,300,000 | 124,110 | 400,000 | WWDC, 2013 |
| | | | **Totals** | **10,230** | | **2,301,000** | **5,343,000** | **9,439** | | **730,279,000** | **2,000,764** | **4,821,000** | |

Notes: (1) Public Water System identification according to USEPA

(2) Data from 2002 WWDC water system survey report or sources included in original Basin Plan technical memorandum

(3) All data from 2013 Wyoming Water Development Commission Public Water System Survey Report unless noted otherwise under remarks.

## Table 3. Summary of Water Usage for Community Public Water Systems in the Pathfinder Dam to Guernsey Subbasin, Wyoming

| | | | | 2002 WWDC Report[2] | | | | 2013 WWDC Report[3] | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Use | County | Public water system identification number[1] | Name | Population served | Water Source | Average daily use (gallons per day) | Peak daily use (gallons per day) | Population served | Water Source | Total Annual Water Use by system (gal) | Average daily use (gallons per day)[4] | Peak daily use (gallons per day)[5] | Source/Remarks |
| Groundwater Use | Platte | WY5600023 | Town of Guernsey | 1,200 | 3 wells | 484,800 | 866,870 | 1,147 | 3 Alluvial Aquifer wells | 144,722,000 | 396,499 | 771,065 | AVI, 2013; WWDC, 2013 |
| | Natrona | WY5600072 | Riverside Trailer Court | 155 | 2 wells | 35,030 | 89,125 | 137 | 2 Alluvial Aquifer wells | 11,301,130 | 30,962 | 78,775 | Usage estimated |
| | Natrona | WY5600074 | Broken Wrench LLC | 50 | 2 springs | 11,300 | 28,750 | 30 | 2 springs | 2,474,700 | 6,780 | 17,250 | Usage estimated |
| | Platte | WY5600186 | Town of Hartville | 94 | 4 wells | 23,500 | 51,000 | 62 | 2 Alluvial Aquifer wells | 6,000,000 | 16,438 | 35,650 | WWDC, 2013; peak estimated |
| | Converse | WY5600199 | Town of Glenrock | 2,500 | 3 wells | 600,000 | 1,400,000 | 2,550 | 4 Casper Aquifer wells | 218,000,000 | 597,260 | 1,700,000 | Weston, 2007; WWDC, 2013 |
| | Platte | WY5600231 | Town of Glendo | 250 | 1 well | 95,587 | 178,685 | 205 | 2 Hartville Aquifer wells | 20,000,000 | 54,795 | 150,000 | Wyoming Groundwater, 2009; WWDC, 2013 |
| | Natrona | WY5600756 | Countryside Court | 125 | 1 well | 28,250 | 71,875 | 125 | 1 Alluvial Aquifer well | 10,311,250 | 28,250 | 71,875 | Usage estimated |
| | Converse | WY5600782 | Town of Rolling Hills | 475 | 4 wells | 70,349 | 387,168 | 450 | 5 Lance/Fox Hills Aquifer wells | 24,329,142 | 66,655 | 174,000 | CEPI, 2012; WWDC, 2013 |
| | Converse | WY5600918 | Fairway Estates | 100 | 5 wells | 22,600 | 57,500 | 100 | 5 High Plains Aquifer wells | 8,249,000 | 22,600 | 57,500 | Usage estimated |
| | Natrona | WY5600959 | Ingram Water Company/Teton Homes | 300 | 1 well | 67,800 | 172,500 | NA | NA | NA | NA | NA | Inactive? |
| | | | **Totals** | **5,249** | | **1,439,216** | **3,303,473** | **4,806** | | **445,387,222** | **1,220,239** | **3,056,115** | |
| Surface Water Use | Natrona | WY5600018 | Town of Evansville | 2,800 | North Platte River | 350,000 | 1,000,000 | 2,500 | North Platte River | 160,235,000 | 445,000 | 820,220 | C.H. Guernsey, 2009; WWDC, 2013 |
| | | | **Totals** | **2,800** | | **350,000** | **1,000,000** | **2,500** | | **160,235,000** | **445,000** | **820,220** | |
| Conjunctive Water Use | Natrona | WY5600009 | Central Wyoming Regional Water System (Casper) | 53,412 | 20 Quaternary Aquifer wells, North Platte River | 10,300,000 | 28,000,000 | 62,000 | 29 Alluvial Aquifer wells, North Platte River | 4,100,000,000 | 11,232,877 | 29,200,000 | CEPI, 2006; WWDC, 2013 |
| | Natrona | WY5600036 | Town of Mills | 5,745 | 7 Quaternary Aquifer wells, North Platte River | 861,750 | 2,500,000 | 3,300 | 7 Alluvial Aquifer wells, North Platte River | 237,107,500 | 649,610 | 1,550,000 | WWDC, 2013 |
| | Converse | WY5600137 | Town of Douglas | 5,800 | 1 spring, 1 well, North Platte River | 1,489,085 | 3,866,500 | 6,120 | 1 Casper Aquifer spring, 1 Casper Aquifer well, North Platte River | 630,739,154 | 1,728,052 | 3,643,853 | Dowl HKM, 2010; WWDC, 2013 |
| | | | **Totals** | **64,957** | | **12,650,835** | **34,366,500** | **71,420** | | **4,967,846,654** | **13,610,539** | **34,393,853** | |

Notes: (1) Public Water System identification according to USEPA

(2) Data from 2002 WWDC water system survey report or sources included in original Basin Plan technical memorandum

(3) All data from 2013 Wyoming Water Development Commission Public Water System Survey Report unless noted otherwise under remarks.

(4) Where estimated, based on 226 gallons per person per day.

(5) Where estimated, based on 575 gallons per person per day.

**Table 4. Summary of Water Usage for Community Public Water Systems in the Guernsey to State Line Subbasin, Wyoming**

| | | | | 2002 WWDC Report[2] | | | | 2013 WWDC Report[3] | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Use** | **County** | **Public water system identification number[1]** | **Name** | **Population served** | **Water Source** | **Average daily use (gallons per day)** | **Peak daily use (gallons per day)** | **Population served** | **Water Source** | **Total Annual Water Use (gal)** | **Average daily use (gallons per day)[4]** | **Peak daily use (gallons per day)[5]** | **Source/Remarks** |
| **Groundwater Use** | Goshen | WY5600030 | Town of Lingle | 510 | 3 Quaternary Aquifer wells | 295,800 | 928,200 | 510 | 3 Alluvial Aquifer wells | 45,000,000 | 123,288 | 600,000 | WWDC, 2013 |
| | Goshen | WY5600164 | Torrington Municipal Water System | 6,500 | 6 Quaternary Aquifer wells | 2,360,000 | 4,700,000 | 5,800 | 5 Alluvial Aquifer wells | 644,000,000 | 1,764,384 | 4,500,000 | Sells to South Torrington; WWDC, 2013 |
| | Goshen | WY5600168 | South Torrington Water & Sewer | 650 | Torrington | 250,250 | 300,000 | 450 | Torrington | 24,300,000 | 66,575 | 100,000 | WWDC, 2013 |
| | Goshen | WY5600171 | Potlach Trailer Court | 75 | 1 well | 16,950 | 43,125 | 70 | 1 Alluvial Aquifer well | 5,774,300 | 15,820 | 40,250 | Usage estimated |
| | Goshen | WY5600185 | Town of Fort Laramie | 248 | 2 Quaternary Aquifer wells | 141,360 | 233,120 | 200 | 2 Alluvial Aquifer wells | 20,160,900 | 55,235 | 176,500 | WWDC, 2013 |
| | Goshen | WY5601233 | Cottonwood Acres | 100 | 4 wells | 22,600 | 57,500 | 100 | 4 Alluvial Aquifer wells | 8,249,000 | 22,600 | 57,500 | Usage estimated |
| | Goshen | WY5601248 | Dillman Estates | 46 | 1 well | 10,396 | 26,450 | 65 | 1 Alluvial Aquifer well | 7,500,000 | 20,548 | 37,375 | WWDC, 2013; peak usage estimated |
| | | | **Totals** | **7,479** | | **3,097,356** | **6,288,395** | **6,745** | | **754,984,200** | **2,068,450** | **5,511,625** | |

Notes: (1) Public Water System identification according to EPA

(2) Data from 2002 WWDC water system survey report or sources included in original Basin Plan technical memorandum

(3) All data from 2013 Wyoming Water Development Commission Public Water System Survey Report unless noted otherwise under remarks.

(4) Where estimated, based on 226 gallons per person per day.

(5) Where estimated, based on 575 gallons per person per day.

**Table 5. Summary of Water Usage for Community Water Systems in the Upper Laramie Subbasin, Wyoming**

| Use | County | Public water system identification number[1] | Name | 2002 WWDC Report[2] Population served | 2002 Water Source | 2002 Average daily use (gallons per day) | 2002 Peak daily use (gallons per day) | 2013 WWDC Report[3] Population served | 2013 Water Source | Total Annual Water Use (gal) | Average daily use (gallons per day)[4] | Peak daily use (gallons per day)[5] | Source/Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Groundwater Use | Albany | WY5600162 | Country Meadow Estates | 375 | 2 wells | 84,750 | 215,625 | 375 | 3 Casper Aquifer wells | 12,154,500 | 33,300 | 215,625 | WWDC, 2013; peak usage estimated |
| | Albany | WY5600208 | Wyoming Technical Institute | 560 | 2 wells | 126,560 | 322,000 | 560 | 2 Casper Aquifer wells | 46,194,400 | 126,560 | 322,000 | Usage estimated |
| | Albany | WY5601232 | Centennial Water & Sewer | 100 | 2 wells | 17,000 | 57,500 | 100 | 2 Casper Aquifer wells | 9,000,000 | 24,658 | 45,000 | WWDC, 2013 |
| | Albany | WY5601457 | Antelope Ridge H.O.A. | 50 | 2 wells | 11,300 | 28,750 | 70 | 2 Casper Aquifer wells | 5,774,300 | 15,820 | 40,250 | Usage estimated |
| | | | **Totals** | **1,085** | | **239,610** | **623,875** | **1,105** | | **73,123,200** | **200,338** | **622,875** | |
| Conjunctive Water Use | Albany | WY5600029 | City of Laramie | 27,000 | Big Laramie River; 9 Casper Aquifer wells | 6,000,000 | 15,750,000 | 30,816 | 9 Casper Aquifer wells, 3 Casper Aquifer springs, Laramie River | 1,963,550,000 | 5,379,589 | 12,670,000 | WWC, 2006; WWDC, 2013 |
| | | | **Totals** | **27,000** | | **6,000,000** | **15,750,000** | **30,816** | | **1,963,550,000** | **5,379,589** | **12,670,000** | |

Notes: (1) Public Water System identification according to EPA
(2) Data from 2002 WWDC water system survey report or sources included in original Basin Plan technical memorandum
(3) All data from 2013 Wyoming Water Development Commission Public Water System Survey Report unless noted otherwise under remarks.
(4) Where estimated, based on 226 gallons per person per day.
(5) Where estimated, based on 575 gallons per person per day.

**Table 6. Summary of Water Usage for Community Public Water Systems in the Lower Laramie Subbasin, Wyoming**

| | | | | 2002 WWDC Report[2] | | | | 2013 WWDC Report[3] | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Use** | **County** | **Public water system identification number[1]** | **Name** | **Population served** | **Water Source** | **Average daily use (gallons per day)** | **Peak daily use (gallons per day)** | **Population served** | **Water Source** | **Total Annual Water Use (gal)** | **Average daily use (gallons per day)[4]** | **Peak daily use (gallons per day)[5]** | **Source/Remarks** |
| **Groundwater Use** | Albany | WY5600162 | Country Meadow Estates | 375 | 2 wells | 84,750 | 215,625 | 375 | 3 Casper Aquifer wells | 12,154,500 | 33,300 | 215,625 | WWDC, 2013; peak usage estimated |
| | Albany | WY5600208 | Wyoming Technical Institute | 560 | 2 wells | 126,560 | 322,000 | 560 | 2 Casper Aquifer wells | 46,194,400 | 126,560 | 322,000 | Usage estimated |
| | Albany | WY5601232 | Centennial Water & Sewer | 100 | 2 wells | 17,000 | 57,500 | 100 | 2 Casper Aquifer wells | 9,000,000 | 24,658 | 45,000 | WWDC, 2013 |
| | Albany | WY5601457 | Antelope Ridge H.O.A. | 50 | 2 wells | 11,300 | 28,750 | 70 | 2 Casper Aquifer wells | 5,774,300 | 15,820 | 40,250 | Usage estimated |
| | | | **Totals** | **1,085** | | **239,610** | **623,875** | **1,105** | | **73,123,200** | **200,338** | **622,875** | |
| **Conjunctive Water Use** | Albany | WY5600029 | City of Laramie | 27,000 | Big Laramie River; 9 Casper Aquifer wells | 6,000,000 | 15,750,000 | 30,816 | 9 Casper Aquifer wells, 3 Casper Aquifer springs, Laramie River | 1,963,550,000 | 5,379,589 | 12,670,000 | WWC, 2006; WWDC, 2013 |
| | | | **Totals** | **27,000** | | **6,000,000** | **15,750,000** | **30,816** | | **1,963,550,000** | **5,379,589** | **12,670,000** | |

Notes: (1) Public Water System identification according to EPA
(2) Data from 2002 WWDC water system survey report or sources included in original Basin Plan technical memorandum
(3) All data from 2013 Wyoming Water Development Commission Public Water System Survey Report unless noted otherwise under remarks.
(4) Where estimated, based on 226 gallons per person per day.
(5) Where estimated, based on 575 gallons per person per day.

**Table 7. Summary of Water Usage for Community Public Water Systems in the Horse Creek Subbasin, Wyoming**

| Use | County | Public water system identification number[1] | Name | 2002 WWDC Report[2]<br>Population served | Water Source | Average daily use (gallons per day) | Peak daily use (gallons per day) | 2013 WWDC Report[3]<br>Population served | Water Source | Total Annual Water Use (gal) | Average daily use (gallons per day)[4] | Peak daily use (gallons per day)[5] | Source/Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Groundwater Use | Goshen | WY5600169 | Town of Yoder Water System | 300 | 3 wells | 55,000 | 150,000 | 151 | 3 Chadron Aquifer wells, 1 Lance/Fox Hills Aquifer well | 11,627,100 | 31,855 | 125,000 | Wyoming Groundwater, 2011; WWDC, 2013 |
| | Goshen | WY5600788 | La Grange | 350 | 2 wells | 25,000 | 37,000 | 350 | 2 High Plains Aquifer wells | 28,871,500 | 79,100 | 201,250 | WWDC, 2013; Usage estimated |
| | | | **Totals** | **650** | | **80,000** | **187,000** | **501** | | **40,498,600** | **110,955** | **326,250** | |

Notes: (1) Public Water System identification according to USEPA

(2) Data from 2002 WWDC water system survey report or sources included in original Basin Plan technical memorandum

(3) All data from 2013 Wyoming Water Development Commission Public Water System Survey Report unless noted otherwise under remarks.

(4) Where estimated, based on 226 gallons per person per day.

(5) Where estimated, based on 575 gallons per person per day.

**Table 8. Summary of Water Usage for Community Public Water Systems in the South Platte Subbasin, Wyoming**

| | | | | 2002 WWDC Report[2] | | | | 2013 WWDC Report[3] | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Use | County | Public water system identification number[1] | Name | Population served | Water Source | Average daily use (gallons per day) | Peak daily use (gallons per day) | Population served | Water Source | Total Annual Use (gal) | Average daily use (gallons per day)[4] | Peak daily use (gallons per day)[5] | Source/Remarks |
| Groundwater Use | Laramie | WY5600012 | Orchard Valley Water Company | 300 | 2 wells | 34,500 | 172,500* | 400 | 2 High Plains Aquifer wells | 9,000,000 | 24,658 | 35,000 | WWDC, 2013 |
| | Laramie | WY5600021 | Evergreen Park LLC | 50 | 1 well | 11,300 | 28,750 | 50 | 1 High Plains Aquifer well | 4,124,500 | 11,300 | 28,750 | Usage estimated |
| | Laramie | WY5600040 | Town of Pine Bluffs | 1,153 | 5 Brule Aquifer wells | 288,250 | 662,975 | 1,137 | 2 Lance/Fox Hills Aquifer wells, 2 Brule Aquifer wells, 1 Terrace Aquifer well | 95,444,024 | 261,490 | 735,000 | Lidstone, 2015; WWDC, 2013 |
| | Laramie | WY5600051 | Miller Lower Mobile Home Park | 70 | 1 well | 15,820 | 40,250 | 40 | 2 High Plains Aquifer wells | 3,299,600 | 9,040 | 23,000 | Usage estimated |
| | Laramie | WY5600188 | Town of Burns | 315 | 4 wells | 42,000 | 75,000 | 301 | 4 High Plains Aquifer wells | 38,880,000 | 106,521 | 405,000 | Lidstone, 2011; WWDC, 2013 |
| | Laramie | WY5600189 | Town of Albin | 120 | 3 wells | 15,000 | 40,000 | 120 | 5 High Plains Aquifer wells | 26,664,146 | 73,052 | 200,000 | Benchmark, 2005; WWDC, 2013 |
| | Laramie | WY5600260 | High Plains Ranch | 60 | 1 well | 13,560 | 34,500 | 50 | 1 High Plains Aquifer well | 4,124,500 | 11,300 | 28,750 | Usage estimated |
| | Laramie | WY5600263 | Hide-a-Way Mobile Home Park | 69 | 2 wells | 15,594 | 39,675 | 130 | 2 High Plains Aquifer wells | 10,723,700 | 29,380 | 74,750 | Usage estimated |
| | Laramie | WY5600266 | Avalon Mobile Manor | 120 | 1 well | 27,120 | 69,000 | 120 | 1 High Plains Aquifer well | 9,898,800 | 27,120 | 69,000 | Usage estimated; WWDC, 2013 |
| | Laramie | WY5600779 | Winchester Hills | 600 | 2 wells | 135,600 | 345,000 | 937 | 3 High Plains Aquifer wells | 77,293,130 | 211,762 | 538,775 | Usage estimated |
| | Laramie | WY5601265 | AAA Mobile Home Park | 200 | 2 wells | 45,200 | 115,000 | NA | NA | NA | NA | NA | System Inactive |
| | Laramie | WY5601464 | Carpenter Water & Sewer District | 90 | 2 Chadron Aquifer wells | 20,340 | 51,750 | 100 | 2 Chadron Aquifer wells | 8,249,000 | 22,600 | 57,500 | Usage estimated |
| | | | **Totals** | **3,147** | | **664,284** | **1,501,900** | **3,385** | | **287,701,400** | **788,223** | **2,195,525** | |
| **Conjunctive Water Use** | Laramie | WY5600011 | Cheyenne Board of Public Utilities | 65,000 | 39 wells, Several surface water sources | 13,100,000 | 36,800,000 | 73,836 | 33 High Plains Aquifer wells, numerous surface water sources including N Fork, Little Snake R, Middle Fork, Crow Creek and Douglas Creek | 4,942,100,000 | 13,540,000 | 31,000,000 | HDR, 2013; WWDC, 2013 |
| | | | **Totals** | **65,000** | | **13,100,000** | **36,800,000** | **73,836** | | **4,942,100,000** | **13,540,000** | **31,000,000** | |

Notes: (1) Public Water System identification according to EPA

(2) Data from 2002 WWDC water system survey report or sources included in original Basin Plan technical memorandum

(3) All data from 2013 Wyoming Water Development Commission Public Water System Survey Report unless noted otherwise under remarks.

(4) Where estimated, based on 226 gallons per person per day.

(5) Where estimated, based on 575 gallons per person per day.

## APPENDIX 3-C

Reservoirs Above Pathfinder Subject to Decree Compliance

Water Stored for Irrigation Purposes in Eleven Largest Reservoirs

**Table 1. Reservoirs above Pathfinder Subject to Decree Compliance**

| Reservoir | Permit Number[2] | Capacity (acre-feet) | Township | Range | Section | Subbasin | Source |
|---|---|---|---|---|---|---|---|
| **Anderson** | 4121R<br>4449R | 369 | 15 | 84 | 21 | Saratoga | Teddy Creek, Otto Creek |
| **Antelope** | 5242R | 147 | 16 | 85 | 18 | Saratoga | North Spring Creek |
| **B B** | 2688R | 117 | 30 | 86 | 28 | Sweetwater | Dry Creek |
| **Baby** | 1551R | 28 | 14 | 82 | 19 | Saratoga | Beaver Creek |
| **Brownlee** | 1R | 98 | 14 | 83 | 9 | Saratoga | Cotton Creek |
| **Buck Draw** | 5530R<br>6079R | 315 | 16 | 85 | 6 | Saratoga | Jack Creek |
| **Bucklin[1]** | 1026R<br>1976R | 736 | 28 | 88 | 18 | Sweetwater | Whiskey Creek |
| **Bucklin #2[1]** | 4108R | 519 | 28 | 88 | 18 | Sweetwater | Whiskey Creek |
| **Cardwell** | 692R | 56 | 28 | 84 | 13 | Medicine Bow | Hill Creek |
| **Cherokee Trail** | 1767R | 95 | 14 | 83 | 22 | Saratoga | Indian Creek |
| **Corpening** | 4726R | 116 | 17 | 80 | 34 | Saratoga | Little Canyon Creek |
| **Cotton** | 3804R | 12 | 14 | 83 | 15 | Saratoga | Indian Creek |
| **Cow Creek Lake[1]** | 1726R<br>3960R<br>5486R | 601 | 14 | 85 | 15 | Saratoga | Cow Creek |
| **Dutton Creek[1]** | 528R<br>1215R<br>2375R | 1489 | 19 | 77 | 24 | Medicine Bow | Dutton Creek |
| **East** | 3843R | 13 | 28 | 84 | 13 | Medicine Bow | Hill Creek |
| **Fries** | 459R | 6 | 14 | 84 | 11 | Saratoga | North Fork |
| **Galusha Draw** | 6003R | 28 | 27 | 83 | 16 | Medicine Bow | Indian Creek |
| **Good #1** | 5824R | 191 | 17 | 86 | 15 | Saratoga | Beaver Creek |
| **Greyhound** | 1120R | 108 | 20 | 83 | 26 | Saratoga | Rattlesnake Creek |

**Table 1. Reservoirs above Pathfinder Subject to Decree Compliance (cont.)**

| Reservoir | Permit Number[2] | Capacity (acre-feet) | Township | Range | Section | Subbasin | Source |
|---|---|---|---|---|---|---|---|
| **Gunst** | 240R<br>1552R<br>3260R | 269 | 14 | 83 | 24 | Saratoga | Dufunny Creek |
| **Gunst** | 240R<br>1552R<br>3260R | 269 | 14 | 83 | 24 | Saratoga | Dufunny Creek |
| **Hanna Mahoney #2** | 824R<br>3433R | 84 | 26 | 89 | 2 | Sweetwater | Muddy Creek |
| **Higby #1** | 5545R | 8 | 13 | 82 | 11 | Saratoga | Bear Creek |
| **Horn & Meason** | 1052R<br>2414R | 430 | 17 | 83 | 27 | Saratoga | Cedar Creek |
| **Horne** | 461R<br>6130R | 230 | 21 | 77 | 4 | Medicine Bow | Foote Creek |
| **Indian Creek** | 6002R | 65 | 27 | 83 | 16 | Medicine Bow | Indian Creek |
| **Irene** | 5816R | 251 | 27 | 83 | 13 | Medicine Bow | Dry Creek |
| **Irene #2** | 5904R | 87 | 27 | 83 | 33 | Medicine Bow | Indian Creek |
| **Jack Creek** | 783R<br>2595R | 182 | 16 | 86 | 12 | Saratoga | Jack Creek |
| **Joe D. Reservoir** | 703R | 21 | 21 | 76 | 32 | Medicine Bow | Fieland Creek |
| **John Campbell #1** | 2034R | 56 | 27 | 83 | 9 | Medicine Bow | Indian Creek |
| **Keystone** | 3519R | 172 | 16 | 80 | 23 | Saratoga | South Twin Lakes Creek |
| **Kindt[1]** | 729R | 2422 | 19 | 86 | 33 | Saratoga | Little Sage Creek |
| **Kinney** | 474R | 311 | 21 | 82 | 24 | Saratoga | Dana Springs |
| **King #1[1]** | 3617R | 2900 | 19 | 77 | 29 | Medicine Bow | Canon |
| **Lady Emma** | 1641R | 29 | 32 | 88 | 3 | Sweetwater | Dry Creek |
| **Long Pond** | 5481R | 55 | 17 | 86 | 32 | Saratoga | Beaver Creek |
| **Low** | 5475R | 184 | 16 | 87 | 1 | Saratoga | Willow Creek |
| **Marsh & Company** | 825R<br>823R | 152 | 26 | 88 | 8 | Sweetwater | Muddy Creek |

**Table 1. Reservoirs above Pathfinder Subject to Decree Compliance (cont.)**

| Reservoir | Permit Number[2] | Capacity (acre-feet) | Township | Range | Section | Subbasin | Source |
|---|---|---|---|---|---|---|---|
| **North Spring Creek**[1] | 539R<br>6065R | 1623 | 14 | 86 | 4 | Saratoga | North Spring Creek |
| **Pierce**[1] | 634R<br>2407R | 3895 | 20 | 77 | 20 | Medicine Bow | Rock Creek |
| **Point of Rocks** | 990R | 149 | 26 | 80 | 15 | Medicine Bow | Cottonwood Creek |
| **Rainey Reservoir** | 3547R | 1113 | 19 | 76 | 9 | Medicine Bow | Coalbank Creek |
| **Reversed Kay Seven** | 1766R | 10 | 14 | 83 | 22 | Saratoga | Indian Creek |
| **Robert Cardwell #1** | 959R | 6 | 28 | 83 | 18 | Medicine Bow | Dry Gulch |
| **Robert Cardwell #2** | 960R | 335 | 28 | 83 | 18 | Medicine Bow | Dry Gulch |
| **Rigby's** | P82R<br>P403R | 336 | 29 | 92 | 27 | Sweetwater | Crook's Creek |
| **Rollman** | 281R | 17 | 14 | 82 | 29 | Saratoga | Beaver Creek |
| **Ryan Brothers Lake** | 2134R | 207 | 16 | 80 | 23 | Saratoga | North Twin Lake |
| **Sage Creek**[1] | 2040R | 635 | 18 | 86 | 2 | Saratoga | Sage Creek |
| **Sand Lake**[1] | 6136R | 1300 | 17 | 79 | 9 | Medicine Bow | Rock Creek |
| **Seaverson** | 4612R<br>5531R | 50 | 18 | 85 | 36 | Saratoga | McPhail Creek |
| **Sederlin** | 1162R | 78 | 19 | 81 | 1 | Medicine Bow | Fish Creek |
| **Shell Creek** | P5508R | 130 | 31 | 84 | 26 | Sweetwater | Shell Creek |
| **Silver Lake** | 3763R | 322 | 14 | 85 | 18 | Saratoga | Silver Lake Brook |
| **South Spring Creek Lake**[1] | 2508R | 857 | 14 | 86 | 2 | Saratoga | South Spring Creek |
| **Spring Creek** | 3460R | 240 | 27 | 82 | 32 | Medicine Bow | Spring Creek |
| **Stephenson** | 730R | 75 | 22 | 82 | 23 | Saratoga | Big Ditch Creek |
| **Sucker Lakes** | 3990R | 49 | 16 | 80 | 26 | Saratoga | Snow |

**Table 1. Reservoirs above Pathfinder Subject to Decree Compliance (cont.)**

| Reservoir | Permit Number[2] | Capacity (acre-feet) | Township | Range | Section | Subbasin | Source |
|---|---|---|---|---|---|---|---|
| **Summitt** | 804R<br>6076R | 128 | 13 | 82 | 3 | Saratoga | Beaver Creek |
| **McQueary Reservoir** | 2160R | 81 | 31 | 84 | 27 | Sweetwater | Fish Creek |
| **Meer** | 5952R | 122 | 27 | 81 | 3 | Medicine Bow | Dry Creek |
| **Mule Creek** | 991R | 96 | 26 | 7 | 1 | Medicine Bow | Mule Creek |
| **Three Mile** | 239R | 132 | 28 | 77 | 36 | Medicine Bow | Three Mile Creek |
| **Toothaker** | 5816R | 215 | 14 | 82 | 16 | Saratoga | Beaver Creek |
| **Turpin Park[1]** | 6155R | 1503 | 17 | 80 | 16 | Medicine Bow | Turpin Creek |
| **Verplancke** | 518R<br>6085R | 224 | 14 | 82 | 30 | Saratoga | Billy Creek |
| **White's A** | 3217R | 32 | 20 | 77 | 22 | Medicine Bow | Coalbank Creek |
| **Wiant** | 2202R<br>3859R | 296 | 16 | 80 | 11 | Saratoga | South Bush Creek |

**Notes:** 1) Largest reservoirs with new measuring devices installed per requirement of Modified Decree. Wenck Associates completed surveying and new reservoir capacity tables in 2005. Total capacity volumes in the third column were updated based on new survey data.

2) WSEO original reservoir permits and enlargement permits.

**Table 2. Water Stored for Irrigation Purposes in Eleven Largest Reservoirs**

| Water Year | Carry-Over acre-feet | Estim. Max Water Stored acre-feet | Reported Accrual acre-feet |
|---|---|---|---|
| **2003** | 1,485 | 11,999 | 10,514 |
| **2004** | 1,618 | 5,519 | 3,901 |
| **2005** | 1,483 | 10,877 | 9,394 |
| **2006** | 2,183 | 11,745 | 9,562 |
| **2007** | 3,116 | 13,721 | 10,605 |
| **2008** | 4,591 | 15,235 | 10,644 |
| **2009** | 5,997 | 14,608 | 8,611 |
| **2010** | 6,869 | 14,644 | 7,775 |
| **2011** | 7,595 | 11,699 | 4,104 |
| **2012** | 6,015 | 9,600 | 3,815 |
| **2013** | 3,861 | 11,532 | 7,685 |
| **2014** | 5,185 | 14,756 | 9,571 |
| | | | |
| **Averages** | 4,167 | 12,161 | 8,015 |
| **Minimums** | 1,483 | 5,519 | 3,815 |
| **Maximums** | 7,595 | 15,235 | 10,644 |

**Table 2. Water Stored for Irrigation Purposes in Reservoirs above Pathfinder in Wyoming**

| Water Year | Carry-Over<br>acre-feet | Estim. Max Water Stored[3]<br>acre-feet | Reported Accrual[2]<br>acre-feet |
|---|---|---|---|
| **1951** | | | 11,986 |
| **1952** | 255 | 14,108 | 13,853 |
| **1953** | 371 | 11,691 | 11,320 |
| **1954** | 1,323 | 9,669 | 8,346 |
| **1955** | 787 | 11,080 | 10,293 |
| **1956** | 1,085 | 13,602 | 12,517 |
| **1957** | 910 | 17,319 | 16,409 |
| **1958** | 6,387 | 19,832 | 13,445 |
| **1959** | 5,232 | 17,152 | 11,920 |
| **1960** | 4,910 | 18,643 | 13,733 |
| **1961** | 4,515 | 17,029 | 12,514 |
| **1962** | 3,177 | 17,078 | 13,901 |
| **1963** | 4,068 | 15,611 | 11,543 |
| **1964** | 992 | 15,266 | 14,274 |
| **1965**[1] | 1,066 | 19,014 | 17,948 |
| **1966**[1] | 7,789 | 27,223 | 19,434 |
| **1967**[1] | 7,872 | 14,533 | 6,661 |
| **1968** | 11,301 | 19,098 | 7,797 |
| **1969** | 8,772 | 20,223 | 11,451 |
| **1970** | 6,349 | 17,800 | 11,451 |
| **1971** | 6,349 | 16,087 | 9,738 |
| **1972** | 9,315 | 21,010 | 11,695 |
| **1973** | 8,183 | 21,236 | 13,053 |
| **1974** | 7,836 | 20,399 | 12,563 |
| **1975** | 6,697 | 21,675 | 14,978 |
| **1976** | 8,904 | 22,404 | 13,500 |
| **1977** | 5,018 | 15,679 | 10,661 |
| **1978** | 5,055 | 20,411 | 15,356 |
| **1979** | 5,881 | 23,433 | 17,552 |
| **1980** | 7,730 | 23,324 | 15,594 |
| **1981** | 7,262 | 18,142 | 10,880 |
| **1982** | 5,103 | 20,143 | 15,039 |
| **1983** | 12,956 | 18,710 | 5,754 |
| **1984** | 11,773 | 17,544 | 5,771 |
| **1985** | 9,079 | 17,973 | 8,894 |
| **1986** | 3,273 | 18,361 | 15,088 |
| **1987** | 4,410 | 13,850 | 9,440 |
| **1988** | 4,354 | 17,871 | 13,517 |
| **1989** | 4,023 | 12,139 | 8,116 |
| **1990** | 3,607 | 15,067 | 11,459 |
| **1991** | 3,246 | 16,146 | 12,900 |
| **1992** | 3,846 | 15,052 | 11,206 |

**Table 2. Water Stored for Irrigation Purposes Reservoir above Pathfinder in Wyoming (cont.)**

| Water Year | Carry Over<br>acre-feet | Estim. Max Water Stored[3]<br>acre-feet | Reported Accrual[2]<br>acre-feet |
|---|---|---|---|
| **1993** | 2,889 | 16,784 | 13,895 |
| **1994** | 4,378 | 15,153 | 10,775 |
| **1995** | 1,521 | 15,629 | 14,108 |
| **1996** | 5,878 | 16,009 | 10,131 |
| **1997** | 3,444 | 18,223 | 14,779 |
| **1998** | 7,595 | 19,374 | 11,779 |
| **1999** | 6,540 | 16,448 | 9,908 |
| **2000** | 5,978 | 16,633 | 10,655 |
| **2001** | 2,059 | 15,142 | 13,083 |
| **2002** | 2,464 | 8,412 | 5,429 |
| **2003** | 3,598 | 15,737 | 13,273 |
| **2004** | 3,133 | 9,520 | 5,922 |
| **2005** | 3222 | 16,033 | 12,811 |
| **2006** | 4707 | 16,731 | 12,024 |
| **2007** | 5,111 | 19,427 | 14,316 |
| **2008** | 6,571 | 22,238 | 15,667 |
| **2009** | 8,921 | 21,646 | 12,736 |
| **2010** | 9,561 | 21,874 | 12,313 |
| **2011** | 10,713 | 18,815 | 8,107 |
| **2012** | 9,136 | 15,506 | 6,642 |
| **2013** | 4,772 | 16,373 | 11,626 |
| **2014** | 5,869 | 22,744 | 16,875 |

**Notes:** 1) The Wyoming State Engineer's reports for 1965, 1966, and 1967 mistakenly reported storage that included Seminoe Reservoir storage. Some of the WSEO records were destroyed in a fire in the Torrington field office on February 22, 1969 (WSEO July 1998). The reported values for these three years were not included in the statistics for accruals and estimated maximum storage in Table 5 below.

2) The above accrual reporting was often discussed at the annual Natural Flow and Ownership (NFO) meetings held between 1946 and 2001. Following the issuance of the Final Settlement Stipulation and the Modified Decree, the North Platte Decree Committee meetings are held twice a year in the spring and fall with annual accruals reported annually during the spring meeting.

3) The WSEO reservoir records of the maximum water stored were not available for 1956 through 2002. For the table above, the maximum storage is estimated by adding the carryover from the previous water year to the total accrual amount in the current water year. The maximum storage in the table for 2003 through 2014 is the actual WSEO storage quantities measured in the spring of each year.

**Table 3. New and Enlarged Reservoir Permits**

| Platte Subbasin | SEO Permit No. | Reservoir Name | Priority Date | Overall Capacity | Permitted Uses |
|---|---|---|---|---|---|
| Above Path | P13044R | RED DESERT RECLAMATION 1-2-3 RESERVOIR | 12/7/2007 | 54.72 | IND_SW |
| Above Path | P13579R | CHAPMAN | 1/11/2008 | 68.16 | FIS; REC; STO; WL |
| Above Path | P13681R | ENL. TURPIN PARK RESERVOIR | 8/10/2010 | 186.56 | IRR_SW |
| Above Path | P13895R | ENL. SULLIVAN PIT RESERVOIR | 4/26/2011 | 73,762 | IND_SW |
| Upper Laramie | P14093R | SPIEGELBERG SPRINGS | 4/22/2013 | 131.4 | CMU; STO; WL |
| Lower Laramie | P14249R | WHEATLAND WASTEWATER LAGOON SYS | 5/23/2013 | 418.8 | IND_SW; IRR_SW |
| Path to Guern | P12606R | REESE RESERVOIR | 2/22/2006 | 53 | CMU; FIS; WL |
| Path to Guern | P13125R | EASTDALE CREEK DETENTION RESERVOIR NO. 2 | 9/17/2007 | 57.15 | FLO |
| Path to Guern | P13232R | CCI | 11/1/2006 | 240.4 | CMU; STO; WL |
| Path to Guern | P13409R | EASTGATE RESERVOIR | 2/10/2009 | 575.32 | DOM_SW; IRR_SW; REC; STO; WL |
| Path to Guern | P13729R | MCMURRY NO. 2 RESERVOIR | 2/3/2011 | 92.35 | FIS; REC; STO |
| Path to Guern | P14106R | MCMURRY NO. 4 RESERVOIR | 3/19/2013 | 367.16 | CMU; FIS; IND_SW; IRR_SW; REC; STO |
| Path to Guern | P14174R | HENRIE NO. 2 | 10/14/2013 | 51.95 | STO; FIS, WL |
| Guern to S.L. | P12936R | FRONTIER RESERVOIR | 10/13/2006 | 331.8 | REC |
| South Platte | P12527R | WARREN AIR FORCE BASE BNSF POND RESERVOIR | 3/20/2006 | 130.5 | FLO |
| South Platte | P12970R | BURNETT DAIRY NO. 1 RESERVOIR | 6/27/2007 | 93.18 | IND_SW; IRR_SW |
| South Platte | P13794R | SOUTH LAKE PEARSON RESERVOIR | 8/18/2011 | 84.5 | DSP; FIS; IND_SW; REC |
| South Platte | P13795R | NORTH LAKE PEARSON RESERVOIR | 8/18/2011 | 125.88 | DSP; FIS; IND_SW; REC |

Notes: 1. Permitted Uses: CMU - Combined uses, DSP - domestic supply, FIS - fish propagation, IND_SW - Industrial, REC - recreation, IRR_SW - Irrigation, WL - wildlife.
2. No Appropriation was granted for P13895R since the appropriation was originally permitted under P12415R.


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**Table 4. Reservoirs in the Pathfinder to Guernsey Subbasin**

| Permit number | Reservoir name | Priority date | Active capacity acre-feet | Inactive capacity acre-feet | Enlargement capacity acre-feet | Total capacity acre-feet |
|---|---|---|---|---|---|---|
| P728R | LaPrele Reservoir | 9/21/1905 | | | | 15,106.0 |
| P1581R | LaPrele Reservoir, Enl. | 7/7/1909 | | | 4,894.0 | 20,000.0 |
| P1708R | Johnson No. 1 Reservoir | 10/11/1909 | | | | 11,865.0 |
| P6279R | Soda Lake Reservoir | 1/20/1956 | | | | 8,815.0 |
| P549R | Bates Creek Reservoir | 2/16/1904 | | | | 3,112.0 |
| P5144R | Bates Creek Reservoir, Enl. | 9/29/1939 | | | 1,605.0 | 4,717.0 |
| P5199R | J. and J. Reservoir | 10/19/1939 | | | | 1,423.1 |
| P1067R | Reynolds No. 2 Reservoir | 6/27/1907 | | | | 1,008.0 |
| P13409R | Eastgate Reservoir | 2/10/2009 | | | | 575.3 |
| P14106R | McMurry No. 4 Reservoir | 3/19/2013 | | | | 367.2 |
| P13232R | CCI | 11/1/2006 | | | | 240.4 |
| P13729R | McMurry No. 2 Reservoir | 2/3/2011 | | | | 92.4 |
| P13125R | Eastdale Creek Detention Reservoir no. 2 | 9/17/2007 | | | | 57.2 |
| P12606R | Reese Reservoir | 2/22/2006 | | | | 53.0 |
| P14174R | Henrie No. 2 | 10/14/2013 | | | | 51.1 |
| Source: Wyoming State Engineer's Office. | | | | | | |

**Table 5. Reservoirs in the Guernsey to State Line Subbasin**

| Permit number | Reservoir name | Priority date | Active capacity acre-feet | Inactive capacity acre-feet | Enlargement capacity acre-feet | Total capacity acre-feet |
|---|---|---|---|---|---|---|
| P6423R | Detention Reservoir Pine Ridge - 1 | 4/24/1958 | | | | 2,207.72 |
| P6422R | Detention Reservoir Case Bier - 1 | 4/24/1958 | | | | 1,458.88 |
| P1310R | Harris Reservoir | 6/17/1908 | | | | 292.81 |
| P2110R | Harris Reservoir, Enl. | 4/8/1911 | | | 1,013.04 | 1,305.85 |
| P4594R | Arnold Reservoir | 8/7/1934 | | | | 770.00 |
| P6879R | Arnold Reservoir, Enl. | 7/1/1963 | | | 364.45 | 1,134.45 |
| P12936R | Frontier Reservoir | 10/13/2006 | | | | 331.80 |
| Source: Wyoming State Engineer's Office. | | | | | | |

**Table 6. Reservoirs in the Upper Laramie Subbasin**

| Permit number | Reservoir name | Priority date | Active capacity acre-feet | Inactive capacity acre-feet | Enlargement capacity acre-feet | Total capacity acre-feet |
|---|---|---|---|---|---|---|
| P1724D | Wyoming Development Company No. 2 Reservoir (Wheatland No. 2) | 1/29/1898 | | | | 98,934.00 |
| P4978R | Wheatland Irrigation District No. 3 Reservoir | 5/31/1929 | 47,429.80 | 23,889.00 | | 71,318.80 |
| P1372R | Lake Hattie Reservoir | 5/11/1908 | | | | 28,426.00 |
| P9250R | Lake Hattie Reservoir, Enl. | 5/1/1986 | | | 36,834.00 | 65,260.00 |
| P1279R | James Lake Reservoir | 3/27/1908 | | | | 8,990.00 |
| P7435R | Twin Buttes Reservoir | 2/3/1972 | 936.90 | 2,975.40 | | 3,912.30 |
| P4156R | Twelve Mile Reservoir | 1/31/1929 | | | | 3,420.50 |
| P528R | Dutton Creek Reservoir | 7/1/1904 | | | | |
| P1215R | Dutton Creek Reservoir, Enl. | 2/17/1908 | | | | |
| P2375R | Dutton Creek Reservoir, 2nd Enl. | 8/2/1912 | | | | |
| P3617R | King No. 1 Reservoir | 2/7/1920 | | | | |
| P5641R | Sportsman Lake Reservoir | 10/12/1948 | | | | 1,459.00 |
| P761R | Willow Creek Reservoir (as changed to Willow Creek No. 2 Reservoir) | 10/17/1905 | | | | 284.27 |
| P5620R | Willow Creek Reservoir, 1st Enl. (as changed to Willow Creek No. 2 Reservoir) | 9/15/1947 | | | 472.36 | 756.63 |
| P8026R | Willow Creek No. 2 Reservoir | 8/2/1978 | | | | 473.71 |
| P6537R | Berg (Lake Owen) Reservoir | 5/8/1956 | | | | 750.68 |
| P14093R | Spiegelberg Springs | 4/22/2013 | | | | 131.40 |

Source: Wyoming State Engineer's Office.

## Table 7. Reservoirs in the Lower Laramie Subbasin

| Permit number | Reservoir name | Priority date | Active capacity acre-feet | Inactive capacity acre-feet | Enlargement capacity acre-feet | Total capacity acre-feet |
|---|---|---|---|---|---|---|
| P7649R | Grayrocks Reservoir | 4/24/1973 | 101,551.50 | 2,558.10 | | 104,109.60 |
| P79R | Wyoming Development Company No. 1 Reservoir | 3/00/1897 | | | | 5,360.00 |
| P5387R | Wyoming Development Company No. 1 Reservoir, Enlargement | 8/18/1938 | | | 1,795.75 | 7,155.75 |
| P6470R | Wyoming Development Company No. 1 Reservoir, 2nd Enl. | 7/10/1958 | | | 2,214.00 | 9,369.75 |
| P1515R | North Laramie Land Co. No. 1 Reservoir | 5/1/1909 | | | | 1,909.60 |
| P1517R | North Laramie Land Co. No. 3 Reservoir | 5/1/1909 | | | | 3,064.89 |
| P7252R | Toltec Reservoir | 3/27/1967 | | | | 2,945.00 |
| P7810R | MBPP Ash Pond Reservoir | 11/16/1976 | | | | 2,111.10 |
| P1989R | Glomill Reservoir | 11/17/1910 | 810.00 | | | 810.00 |
| P7670R | Glomill Reservoir, Enlargement of the | 3/11/1975 | | | 486.40 | 1,296.40 |
| P14249R | Wheatland Wastewater Lagoon Sys. | 5/23/2013 | | | | 418.80 |

Source: Wyoming State Engineer's Office.

## Table 8. Reservoirs in the Horse Creek Subbasin

| Permit number | Reservoir name | Priority date | Active capacity acre-feet | Inactive capacity acre-feet | Enlargement capacity acre-feet | Total capacity acre-feet |
|---|---|---|---|---|---|---|
| P1307R | Hawk Springs Reservoir | 5/25/1908 | | | | 15,718.00 |
| P2568R | Hawk Springs Reservoir, Enlargement | 10/13/1913 | | | 1,017.00 | 16,735.00 |
| P349R | Goshen Hole Reservoir | 11/5/1902 | | | | 3,327.24 |
| P4425R | Goshen Hole Reservoir, Enlargement | 6/7/1930 | | | 1,633.95 | 4,961.19 |
| P941R | J.H.D. No. 1 Reservoir | 10/19/1906 | | | | 2,040.85 |
| P2140R | Goshen Reservoir | 5/22/1911 | | | | 765.60 |
| P3517R | Goshen Nos. 1 and 2 Reservoir, Enlargement | 1/8/1919 | | | 287.40 | 1,929.00 |
| P2716R | Goshen No. 2 Reservoir | 7/16/1914 | | | | 876.00 |
| P3605R | Sinnard Reservoir | 2/11/1920 | | | | 1,358.31 |

Source: Wyoming State Engineer's Office.

**Table 9. Reservoirs in the South Platte Subbasin**

| Permit number | Reservoir name | Priority date | Active capacity acre-feet | Inactive capacity acre-feet | Enlargement capacity acre-feet | Total capacity acre-feet |
|---|---|---|---|---|---|---|
| P261R | Cheyenne No. 2 Reservoir (Granite Springs Reservoir) | 11/9/1901 | | | | 7,367.00 |
| P1317R | Crystal Lake Reservoir | 10/10/1906 | | | | 3,618.00 |
| P3684R | Crystal Lake Reservoir, Enl. | 1/31/1921 | | | 894.70 | 4,512.70 |
| P928R | One Mile Reservoir | 10/5/1906 | | | | 127.16 |
| P1060R | One Mile Reservoir,Enl. | 6/8/1907 | | | 2,120.00 | 2,247.16 |
| P4152R | Upper Van Tassell Reservoir | 10/24/1912 | | | | 1,867.90 |
| P3984R | W.H.R. Reservoir | 9/25/1924 | | | | 674.29 |
| P4402R | W.H.R. Reservoir, Enl. | 10/8/1929 | | | 203.75 | 878.04 |
| P4032R | W.H.R. No. 2 Reservoir | 12/11/1925 | | | | 794.65 |
| P4640R | W.H.R. No. 2 Reservoir, 1st Enl. | 2/10/1936 | | | 82.70 | 877.35 |
| P994R | Polaris Reservoir | 12/22/1906 | | | | 440.00 |
| P1476R | Polaris Reservoir | 3/30/1909 | | | 607.62 | 1,047.62 |
| P12527R | Warren Air Force Base BNSF Pond Reservoir | 3/20/2006 | | | | 130.50 |
| P13795R | North Lake Pearson Reservoir | 8/18/2011 | | | | 125.88 |
| P12970R | Burnett Diary No. 1 Reservoir | 6/27/2007 | | | | 93.18 |
| P13794R | South Lake Pearson Reservoir | 8/18/2011 | | | | 84.50 |

Source: Wyoming State Engineer's Office.

## APPENDIX 3-D

Industrial Water Wells Yielding 50+ GPM Completed After January 1, 2005 with Priority Dates Since 2006

Oil and Gas Water Wells and CBM Wells with Priority Dates after 2006 Completed After January 1, 2014

Industrial Reservoirs Permitted by the Wyoming SEO Since the 2006 Platte River Basin Plan

**Table 1: Industrial Water Wells Yielding 50+ GPM Completed After January 1, 2004 with Priority Dates Since 2006**

| | Permit No | Priority Date | Company/Name | Facility Name | Latitude | Longitude | Twn | Rng | Sec | Qtr Qtr | Total Flow | Subcategory |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **Above Pathfinder Dam Subbasin** | | | | | | | | | | | |
| 1 | P189879.0W | 2/23/2009 | WYDOT | BROKAW PIT | 41.595167 | -106.1995 | 019N | 078W | 30 | NW1/4NE1/4 | 50 | Agg |
| 2 | P201721.0W | 12/19/2013 | ENERGY FUELS WYOMING INC. | SHEEP II SHAFT | 42.3758 | -107.82111 | 028N | 092W | 28 | NW1/4NE1/4 | 1,000 | Mine |
| 3 | P201720.0W | 12/19/2013 | ENERGY FUELS WYOMING INC. | SHEEP I SHAFT | 42.38293 | -107.8113 | 028N | 092W | 22 | NW1/4SW1/4 | 1,000 | Mine |
| 4 | P200271.0W | 2/21/2013 | ARCH OF WYOMING, LLC | SBH-SOUTH PORTAL #1 | 41.738964 | -106.390869 | 020N | 080W | 4 | SW1/4NE1/4 | 1,000 | Mine |
| 5 | P200270.0W | 2/21/2013 | ARCH OF WYOMING, LLC | SBH-EAST PORTAL #1 | 41.752336 | -106.444008 | 021N | 080W | 31 | NE1/4NE1/4 | 1,300 | Mine |
| 6 | P181753.0W | 6/5/2007 | KENNECUTT URANIUM COMPANY | BE-001 | 42.34625 | -107.74412 | 027N | 091W | 6 | NW1/4NE1/4 | 150 | Mine |
| 7 | P191170.0W | 7/1/2009 | MCMURRY READY MIX | PIT SEC. 14 | 41.791469 | -107.3052 | 021N | 088W | 14 | NE1/4SW1/4 | 100 | Road |
| 8 | P200679.0W | 5/1/2013 | ARCH OF WYOMING, LLC | ROSEBUDPIT #1 | 41.874631 | -106.584519 | 022N | 082W | 13 | NW1/4SE1/4 | 200 | Stk |
| 9 | P173173.0W | 1/9/2006 | Wyo State Game & Fish Dept. | PENNOCK SECTION 34 | 41.48356 | -106.72524 | 018N | 083W | 34 | SW1/4SW1/4 | 75 | Stk |
| | **Pathfinder to Guernsey Subbasin** | | | | | | | | | | | |
| | **Permit_No** | **Priority_Date** | **Company/Name** | **Facility_Name** | **Latitude** | **Longitude** | **Twn** | **Rng** | **Sec** | **Qtr_Qtr** | **Total_Flow** | **Subcategory** |
| 1 | P203146.0W | 10/17/2014 | GGH AGGREGATE LLC | JOE BRIGHT G.A. #1 | 42.67944 | -105.02162 | 031N | 068W | 9 | NE1/4NW1/4 | 1,000 | Agg |
| 2 | P194726.0W | 1/4/2011 | CROELL REDI-MIX INC | ELKHORN SAND & GRAVEL PIT #1 | 42.573275 | -105.075272 | 030N | 069W | 13 | SW1/4NE1/4 | 200 | Agg |
| 3 | P198424.0W | 6/26/2012 | CROELL REDI MIX, INC. | ENL. ELKHORN SAND & GRAVEL PIT #1 | 42.57285 | -105.075039 | 030N | 069W | 13 | SW1/4NE1/4 | 300 | Agg |
| 4 | P203080.0W | 10/27/2014 | CAMECO RESOURCES | SWNE 21-35-74 (UP TO 56 WELLS) MINE UNIT 10 EXT | 42.99193 | -105.73938 | 035N | 074W | 21 | SW1/4NE1/4 | 1,400 | Mine |
| 5 | P203079.0W | 10/27/2014 | CAMECO RESOURCES | NWNE 21-35-74 (UP TO 87 WELLS) MINE UNIT 10 EXT | 42.99578 | -105.73939 | 035N | 074W | 21 | NW1/4NE1/4 | 2,175 | Mine |
| 6 | P203078.0W | 10/27/2014 | CAMECO RESOURCES | NENW 21-35-74 (UP TO 70 WELLS) MINE UNIT 10 EXT | 42.99575 | -105.74432 | 035N | 074W | 21 | NE1/4NW1/4 | 1,750 | Mine |
| 7 | P203077.0W | 10/27/2014 | CAMECO RESOURCES | SWSE 16-35-74 (UP TO 52 WELLS) MINE UNIT 10 EXT | 42.99927 | -105.73953 | 035N | 074W | 16 | SW1/4SE1/4 | 1,300 | Mine |
| 8 | P203076.0W | 10/27/2014 | CAMECO RESOURCES | SESW 16-35-74 (UP TO 81 WELLS) MINE UNIT 10 EXT | 42.99927 | -105.74418 | 035N | 074W | 16 | SE1/4SW1/4 | 2,025 | Mine |
| 9 | P203075.0W | 10/27/2014 | CAMECO RESOURCES | NESW 16-35-74 (UP TO 117 WELLS) MINE UNIT 10 EXT | 43.00293 | -105.74427 | 035N | 074W | 16 | NE1/4SW1/4 | 2,925 | Mine |
| 10 | P203074.0W | 10/27/2014 | CAMECO RESOURCES | NWSW 16-35-74 (UP TO 11 WELLS) MINE UNIT 10 EXT | 43.00296 | -105.75153 | 035N | 074W | 16 | NW1/4SW1/4 | 275 | Mine |
| 11 | P201526.0W | 1/29/2014 | CAMECO RESOURCES | SE/SE 7-35-74 (UP TO 15 WELLS)-MINE UNIT 9 (I & P) | 43.01339 | -105.7741 | 035N | 074W | 7 | SE1/4SE1/4 | 375 | Mine |
| 12 | P199096.0W | 8/30/2012 | CAMECO RESOURCES | 3674-36-CPPWW-1 | 43.05326 | -105.68603 | 036N | 074W | 36 | NE1/4NW1/4 | 50 | Mine |
| 13 | P198125.0W | 5/4/2012 | CAMECO RESOURCES | SE/NW 26-36-74(UP TO 15 WELLS) - MINE UNIT 3 (I&P) | 43.06415 | -105.69914 | 036N | 074W | 26 | SW1/4NE1/4 | 375 | Mine |
| 14 | P198124.0W | 5/4/2012 | CAMECO RESOURCES | SE/NW 26-36-74(UP TO 20 WELLS) - MINE UNIT 3 (I&P) | 43.06402 | -105.70565 | 036N | 074W | 26 | SE1/4NW1/4 | 500 | Mine |
| 15 | P197323.0W | 1/9/2012 | CAMECO RESOURCES | SW/SE 27-36-74 (UP TO 66 WELLS)-MINE UNIT 7(I&P) | 43.056881 | -105.720261 | 036N | 074W | 27 | SW1/4SE1/4 | 1,650 | Mine |
| 16 | P197317.0W | 1/9/2012 | CAMECO RESOURCES | NW/SE 27-36-74 (UP TO 25 WELLS)-MINE UNIT 7(I&P) | 43.060467 | -105.720328 | 036N | 074W | 27 | NW1/4SE1/4 | 625 | Mine |
| 17 | P196924.0W | 10/5/2011 | CAMECO RESOURCES | SE/NE 11-35-74(16 WELLS)-MINE UNIT 15A (I&P WELLS) | 43.021953 | -105.695233 | 035N | 074W | 11 | SE1/4NE1/4 | 160 | Mine |
| 18 | P195811.0W | 5/2/2011 | CAMECO RESOURCES | SE/NE 26-36-74 (75 WELLS)-MINE UNIT 3 (I&P WELLS) | 43.06467 | -105.69738 | 036N | 074W | 26 | SE1/4NE1/4 | 1,125 | Mine |
| 19 | P195810.0W | 5/2/2011 | CAMECO RESOURCES | SW/NE 26-36-74 (4 WELLS) - MINE UNIT 3 (I&P WELLS) | 43.06425 | -105.69925 | 036N | 074W | 26 | SW1/4NE1/4 | 60 | Mine |
| 20 | P191231.0W | 6/22/2009 | CAMECO RESOURCES | ENL. NE/SW 11-35-74 - MINE UNIT 15A | 43.016856 | -105.705169 | 035N | 074W | 11 | NE1/4SW1/4 | 1,155 | Mine |
| 21 | P189700.0W | 1/7/2009 | CAMECO RESOURCES | WELLFIELD 3 SW/NW/26 | 43.062778 | -105.708656 | 036N | 074W | 26 | SW1/4NW1/4 | 120 | Mine |
| 22 | P189699.0W | 1/7/2009 | CAMECO RESOURCES | WELLFIELD 3 SE/NW/26 | 43.062903 | -105.707369 | 036N | 074W | 26 | SE1/4NW1/4 | 210 | Mine |
| 23 | P189698.0W | 1/7/2009 | CAMECO RESOURCES | WELLFIELD 3 NW/SW/26 | 43.062069 | -105.709608 | 036N | 074W | 26 | NW1/4SW1/4 | 930 | Mine |
| 24 | P189697.0W | 1/7/2009 | CAMECO RESOURCES | WELLFIELD 3 NE/SW/26 | 43.061153 | -105.705483 | 036N | 074W | 26 | NE1/4SW1/4 | 1,695 | Mine |
| 25 | P189696.0W | 1/7/2009 | CAMECO RESOURCES | WELLFIELD 3 SW/NE/26 | 43.062806 | -105.70325 | 036N | 074W | 26 | SW1/4NE1/4 | 75 | Mine |
| | | | | | | | | | | | | |
| | **Pathfinder to Guernsey Subbasin (cont'd)** | | | | | | | | | | | |

**Table 1: Industrial Water Wells Yielding 50+ GPM Completed After January 1, 2004 with Priority Dates Since 2006**

| | Permit No | Priority Date | Company/Name | Facility Name | Latitude | Longitude | Twn | Rng | Sec | Qtr Qtr | Total Flow | Subcategory |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 26 | P189695.0W | 1/7/2009 | CAMECO RESOURCES | WELLFIELD 3 SW/SE/26 | 43.058975 | -105.701725 | 036N | 074W | 26 | SW1/4SE1/4 | 285 | Mine |
| 27 | P189694.0W | 1/7/2009 | CAMECO RESOURCES | WELLFIELD 3 NW/SE/26 | 43.060889 | -105.702114 | 036N | 074W | 26 | NW1/4SE1/4 | 1,680 | Mine |
| 28 | P185943.0W | 2/26/2008 | CAMECO RESOURCES | ENL. NW/SW 11-35-74 (60 WELLS) - MINE UNIT 15A | 43.016772 | -105.712517 | 035N | 074W | 11 | NW1/4SW1/4 | 900 | Mine |
| 29 | P185942.0W | 2/26/2008 | CAMECO RESOURCES | ENL. SW/NW 11-35-74 (90 WELLS) - MINE UNIT 15A | 43.020428 | -105.710061 | 035N | 074W | 11 | SW1/4NW1/4 | 1,350 | Mine |
| 30 | P194965.0W | 1/20/2011 | POWER RESOURCES DBA CAMECO RESOURCES | WELLFIELD 1 NE/NW/36 | 43.05238 | -105.68368 | 036N | 074W | 36 | NE1/4NW1/4 | 225 | Mine |
| 31 | P194964.0W | 1/20/2011 | POWER RESOURCES DBA CAMECO RESOURCES | WELLFIELD 1 SW/NE/36 | 43.05021 | -105.68066 | 036N | 074W | 36 | SW1/4NE1/4 | 1,200 | Mine |
| 32 | P194963.0W | 1/20/2011 | POWER RESOURCES DBA CAMECO RESOURCES | WELL FIELD 1 SE/NW/36 | 43.05114 | -105.68562 | 036N | 074W | 36 | SE1/4NW1/4 | 1,450 | Mine |
| 33 | P193386.0W | 7/12/2010 | POWER RESOURCES INC | NE/SW 16-35-74 (35 WELLS) - MU 10 (I&P WELLS) | 43.0025 | -105.7443 | 035N | 074W | 16 | NE1/4SW1/4 | 195 | Mine |
| 34 | P193384.0W | 7/12/2010 | POWER RESOURCES INC | SW/NW 16-35-74-(94 WELLS) - MU 10 (I&P WELLS) | 43.00675 | -105.75001 | 035N | 074W | 16 | SW1/4NW1/4 | 525 | Mine |
| 35 | P193382.0W | 7/12/2010 | POWER RESOURCES INC | SW/NE 17-35-74 (51 WELLS) - MU 10 (I&P WELLS) | 43.00717 | -105.75961 | 035N | 074W | 17 | SW1/4NE1/4 | 270 | Mine |
| 36 | P193380.0W | 7/12/2010 | POWER RESOURCES INC | SW/NW 17-35-74 (55 WELLS) - MU 10 (I&P WELLS) | 43.00529 | -105.76889 | 035N | 074W | 17 | SW1/4NW1/4 | 300 | Mine |
| 37 | P182216.0W | 6/20/2007 | POWER RESOURCES, INC | SE/SE 7-35-74 (11 WELLS) - MINE UNIT 9 (I&P WELLS) | 43.01524 | -105.77416 | 035N | 074W | 7 | SE1/4SE1/4 | 165 | Mine |
| 38 | P182210.0W | 6/20/2007 | POWER RESOURCES, INC | SW/NE 18-35-74 (11 WELLS) - MINE UNIT 9 (I&P WELLS) | 43.004747 | -105.777047 | 035N | 074W | 18 | SW1/4NE1/4 | 110 | Mine |
| 39 | P182207.0W | 6/20/2007 | POWER RESOURCES, INC | NE/SW 18-35-74 (51 WELLS) - MINE UNIT 9 (I&P WELLS) | 43.001433 | -105.783731 | 035N | 074W | 18 | NE1/4SW1/4 | 510 | Mine |
| 40 | P182206.0W | 6/20/2007 | POWER RESOURCES, INC | NW/SE 18-35-74 (45 WELLS) - MINE UNIT 9 (I&P WELLS) | 43.003681 | -105.779225 | 035N | 074W | 18 | NW1/4SE1/4 | 450 | Mine |
| 41 | P182205.0W | 6/20/2007 | POWER RESOURCES, INC | SW/SW 18-35-74 (53 WELLS) - MINE UNIT 9 (I&P WELLS) | 42.999508 | -105.786686 | 035N | 074W | 18 | SW1/4SW1/4 | 795 | Mine |
| 42 | P182204.0W | 6/20/2007 | POWER RESOURCES, INC | SE/SW 18-35-74 (12 WELLS) - MINE UNIT 9 (I&P WELLS) | 43.000367 | -105.785714 | 035N | 074W | 18 | SE1/4SW1/4 | 120 | Mine |
| | **Pathfinder to Guernsey Subbasin** | | | | | | | | | | | |
| | **Permit No** | **Priority Date** | **Company/Name** | **Facility Name** | **Latitude** | **Longitude** | **Twn** | **Rng** | **Sec** | **Qtr Qtr** | **Total Flow** | **Subcategory** |
| 43 | P172673.0W | 9/21/2005 | POWER RESOURCES, INC | SW/NW 11-35-74 (7 WELLS)-MINE UNIT 15 (I&P WELLS) | 43.0203 | -105.7125 | 035N | 074W | 11 | SW1/4NW1/4 | 105 | Mine |
| 44 | P172669.0W | 9/21/2005 | POWER RESOURCES, INC | NE/SE 10-35-74 (114 WELLS)-MINE UNIT 15 (I&P WELLS) | 43.017342 | -105.715028 | 035N | 074W | 10 | NE1/4SE1/4 | 1,710 | Mine |
| 45 | P172666.0W | 9/21/2005 | POWER RESOURCES, INC | NW/SW 10-35-74 (50 WELLS)-MINE UNIT 15 (I&P WELLS) | 43.01736 | -105.72979 | 035N | 074W | 10 | NW1/4SW1/4 | 750 | Mine |
| 46 | P197081.0W | 11/7/2011 | POWER RESOURCES, INC. | SE/NE 18-35-74 (85 WELLS)- MINE UNIT 9 (I&P WELLS) | 43.006386 | -105.773892 | 035N | 074W | 18 | SE1/4NE1/4 | 850 | Mine |
| 47 | P195273.0W | 2/2/2011 | CHESAPEAKE OPERATING | SOUTH HYLTON RANCH 34-74 24-1H WW | 42.908353 | -105.680028 | 034N | 074W | 24 | NW1/4NE1/4 | 150 | Mine |
| 48 | P198801.0W | 8/9/2012 | DENBURY ONSHORE, LLC | MORTON 1-22-1 | 42.7325 | -107.0056 | 032N | 085W | 22 | SE1/4NW1/4 | 150 | Mine |
| 49 | P198881.0W | 9/11/2012 | PINNACLE MATERIALS, LLC | SHAWNEE QUARRY NO. 1 WELL | 42.678886 | -105.021567 | 031N | 068W | 9 | NE1/4NW1/4 | 250 | Mine |
| 50 | P202033.0W | 11/27/2013 | TEXACO DOWNSTREAM PROPERTIES INC | EW-3B | 42.86263 | -106.26101 | 033N | 079W | 1 | NE1/4NE1/4 | 120 | Mine |
| 51 | P199729.0W | 1/31/2013 | FULLSPEED SERVICE, LLC | CAND1 | 42.88685 | -106.339247 | 034N | 079W | 29 | SE1/4NE1/4 | 50 | Misc |
| 52 | P197879.0W | 3/23/2012 | ACME HOLDINGS LLC | BUCKSHOT 1 | 42.77715 | -105.37908 | 032N | 071W | 4 | SE1/4NW1/4 | 75 | Misc |
| 53 | P202124.0W | 5/29/2014 | WYDOT | ENL. BIG HOLE #1 WELL | 42.74961 | -104.81842 | 032N | 066W | 18 | SE1/4NE1/4 | 50 | Road |
| 54 | P199867.0W | 1/10/2013 | WYDOT | EL RANCHO WELL #1 | 42.26499 | -105.03857 | 027N | 068W | 32 | SE1/4SW1/4 | 150 | Road |
| 55 | P199866.0W | 1/9/2013 | WYDOT | CASSA NORTH WELL #1 | 42.34533 | -105.04371 | 027N | 068W | 5 | SW1/4NW1/4 | 150 | Road |
| 56 | P176949.0W | 5/15/2006 | TRUE DRILLING LLC | SUSIE NO. 5 WELL | 42.79678 | -106.34921 | 033N | 079W | 29 | NE1/4SW1/4 | 50 | Stk |
| 57 | P155944.0W | 12/15/2003 | WAGONHOUND LAND AND LIVESTOCK CO LLC | ENL MAIN HOUSE WELL | 42.58188 | -105.56247 | 030N | 073W | 11 | NE1/4SE1/4 | 100 | Stk |
| | **Guernsey to State Line Subbasin** | | | | | | | | | | | |
| | **Permit No** | **Priority Date** | **Company/Name** | **Facility Name** | **Latitude** | **Longitude** | **Twn** | **Rng** | **Sec** | **Qtr Qtr** | **Total Flow** | **Subcategory** |
| 1 | P185107.0W | 1/28/2008 | SIMPLOT GROWER SOLUTIONS | SIMPLOT GROWER SOLUTIONS #1 | 42.042222 | -104.187222 | 024N | 061W | 22 | NW1/4NW1/4 | 50 | Misc |
| 2 | P201378.0W | 11/19/2013 | PANHANDLE COOP | PANHANDLE COOP#1 | 42.06678 | -104.19452 | 024N | 061W | 9 | NW1/4SE1/4 | 100 | Misc |

**Table 1: Industrial Water Wells Yielding 50+ GPM Completed After January 1, 2004 with Priority Dates Since 2006**

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3 | P200320.0W | 5/20/2013 | HERITAGE MATERIALS & SUPPLY, LLC | STOCK #1 | 42.033667 | -104.198972 | 024N | 061W | 21 | SE1/4SW1/4 | 200 | Misc |
| 4 | P195704.0W | 10/15/2010 | DENNIS R AND CYNTHIA L HUCKFELDT | HUCKFELDT WEST PIT NO. 2 WELL | 42.06519 | -104.19251 | 024N | 061W | 9 | NE1/4SE1/4 | 80 | Misc |
| 5 | P195703.0W | 10/15/2010 | DENNIS R AND CYNTHIA L HUCKFELDT | HUCKFELDT EAST PIT NO. 1 WELL | 42.06523 | -104.19227 | 024N | 061W | 9 | NE1/4SE1/4 | 80 | Misc |
| 6 | P165511.0W | 1/19/2005 | | GOSHEN COUNTY WEED AND PEST DISTRICT WELL NO. 1 | 42.080236 | -104.224683 | 024N | 061W | 5 | NW1/4SW1/4 | 50 | Misc |
| 7 | P169879.0W | 6/10/2005 | LEROY & SALLY LAMB | LAMB NO. 1 | 42.08709 | -104.2442 | 024N | 061W | 6 | NW1/4NW1/4 | 100 | Stk |
| 8 | P169598.0W | 7/29/2004 | BLAIR J MERRIAM | BIG PRAIRIE #2 | 42.51511 | -104.15589 | 029N | 061W | 2 | NE1/4SW1/4 | 400 | Stk |
| 9 | P160985.0W | 7/23/2004 | WYOMING STOCKYARDS, INC | WYOMING STOCKYARD INC. #2 | 42.0694 | -104.19088 | 024N | 061W | 9 | SE1/4NE1/4 | 60 | Stk |
| 10 | P154977.0W | 10/6/2003 | MAKE BEBO | BEBO #5 | 42.16995 | -104.43728 | 025N | 063W | 4 | SW1/4NW1/4 | 200 | Stk |
| | **Upper Laramie Subbasin** | | | | | | | | | | | |
| | **Permit No** | **Priority Date** | **Company/Name** | **Facility Name** | **Latitude** | **Longitude** | **Twn** | **Rng** | **Sec** | **Qtr Qtr** | **Total Flow** | **Subcategory** |
| 1 | P200785.0W | 5/20/2013 | PETE LIEN & SONS, INC. | JONATHON WELL NO. 1 | 41.462783 | -105.584086 | 017N | 073W | 9 | SW1/4NE1/4 | 500 | Agg |
| | **Lower Laramie Subbasin** | | | | | | | | | | | |
| | **Permit No** | **Priority Date** | **Company/Name** | **Facility Name** | **Latitude** | **Longitude** | **Twn** | **Rng** | **Sec** | **Qtr Qtr** | **Total Flow** | **Subcategory** |
| 1 | P198469.0W | 12/12/2011 | CHRISTOPHER WRIGHT | WRIGHT NO. 1 | 42.09063 | -104.96948 | 025N | 068W | 35 | SE1/4SE1/4 | 50 | Agg |
| 2 | P171681.0W | 6/27/2005 | BASIN ELECTRIC POWER COOPERATIVE | FORELL BAUMGARDNER NO.2 WELL | 42.113319 | -104.874346 | 025N | 067W | 27 | SW1/4NE1/4 | 950 | Power |
| 3 | P198529.0W | 4/6/2012 | FLYING H LAND AND CATTLE | FLYING H NO. 2 | 41.953253 | -105.043025 | 023N | 068W | 19 | SE1/4NE1/4 | 100 | Stk |
| 4 | P169878.0W | 4/27/2005 | | MURIEL #1 | 42.0762 | -104.97535 | 024N | 068W | 2 | SE1/4SW1/4 | 100 | Stk |
| | **Horse Creek Subbasin** | | | | | | | | | | | |
| | **Permit No** | **Priority Date** | **Company/Name** | **Facility Name** | **Latitude** | **Longitude** | **Twn** | **Rng** | **Sec** | **Qtr Qtr** | **Total Flow** | **Subcategory** |
| 1 | P202295.0W | 4/12/2014 | | FEEDYARD WELL #3 | 41.92061 | -104.129 | 023N | 060W | 31 | NW1/4SW1/4 | 85 | Stk |
| | **South Platte Subbasin** | | | | | | | | | | | |
| | **Permit No** | **Priority Date** | **Company/Name** | **Facility Name** | **Latitude** | **Longitude** | **Twn** | **Rng** | **Sec** | **Qtr Qtr** | **Total Flow** | **Subcategory** |
| 1 | P200088.0W | 3/1/2013 | GRANITE CANYON QUARRY, MARTIN MARIETTA MATERIALS | SECONDARY #2 | 41.104664 | -105.175922 | 013N | 070W | 12 | SE1/4SE1/4 | 50 | Agg |
| 2 | P189917.0W | 1/21/2009 | POLO RANCH COMPANY | ENL POLO 18-3 | 41.180717 | -104.931347 | 014N | 067W | 18 | NW1/4SE1/4 | 75 | Agg |
| 3 | P200770.0W | 7/16/2013 | WILLITS COMPANY INC | HARRIMAN #1 | 41.097483 | -105.175789 | 013N | 070W | 13 | SE1/4NE1/4 | 125 | Agg |
| 4 | P194604.0W | 11/12/2010 | JEBRO INC | JEBRO SITE NO. 2 | 41.06042 | -104.88864 | 013N | 067W | 28 | SE1/4SE1/4 | 200 | Agg |
| 5 | P194603.0W | 11/12/2010 | JEBRO INC | JEBRO SITE NO. 1 | 41.06009 | -104.89066 | 013N | 067W | 28 | SE1/4SE1/4 | 200 | Agg |
| 6 | P195611.0W | 2/18/2011 | CHEYENNE-LARAMIE COUNTY CORP FOR ECONOMIC DEVELOPM | CHEYENNE LEADS SWAN RANCH WELL # 1 | 41.056847 | -104.889144 | 013N | 067W | 33 | NE1/4NE1/4 | 50 | Misc |
| 7 | P202799.0W | 8/26/2013 | GENERATION DEVELOPMENT COMPANY, LLC | CPGS 1 | 41.11826 | -104.72539 | 013N | 066W | 1 | SE1/4SW1/4 | 400 | Power |
| 8 | P167488.0W | 4/25/2005 | | HEREFORD PIT #1 | 41.13608 | -104.68709 | 014N | 065W | 32 | NE1/4SW1/4 | 50 | Road |
| 9 | P164656.0W | 1/3/2005 | Wyo State Dept. of Transportation | LONE TREE #1 | 41.13406 | -105.35019 | 014N | 071W | 33 | SE1/4SE1/4 | 50 | Road |
| 10 | P194170.0W | 4/16/2010 | DAVID DUELLO | DUELLO 2010 | 41.22005 | -104.08855 | 015N | 060W | 33 | NW1/4SE1/4 | 50 | Stk |
| 11 | P168103.0W | 12/30/2004 | BURNETT LAND & LIVESTOCK LTD LLLP | BURNETT DAIRY #4 (SW) | 41.025422 | -104.2503 | 012N | 061W | 7 | SE1/4NW1/4 | 60 | Stk |
| 12 | P168102.0W | 12/30/2004 | BURNETT LAND & LIVESTOCK LTD LLLP | BURNETT DAIRY #3 (SE) | 41.0254 | -104.250258 | 012N | 061W | 7 | SE1/4NW1/4 | 60 | Stk |
| 13 | P168101.0W | 12/30/2004 | BURNETT LAND & LIVESTOCK LTD LLLP | BURNETT DAIRY #2 (NE) | 41.025406 | -104.245531 | 012N | 061W | 7 | SW1/4NE1/4 | 60 | Stk |

**Table 2: Oil and Gas Water Wells and CBM Wells with Priority Dates After 2006 Completed After January 1, 2014**

| | Permit No | Priority Date | Company | Facility Name | Latitude | Longitude | Twn | Rng | Sec | Qtr Qtr | Total Flow |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | **Above Pathfinder Dam Subbasin** | | | | | | | | | | |
| 1 | P186571.0W | 7/25/2006 | MEDICINE BOW FUEL AND POWER, LLC | MBFP #29-4 | 41.756283 | -106.308503 | 021N | 079W | 29 | SE1/4SE1/4 | 1000 |
| 2 | P186570.0W | 7/25/2006 | MEDICINE BOW FUEL AND POWER, LLC | MBFP #29-1 | 41.759897 | -106.308544 | 021N | 079W | 29 | NE1/4SE1/4 | 1000 |
| 3 | P186568.0W | 7/25/2006 | MEDICINE BOW FUEL AND POWER, LLC | MBFP #20-2 | 41.77075 | -106.313414 | 021N | 079W | 20 | SW1/4SE1/4 | 1000 |
| 4 | P186569.0W | 7/25/2006 | MEDICINE BOW FUEL AND POWER, LLC | MBFP #21-1 | 41.778114 | -106.289372 | 021N | 079W | 21 | SE1/4NE1/4 | 1000 |
| 5 | P201252.0W | 8/16/2013 | ELLEN FOX | ELLEN FOX NO. 1 | 42.32635 | -108.25353 | 027N | 096W | 11 | NE1/4SW1/4 | 80 |
| 6 | P198802.0W | 8/13/2012 | STRATHMORE RESOURCES | STM-WS-1 | 42.725617 | -107.599669 | 032N | 090W | 22 | SW1/4SW1/4 | 150 |
| | **Pathfinder to Guernsey Subbasin** | | | | | | | | | | |
| | **Permit No** | **Priority Date** | **Company** | **Facility Name** | **Latitude** | **Longitude** | **Twn** | **Rng** | **Sec** | **Qtr Qtr** | **Total Flow** |
| 1 | P199106.0W | 8/20/2010 | CHESAPEAKE OPERATING INC | SMITH CREEK UNIT 32-70 6WW | 42.77985 | -105.29056 | 032N | 070W | 6 | NE1/4NE1/4 | 150 |
| 2 | P196624.0W | 8/20/2010 | CHESAPEAKE OPERATING INC | COMBS RANCH UNIT 33-70 29-1HWW | 42.7979 | -105.28341 | 033N | 070W | 29 | SW1/4SE1/4 | 150 |
| 3 | P201432.0W | 12/18/2013 | CHESAPEAKE OPERATING INC | CZAR BENNETT WSW | 42.80489 | -105.38647 | 033N | 071W | 28 | SE1/4NW1/4 | 500 |
| 4 | P199881.0W | 3/8/2013 | CHESAPEAKE OPERATING INC | COMBS RANCH 24-33-71 WW | 42.81285 | -105.32435 | 033N | 071W | 24 | SW1/4SE1/4 | 180 |
| 5 | P199095.0W | 6/7/2012 | CHESAPEAKE OPERATING INC | COMBS 22-33-70 A 1H WW | 42.81914 | -105.23873 | 033N | 070W | 22 | SE1/4NE1/4 | 150 |
| 6 | P199134.0W | 9/28/2012 | CHESAPEAKE OPERATING INC | YORK RANCH 19-33-69 WW | 42.82375 | -105.18067 | 033N | 069W | 19 | NE1/4NE1/4 | 180 |
| 7 | P201596.0W | 2/19/2014 | CHESAPEAKE OPERATING INC | COMBS RANCH 10-33-70 WSW | 42.85172 | -105.24133 | 033N | 070W | 10 | NW1/4NE1/4 | 150 |
| 8 | P198889.0W | 9/14/2012 | CHESAPEAKE OPERATING, INC. | MVL 34-33-71 WW | 42.79468 | -105.36422 | 033N | 071W | 34 | NW1/4NE1/4 | 130 |
| 9 | P200976.0W | 5/24/2013 | CHESAPEAKE OPERATING, INC. | COMBS RANCH 28-33-70 WW | 42.801297 | -105.268528 | 033N | 070W | 28 | NE1/4SW1/4 | 180 |
| 10 | P200202.0W | 3/8/2013 | CHESAPEAKE OPERATING, INC. | YORK RANCH 17-33-69 WW | 42.833839 | -105.169219 | 033N | 069W | 17 | SE1/4NW1/4 | 180 |
| 11 | P198835.0W | 8/29/2012 | CHESAPEAKE OPERATING, INC. | KRAUSE 10-33-69 WW | 42.84094 | -105.13159 | 033N | 069W | 10 | SE1/4SW1/4 | 80 |
| 12 | P198775.0W | 7/31/2012 | CHESAPEAKE OPERATING, INC. | COMBS RANCH 7-33-70 WW | 42.84759 | -105.308 | 033N | 070W | 7 | SE1/4NW1/4 | 150 |
| 13 | P200201.0W | 2/21/2013 | CHESAPEAKE OPERATING, INC. | COMBS RANCH 11-33-70 WW | 42.847806 | -105.223658 | 033N | 070W | 11 | SW1/4NE1/4 | 200 |
| 14 | P200199.0W | 1/22/2013 | CHESAPEAKE OPERATING, INC. | YORK RANCH 4-33-69 WW | 42.859369 | -105.149647 | 033N | 069W | 4 | NE1/4SW1/4 | 180 |
| 15 | P200448.0W | 6/3/2013 | CHESAPEAKE OPERATING, INC. | SUNDQUIST FLATS 12-34-72 WW | 42.927886 | -105.449464 | 034N | 072W | 12 | SE1/4SW1/4 | 180 |
| 16 | P202711.0W | 8/6/2014 | CONTANGO ROCKY MOUNTAIN INC | CONTANGO-FORGEY #1 | 43.00928 | -106.34048 | 035N | 079W | 8 | SE1/4SE1/4 | 120 |
| 17 | P177515.0W | 8/11/2006 | FIDELITY EXPLORATION & PRODUCTIN COMPANY | OXBOW WSW #1 | 42.778417 | -106.94815 | 032N | 084W | 6 | NE1/4NW1/4 | 50 |
| 18 | P201652.0W | 3/12/2014 | HOUT FENCING OF WYOMING INC. | HOUT # 1 | 42.68082 | -105.2304 | 031N | 070W | 3 | SE1/4SE1/4 | 100 |
| 19 | P197201.0W | 11/10/2011 | JIM'S WATER SERVICE | JIM'S WATER SERVICE NO. 1 | 42.785833 | -105.370278 | 033N | 071W | 34 | NE1/4SW1/4 | 56 |
| 20 | P199963.0W | 3/14/2013 | LEBAR RANCH LLC | DW BILL HALL #2 | 42.826139 | -105.298031 | 033N | 070W | 18 | SE1/4SE1/4 | 250 |
| 21 | P199964.0W | 3/14/2013 | LEBAR RANCH LLC | DW FLAT TOP #3 | 42.851194 | -105.268603 | 033N | 070W | 9 | NE1/4NW1/4 | 250 |
| 22 | P198905.0W | 8/29/2012 | OXBOW PROPERTIES, INC. | OXBOW WSW #1 | 42.778417 | -106.94815 | 032N | 084W | 6 | NE1/4NW1/4 | 50 |
| 23 | P200087.0W | 6/1/2011 | PARKERTON RANCH, INC. | ENL. #22 SOUTH BIG MUDDY MADISON WATER WELL | 42.827253 | -105.978247 | 033N | 076W | 16 | NE1/4SW1/4 | 160 |
| 24 | P193308.0W | 2/5/2010 | RKI EXPLORATION & PRODUCTION LLC | SPILLMAN DRAW UNIT 35-73 15 - 1H WATER WELL | 43.00263 | -105.60671 | 035N | 073W | 15 | NE1/4SW1/4 | 150 |
| 25 | P198907.0W | 9/6/2012 | THE SOD FARM LLC | ENL. HOME RANCH NO. 3 WELL | 42.867811 | -105.895439 | 034N | 075W | 31 | SW1/4SE1/4 | 110 |
| 26 | P198909.0W | 9/6/2012 | THE SOD FARM LLC | 2ND. ENL. HOME RANCH #1 | 42.867833 | -105.895542 | 034N | 075W | 31 | SW1/4SE1/4 | 100 |
| 27 | P198908.0W | 9/6/2012 | THE SOD FARM LLC | ENL. HOME RANCH NO. 2 WELL | 42.867856 | -105.895458 | 034N | 075W | 31 | SW1/4SE1/4 | 120 |
| | **Pathfinder to Guernsey Subbasin** | | | | | | | | | | |
| | **Permit No** | **Priority Date** | **Company** | **Facility Name** | **Latitude** | **Longitude** | **Twn** | **Rng** | **Sec** | **Qtr Qtr** | **Total Flow** |
| 28 | P199368.0W | 12/4/2012 | WESTERN CABLE, LLC | WESTERN SKY 1 | 42.804328 | -105.3478 | 033N | 071W | 26 | SE1/4NW1/4 | 300 |

**Table 2: Oil and Gas Water Wells and CBM Wells with Priority Dates After 2006 Completed After January 1, 2014**

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 29 | P202882.0W | 9/8/2014 | | ENSERCO DEPOT #2 | 42.67884 | -105.34076 | 031N | 071W | 2 | NW1/4SW1/4 | 200 |
| 30 | P197086.0W | 11/28/2011 | BRAD REESE | ENL HIGH HOPES #2 | 42.73087 | -104.80799 | 032N | 066W | 20 | NE1/4SW1/4 | 250 |
| 31 | P197087.0W | 11/28/2011 | BRAD REESE | ENL HIGH HOPES #3 | 42.73803 | -104.80813 | 032N | 066W | 20 | NE1/4NW1/4 | 250 |
| 32 | P202008.0W | 4/10/2014 | BRIAN MENSING | K & M #1 | 42.78321 | -105.36786 | 033N | 071W | 34 | SE1/4SW1/4 | 200 |
| 33 | P199728.0W | 1/28/2013 | JAY BAUMANN | BAUMANN #1 | 42.82606 | -105.30799 | 033N | 070W | 18 | SE1/4SW1/4 | 250 |
| 34 | P202250.0W | 5/29/2014 | MARTY TILLARD | ENL. TILLARD 15 | 42.89389 | -105.83227 | 034N | 075W | 27 | NE1/4NE1/4 | 50 |
| 35 | P202032.0W | 11/27/2013 | TEXACO DOWNSTREAM PROPERTIES INC | EW-4B | 42.86265 | -106.26099 | 033N | 079W | 1 | NE1/4NE1/4 | 120 |
| 36 | P202031.0W | 11/27/2013 | TEXACO DOWNSTREAM PROPERTIES INC | EW-2B | 42.86265 | -106.25622 | 033N | 078W | 6 | NW1/4NW1/4 | 70 |
| 37 | P202030.0W | 11/27/2013 | TEXACO DOWNSTREAM PROPERTIES INC | EW-1B | 42.86272 | -106.26099 | 033N | 079W | 1 | NE1/4NE1/4 | 80 |
| 38 | P202029.0W | 11/27/2013 | TEXACO DOWNSTREAM PROPERTIES INC | EW-4A | 42.86259 | -106.2609 | 033N | 079W | 1 | NE1/4NE1/4 | 120 |
| 39 | P202028.0W | 11/27/2013 | TEXACO DOWNSTREAM PROPERTIES INC | EW-3A | 42.86263 | -106.26097 | 033N | 079W | 1 | NE1/4NE1/4 | 120 |
| 40 | P202027.0W | 11/27/2013 | TEXACO DOWNSTREAM PROPERTIES INC | EW-2A | 42.86273 | -106.25618 | 033N | 078W | 6 | NW1/4NW1/4 | 70 |
| 41 | P202026.0W | 11/27/2013 | TEXACO DOWNSTREAM PROPERTIES INC | EW-1A | 42.86265 | -106.26095 | 033N | 079W | 1 | NE1/4NE1/4 | 120 |
| 42 | P200447.0W | 5/15/2013 | BP PRODUCTS NORTH AMERICA INC | R-132 | 42.84596 | -106.33726 | 033N | 079W | 8 | SE1/4NE1/4 | 75 |
| 43 | P200446.0W | 5/15/2013 | BP PRODUCTS NORTH AMERICA INC | R-131 | 42.8449 | -106.34279 | 033N | 079W | 8 | SW1/4NE1/4 | 75 |
| 44 | P200445.0W | 5/15/2013 | BP PRODUCTS NORTH AMERICA, INC. | R-130 | 42.84477 | -106.34381 | 033N | 079W | 8 | SW1/4NE1/4 | 75 |
| 45 | P200444.0W | 5/15/2013 | BP PRODUCTS NORTH AMERICA INC | R-129 | 42.84467 | -106.34458 | 033N | 079W | 8 | SW1/4NE1/4 | 75 |
| 46 | P200443.0W | 5/15/2013 | BP PRODUCTS NORTH AMERICA INC | R-128 | 42.84445 | -106.34559 | 033N | 079W | 8 | SW1/4NE1/4 | 75 |
| 47 | P200442.0W | 5/15/2013 | BP PRODUCTS NORTH AMERICA INC | R-127 | 42.84428 | -106.3464 | 033N | 079W | 8 | SW1/4NE1/4 | 75 |
| | **Guernsey to State Line Subbasin** | | | | | | | | | | |
| | **Permit No** | **Priority Date** | **Company** | **Facility Name** | **Latitude** | **Longitude** | **Twn** | **Rng** | **Sec** | **Qtr Qtr** | **Total Flow** |
| 1 | P191906.0W | 8/21/2009 | WYOMING ETHANOL LLC | ENL BRIMM NO. 2 WELL | 42.03991 | -104.19125 | 024N | 061W | 21 | SE1/4NE1/4 | 65 |
| 2 | P191907.0W | 8/21/2009 | WYOMING ETHANOL LLC | WYOMING ETHANOL #1 MISC. | 42.04075 | -104.19189 | 024N | 061W | 21 | SE1/4NE1/4 | 100 |
| 3 | P199077.0W | 8/16/2011 | WYOMING ETHANOL LLC | ENL BRIMM #6 | 42.03981 | -104.19114 | 024N | 061W | 21 | SE1/4NE1/4 | 600 |
| 4 | P200364.0W | 5/17/2013 | | JOHNS PUMP SERVICE #1 | 42.046978 | -104.182692 | 024N | 061W | 15 | SE1/4SW1/4 | 500 |
| | **Upper Laramie Subbasin** | | | | | | | | | | |
| | **Permit No** | **Priority Date** | **Company** | **Facility Name** | **Latitude** | **Longitude** | **Twn** | **Rng** | **Sec** | **Qtr Qtr** | **Total Flow** |
| 1 | P194147.0W | 10/4/2010 | CHESAPEAKE OPERATING INC | ENTERPRISE-US 27 STATE 1-36H-WW | 41.929056 | -104.374056 | 023N | 063W | 36 | NE1/4NE1/4 | 150 |
| 2 | P199862.0W | 3/7/2013 | H & T RANCH COMPANY | H & T WATER WELL #1 | 42.038817 | -104.50875 | 024N | 064W | 23 | SE1/4NW1/4 | 85 |
| 3 | P195844.0W | 2/28/2011 | Y-O INVESTMENTS INC | Y-O TRACTS #1 WELL PERMIT NO UW 44727 | 42.03187 | -104.94147 | 024N | 067W | 19 | SW1/4SW1/4 | 250 |
| | **Horse Creek Subbasin** | | | | | | | | | | |
| | **Permit No** | **Priority Date** | **Company** | **Facility Name** | **Latitude** | **Longitude** | **Twn** | **Rng** | **Sec** | **Qtr Qtr** | **Total Flow** |
| 1 | P197157.0W | 11/3/2011 | JACOBSON RANCH INC. | DUVALL IRRIGATION NO. 11 | 41.560983 | -104.917417 | 018N | 067W | 5 | SE1/4NW1/4 | 50 |
| 2 | P194099.0W | 10/14/2010 | HEART BENT ARROW, LLC | HEART BENT ARROW, LLC #3 | 41.7418 | -104.5455 | 021N | 064W | 33 | SW1/4SE1/4 | 150 |
| | **South Platte Subbasin** | | | | | | | | | | |
| | **Permit No** | **Priority Date** | **Company** | **Facility Name** | **Latitude** | **Longitude** | **Twn** | **Rng** | **Sec** | **Qtr Qtr** | **Total Flow** |
| 1 | P203370.0W | 4/22/2014 | EOG RESOURCES, INC. | BIG SANDY 132-33 WSW | 41.13636 | -104.67014 | 014N | 065W | 33 | NE1/4SW1/4 | 300 |
| 2 | P166808.0W | 4/11/2005 | PALADIN ENERGY PARTNERS | WALLEYE #1 | 41.27625 | -104.55683 | 015N | 064W | 9 | SW1/4SW1/4 | 200 |
| 3 | P196444.0W | 11/18/2010 | SM ENERGY | HERRINGTON SEC.20 WSW | 41.170244 | -104.560622 | 014N | 064W | 20 | NE1/4NE1/4 | 200 |
| 4 | P191850.0W | 10/19/2009 | ST. MARY LAND & EXPLORATION COMPANY | SUNLIGHT 41-20 WSW - OVER-FILING | 41.259142 | -104.562683 | 015N | 064W | 20 | NE1/4NE1/4 | 80 |
| 5 | P192629.0W | 2/16/2010 | SUNCOR ENERGY (U.S.A.) PIPELINE CO. | ENL OF WATER WELL#1 | 41.123233 | -104.781783 | 013N | 066W | 4 | NE1/4SW1/4 | 485 |
| 6 | P175177.0W | 4/19/2006 | TEXAS AMERICAN RESOURCES | WATER SUPPLY WELL #2 | 41.11181 | -104.97003 | 013N | 068W | 11 | SW1/4NE1/4 | 50 |

**Table 2: Oil and Gas Water Wells and CBM Wells with Priority Dates After 2006 Completed After January 1, 2014**

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 7 | P177384.0W | 9/1/2006 | TEXAS AMERICAN RESOURCES CO. | SQUIRE 22-11-WATER SUPPLY WELL #2 | 41.11178 | -104.97482 | 013N | 068W | 11 | SE1/4NW1/4 | 2500 |
| 8 | P197393.0W | 9/28/2011 | UNITED SURFACE AND MINERALS, LLC | DIAMOND K LANCE-FOX HILLS #2 | 41.079333 | -104.118769 | 013N | 060W | 20 | SW1/4NW1/4 | 400 |
| 9 | P197392.0W | 9/28/2011 | UNITED SURFACE AND MINERALS, LLC | DIAMOND K LANCE - FOX HILLS #1 | 41.086642 | -104.118761 | 013N | 060W | 17 | SW1/4SW1/4 | 400 |
| 10 | P202090.0W | 12/10/2013 | JANET SHATTO | SHATTO 1-10 WSW | 41.11483 | -104.64456 | 013N | 065W | 10 | NW1/4NE1/4 | 600 |

Table 3: Industrial Reservoirs Permitted by the Wyoming SEO Since the 2006 Platte River Basin Plan

| WR Number | Priority Date | Summary / WR Status | Company | Facility Name | Uses | Twn | Rng | Sec | Qtr-Qtr | Longitude | Latitude |
|---|---|---|---|---|---|---|---|---|---|---|---|
| P12497.0R | 03/15/2006 | Complete | WILLITS COMPANY INC | POLO RANCH RESERVOIR | IND_SW | 014N | 067W | 18 | SE1/4NW1/4 | -104.936 | 41.18423 |
| P12963.0R | 07/02/2007 | Complete | CITY OF DOUGLAS | DOUGLAS WATER TREATMENT PLANT RESERVOIR | IND_SW | 032N | 071W | 08 | NW1/4NE1/4 | -105.393 | 42.7657 |
| P12970.0R | 06/27/2007 | Complete | BURNETT LAND & LIVESTOCK, LTD, LLLP | BURNETT DAIRY NO. 1 RESERVOIR | IND_SW; IRR_SW | 012N | 061W | 07 | NE1/4NE1/4 | -104.239 | 41.03122 |
| P13008.0R | 09/10/2007 | Complete | AQUA TERRA CONSULTANTS | SEDIMENTATION POND SP1 | IND_SW | 027N | 066W | 33 | SE1/4NW1/4 | -104.783 | 42.2713 |
| P13346.0R | 09/12/2008 | Complete | WILLITS COMPANY INC | HARRIMAN QUARRY RESERVOIR | IND_SW | 013N | 070W | 13 | SE1/4NE1/4 | -105.178 | 41.09888 |
| P13479.0R | 07/06/2009 | Complete | WWC ENGINEERING | SEDIMENT POND NO. 2 | IND_SW | 021N | 088W | 14 | NW1/4SE1/4 | -107.302 | 41.7905 |
| P13603.0R | 03/31/2010 | Complete | NEW FASHION PORK LLP | NEW FASHION PORK NO. 2 | IND_SW | 017N | 062W | 26 | NE1/4SW1/4 | -104.277 | 41.40799 |
| P13612.0R | 11/10/2009 | Complete | WWC ENGINEERING | MONOLITH SHALE QUARRY SEDIMENT POND | IND_SW; WET | 014N | 075W | 12 | NW1/4NE1/4 | -105.76 | 41.20147 |
| P13615.0R | 05/14/2010 | Complete | TRIHYDRO CORPORATION | SURFACE IMPOUNDMENT NO. 1 | IND_SW | 013N | 066W | 04 | SW1/4NW1/4 | -104.789 | 41.12547 |
| P13616.0R | 05/14/2010 | Complete | TRIHYDRO CORPORATION | SURFACE IMPOUNDMENT NO. 3/4 | IND_SW | 013N | 066W | 04 | SW1/4NW1/4 | -104.787 | 41.12624 |
| P13617.0R | 05/14/2010 | Complete | TRIHYDRO CORPORATION | SURFACE IMPOUNDMENT NO. 5 | IND_SW | 013N | 066W | 04 | SW1/4NW1/4 | -104.786 | 41.12637 |
| P13703.0R | 11/09/2010 | Complete | COFFEY ENGINEERING AND SURVEYING | POLAR BEAR WATER RESERVOIR | IND_SW | 021N | 090W | 29 | SE1/4SE1/4 | -107.587 | 41.75658 |
| P13750.0R | 03/24/2011 | Complete | DYNO NOBEL INC | CELL 7 RESERVOIR | IND_SW | 013N | 067W | 16 | SW1/4NW1/4 | -104.905 | 41.09636 |
| P13762.0R | 01/28/2011 | Complete | UINTA ENGINEERING AND SURVEYING | RED DESERT RECLAMATION 1-2-3 RESERVOIR | IND_SW | 021N | 090W | 11 | SE1/4SW1/4 | -107.535 | 41.80064 |
| P13764.0R | 06/16/2011 | Complete | R360 NIOBRARA INC | R360 SILO FIELD FACILITY RESERVOIR | IND_SW | 015N | 065W | 12 | SW1/4NE1/4 | -104.605 | 41.28522 |
| P13771.0R | 10/26/2010 | Complete | ARCH OF WYOMING LLC | ENL OF 29-23-1 RESERVOIR | IND_SW; STO | 024N | 083W | 29 | NW1/4NW1/4 | -106.789 | 42.02759 |
| P13772.0R | 10/26/2010 | Complete | ARCH OF WYOMING LLC | ENL OF 29-35-4 RESERVOIR | IND_SW; STO | 024N | 083W | 29 | SE1/4SE1/4 | -106.774 | 42.01619 |
| P13794.0R | 08/18/2011 | Complete | 90 CES CEAN | SOUTH LAKE PEARSON RESERVOIR | DSP; FIS; IND_SW; REC | 014N | 067W | 23 | SW1/4SE1/4 | -104.856 | 41.16289 |
| P13795.0R | 08/18/2011 | Complete | 90 CES CEAN | NORTH LAKE PEARSON RESERVOIR | DSP; FIS; IND_SW; REC | 014N | 067W | 23 | NW1/4SE1/4 | -104.857 | 41.16483 |
| P13839.0R | 09/02/2011 | Complete | LARAMIE COUNTY | ARCHER COMPLEX RESERVOIR | DSP; IND_SW | 014N | 065W | 28 | NE1/4SW1/4 | -104.666 | 41.14944 |
| P13895.0R | 04/26/2011 | Complete | HAGEMAN & BRIGHTON PC | ENLARGEMENT OF THE SULLIVAN PIT | IND_SW | 027N | 078W | 14 | SW1/4NW1/4 | -106.159 | 42.31395 |
| P14052.0R | 02/27/2013 | Complete | R & R SERVICES, INC | BAUMANN POND | IND_SW | 033N | 070W | 18 | SE1/4SW1/4 | -105.31 | 42.8257 |
| P14106.0R | 03/19/2013 | Complete | JLM ENGINEERING, INC | MCMURRY NO. 4 | CMU; FIS; IND_SW; IRR_SW; REC; STO | 033N | 079W | 24 | SE1/4SW1/4 | -106.272 | 42.80736 |
| P14164.0R | 09/11/2013 | Complete | CHESAPEAKE OPERATING INC | COMBS RANCH 29 FRAC POND | IND_SW | 033N | 070W | 29 | SE1/4SW1/4 | -105.286 | 42.7971 |
| P14177.0R | 10/04/2013 | Complete | CHESAPEAKE OPERATING, INC. | MOUNTAIN VALLEY WTR IMP | IND_SW | 033N | 071W | 34 | NW1/4NE1/4 | -105.365 | 42.7945 |
| P14222.0R | 11/18/2013 | Complete | CHESAPEAKE OPERATING INC | NORTHWEST FETTER WTR IMP | IND_SW | 033N | 072W | 01 | SW1/4NW1/4 | -105.454 | 42.8634 |
| P14241.0R | 03/20/2014 | Complete | COFFEY ENGINEERING & SURVEYING | ENLARGEMENT OF THE POLAR BEAR WATER RESERVOIR | IND_SW | 021N | 090W | 29 | SE1/4SE1/4 | -107.587 | 41.75658 |
| P14249.0R | 05/23/2013 | Complete | K2 ENGINEERING | STORAGE ENL OF THE WHEATLAND WASTEWATER LAGOON SYS | IND_SW; IRR_SW | 024N | 067W | 06 | SE1/4NE1/4 | -104.929 | 42.08148 |
| P14260.0R | 06/30/2014 | Complete | SUNRISE ENGINEERING | RESERVOIR NUMBER 6 | FLO; IND_SW | 013N | 066W | 04 | NE1/4NW1/4 | -104.781 | 41.1278 |
| CR CR19/214 | 07/06/2009 | Fully Adjudicated | MCMURRY READY MIX | SEDIMENT POND NO. 2 | IND_SW | 021N | 088W | 14 | NW1/4SE1/4 | -107.301 | 41.79055 |
| CR CR20/054 | 07/02/2007 | Fully Adjudicated | CITY OF DOUGLAS | DOUGLAS WATER TREATMENT PLANT RESERVOIR | IND_SW | 032N | 071W | 08 | NW1/4NE1/4 | -105.393 | 42.7657 |
| CR CR20/165 | 05/14/2010 | Fully Adjudicated | FRONTIER REFINING INC | SURFACE IMPOUNDMENT NO. 1 RESERVOIR | IND_SW | 013N | 066W | 04 | SW1/4NW1/4 | -104.789 | 41.12547 |

**Table 3: Industrial Reservoirs Permitted by the Wyoming SEO Since the 2006 Platte River Basin Plan**

| WR Number | Priority Date | Summary / WR Status | Company | Facility Name | Uses | Twn | Rng | Sec | Qtr-Qtr | Longitude | Latitude |
|---|---|---|---|---|---|---|---|---|---|---|---|
| CR CR20/166 | 05/14/2010 | Fully Adjudicated | FRONTIER REFINING INC | SURFACE IMPOUNDMENT NO. 3/4 RESERVOIR | IND_SW | 013N | 066W | 04 | SW1/4NW1/4 | -104.787 | 41.12624 |
| CR CR20/167 | 05/14/2010 | Fully Adjudicated | FRONTIER REFINING INC | SURFACE IMPOUNDMENT NO. 5 RESERVOIR | IND_SW | 013N | 066W | 04 | SW1/4NW1/4 | -104.786 | 41.12637 |
| CR CR21/241 | 08/18/2011 | Fully Adjudicated | USAF FE WARREN AIR FORCE BASE | SOUTH LAKE PEARSON RESERVOIR | DSP; FIS; IND_SW; REC | 014N | 067W | 23 | SW1/4SE1/4 | -104.856 | 41.16289 |
| CR CR21/242 | 08/18/2011 | Fully Adjudicated | USAF FE WARREN AIR FORCE BASE | NORTH LAKE PEARSON RESERVOIR | DSP; FIS; IND_SW; REC | 014N | 067W | 23 | NW1/4SE1/4 | -104.856 | 41.166 |
| CR CR23/179 | 05/23/2013 | Fully Adjudicated | | ENL. WHEATLAND WASTEWATER LAGOON SYSTEM | IND_SW; IRR_SW | 025N | 067W | 06 | NE1/4SW1/4 | -104.938 | 42.16831 |
| CR CR23/219 | 03/19/2013 | Fully Adjudicated | EAST ELKHORN RANCH LLC | MCMURRY NO. 4 RESERVOIR | CMU; FIS; IND_SW; IRR_SW; REC; STO | 033N | 079W | 24 | SE1/4SW1/4 | -106.272 | 42.80731 |
| CR CR23/229 | 04/26/2011 | Fully Adjudicated | HAGEMAN & BRIGHTON PC | ENL. SULLIVAN PIT RESERVOIR | IND_SW | 027N | 078W | 14 | SW1/4NW1/4 | -106.159 | 42.314 |
| P12391.0R | 01/04/2006 | Incomplete | ARCH OF WYOMING LLC | S2-1 RESERVOIR | IND_SW | 021N | 080W | 34 | NE1/4SE1/4 | -106.386 | 41.74463 |
| P13247.0R | 02/29/2008 | Incomplete | ARCH OF WYOMING LLC | SC3-1 RESERVOIR | IND_SW | 021N | 079W | 32 | NE1/4NW1/4 | -106.32 | 41.75158 |
| P13248.0R | 02/29/2008 | Incomplete | ARCH OF WYOMING LLC | SC3-2 RESERVOIR | IND_SW | 021N | 079W | 32 | NE1/4NW1/4 | -106.317 | 41.75331 |
| P13249.0R | 02/29/2008 | Incomplete | ARCH OF WYOMING LLC | SC3-3 RESERVOIR | IND_SW | 021N | 079W | 32 | NW1/4NW1/4 | -106.323 | 41.75247 |
| P13602.0R | 03/31/2010 | Incomplete | NEW FASHION PORK LLP | NEW FASHION PORK WETLANDS NO. 1 | IND_SW; WET | 017N | 062W | 26 | NE1/4SW1/4 | -104.28 | 41.40881 |
| P13759.0R | 04/26/2011 | Incomplete | UNITED SURFACE & MINERALS | EAST RESERVOIR | IND_SW; STO | 021N | 064W | 02 | NW1/4NW1/4 | -104.516 | 41.82675 |
| P13760.0R | 04/26/2011 | Incomplete | UNITED SURFACE & MINERALS | CANYON VIEW RESERVOIR | IND_SW; STO | 022N | 064W | 34 | SE1/4NE1/4 | -104.522 | 41.83681 |
| P13761.0R | 04/26/2011 | Incomplete | UNITED SURFACE & MINERALS | WEST RESERVOIR | IND_SW; STO | 021N | 064W | 03 | NW1/4NE1/4 | -104.526 | 41.82697 |
| P14389.0R | 09/25/2014 | Incomplete | EARTH WORK SOLUTIONS | PRBIC | IND_SW | 031N | 071W | 000 | | -105.338 | 42.6797 |
| P14461.0R | 05/16/2014 | Incomplete | TRIHYDRO CORP | NORTH PROPERTY EVAPORATION AND INLET RESERVOIR | IND_SW | 034N | 078W | 29 | SW1/4SW1/4 | -106.239 | 42.88238 |
| P14481.0R | 02/05/2016 | Incomplete | R360 ENVIRONMENTAL SOLUTIONS LLC | ENLARGED R360 SILO FIELD FACILITY | IND_SW | 015N | 065W | 12 | SW1/4NE1/4 | -104.605 | 41.28522 |
| P14501.0R | 05/13/2016 | Incomplete | TRIHYDRO CORPORATION | FINCH RESERVOIR | IND_SW; STO | 021N | 080W | 32 | NE1/4NE1/4 | -106.425 | 41.7543 |
| P14526.0R | 08/08/2016 | Incomplete | BP AMERICA PRODUCTION COMPANY | SECTION 5 FRESHWATER PITS | IND_SW | 017N | 093W | 05 | NW1/4NE1/4 | -107.898 | 41.48392 |
| P7834.0E | 07/07/2016 | Incomplete | | SECOND ENLARGEMENT OF COXBILL PORTABLE IRR SYSTEM ACIPT COXBILL PUMP&PL | IND_SW | 023N | 061W | 34 | SW1/4SW1/4 | -104.183 | 41.9175 |

# Platte River Basin Plan 2016 Update
# Volume 3
# Basin Surface Water Use Profile

*Prepared for:*

Wyoming Water Development Commission

6920 Yellowtail Road
Cheyenne, WY 82002


*Prepared by:*
Wenck Associates
1904 East 15th Street
Cheyenne, WY 82001

WENCK ASSOCIATES
Responsive partner.
Exceptional outcomes.

*In Association With:*
Lidstone & Associates, a Wenck Company
Harvey Economics
HDR Engineering

**PLATTE RIVER BASIN PLAN 2016 UPDATE**
**VOLUME 3**
**BASIN SURFACE WATER USE PROFILE**

December 2016

**Explanation of Cover Photos**

Lake Marie in the Snowy Range Mountains. Lake Marie lies south in the shadow of the quartzite massif of 12,847-foot Medicine Bow Peak at an elevation of 11,000-feet. Winter and Spring precipitation in the Snowing Range constitutes an important portion of the water supply in the Platte River Basin.

The bald eagle (*Haliaeetus leucocephalus*, from Greek hali "sea", aiētos "eagle", leuco "white", cephalos "head"). It is a common, frequently observed breeding and winter resident in the North Platte Basin of Wyoming. The bird is strongly associated with large rivers, lakes and reservoirs with an abundant food supply and riparian environments with large trees used for roosting and nesting. The bald eagle is an opportunistic predator which subsists primarily on fish. During the winter, they also feed on dead or injured waterfowl and road or winter killed deer and antelope. The bald eagle is both the national bird and national animal of the United States of America. It is the most familiar success story of the Federal Endangered Species Act. During the latter half of the 20th century it was on the brink of extirpation in the contiguous United States and was one of the first species to receive protections under the precursor to the Endangered Species Act in 1967. Populations have since recovered and the species was removed from the U.S. government's list of endangered species on July 12, 1995 and transferred to the list of threatened species. It was removed from the List of Endangered and Threatened Wildlife in the Lower 48 States on June 28, 2007 but remains protected under the provisions of the Bald and Golden Eagle Protection Act.

Historical photo of flood irrigation. Flood irrigation is an ancient method of irrigating crops and was the first form of irrigation used by humans as they began cultivating crops. In the Platte River Basin, it is still commonly used to irrigate grass hay. In areas of the Platte River Basin where higher value crops are raised such as corn, sugar beets and alfalfa hay, conversion to sprinkler irrigation has the dual benefits of improved crop yields while conserving water.

The Dave Johnston Power Plant is named for W.D. “Dave” Johnston a former PacifiCorp Vice-President. The plant generates power by burning coal that produces steam under high pressure. The steam drives turbines and the turbine blades to engage generator that produce electricity. The plant was commissioned in 1958. There have been four phases of plant expansion to-date and numerous upgrades to comply with changing environmental requirements. The present power generation capacity is 817 megawatts.

**PLATTE RIVER BASIN PLAN 2016 UPDATE**
**VOLUME 3**
**BASIN SURFACE WATER USE PROFILE**

December 2016

**PREPARED FOR:**

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Professional Engineer (Civil)
PHILLIP STUMP
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Date 4/10/17
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**The Platte River Basin Plan 2016 Update is a planning tool developed for the Wyoming Water Development Office. It presents estimated current and estimated future uses of water in Wyoming's Platte River Basin. The Plan is not intended to be used to determine compliance with the administration of state law, federal law, court decrees, interstate compacts, or interstate agreements.**

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# Appendices

# 3.0 Basin Surface Water Use Profile

## 3.1 SUMMARY

***"Our lifestyle, our wildlife, our land and our water remain critical to our definition of Wyoming and to our economic future."***
- Dave Freudenthal, Former Governor of Wyoming

The water supplies in the Platte Basin significantly contribute to the economy of the entire State of Wyoming. The Platte region is home to 44% of the State's population and supports a diversified economic base of agricultural, industrial, government, education, and recreation resources. The water uses that were evaluated in this study are the industrial, municipal, agricultural, recreational and environmental sectors.

### 3.1.1 Industrial Use

Since 2004, the types of industrial water use have not changed appreciably in the Platte River Basin. The principal industrial users continue to include oil and gas, coal and uranium as well as power generation, aggregate mining, cement production, chemical processing and ethanol production. Overall, annual industrial water use is estimated to be approximately 147,950 acre-feet. Increases in industrial water use were limited to a few areas. The Pathfinder to Guernsey Subbasin experienced the most robust increase in industrial water use with additional groundwater production to serve the oil and gas industry near Douglas and uranium mining near Glenrock. Industrial activity increased the subbasin's percentage of total water use in the Platte River Basin from 36.4 to 38.0%. The South Platte Subbasin also witnessed an increase in industrial water use with the addition of a new power plant, dairy, and oil and gas development. This industrial activity raised the subbasin's percentage of total water use from 6.1% to 7.2%

### 3.1.2 Municipal and Domestic Use

There are 54 community public water systems located within the seven subbasins of the Platte River Basin. Since the completion of the 2006 Basin Plan, additional water usage data have been developed and compiled through master planning projects sponsored by the Wyoming Water Development Commission (WWDC), the Wyoming State Engineer's Office (SEO) annual municipal water use surveys and the WWDC's public water system surveys.

Groundwater remains a significant water supply for municipal and domestic users. Since January 1, 2004, 32 new wells or enlargements have been filed with the SEO for municipal use. Between January 1, 2004 and January 26, 2015, 5,043 domestic well permits were obtained and presumably completed within the subbasins of the Platte River Basin. An assumed per capita usage rate of 150 to 300 gpd was used to calculate rural domestic water usage for each of the subbasins. With a total rural population of approximately 20,000, the South Platte subbasin has the highest estimated usage at approximately 3.0 to 6.0 million gpd. The Pathfinder to Guernsey subbasin had the second highest usage estimated at 1.8 to 3.6 million gpd. With the lowest rural population, the Horse Creek subbasin had the lowest estimated usage at 0.2 to 0.4 million gpd. Municipal use accounts for 6.1% to 7.2% percent of the South Platte subbasin's total groundwater use.

### 3.1.3 Irrigation Use

Surface water and groundwater are both used for irrigation purposes in the Platte River Basin. Trihydro (2006) and The Wyoming Geological Survey tabulated the quantities of permitted irrigation groundwater rights. Total annual average groundwater withdrawals f or irrigation were estimated to be 206,745 acre-feet (Taucher and others, 2013). Assuming surface water is applied at a rate of 1 cubic foot per second (cfs) per 70 acres, total surface water use during the irrigation season based on the number of irrigated acres in 2012 would be approximately 2.4 million acre-feet.

### 3.1.4 Recreation and Environmental Use

There are numerous and excellent water-based recreational opportunities in most of the Platte subbasins, primarily flat water boating, swimming, river rafting and stream fishing. There are also extensive environmental water uses, including wetland areas, crucial habitat areas and in-stream flows. Overall, almost all of the environmental and recreational uses (E&R) uses in the Basin have been determined to be protected or complementary. Of those that are competing, most are likely already unavailable in many years due to over-appropriation of Basin water resources.

### 3.1.5 Water Use from Storage

The reservoirs above Pathfinder have permitted and actual active storage capacities that exceed 18,000 ace-feet so the potential exists for Wyoming to exceed the cap in any one year. The records reviewed for the largest reservoirs instrumented with new measuring devices confirmed that most reservoirs filled nearly every year except when affected by severe drought conditions or when reservoir or conveyance deficiencies prevented their physical ability to store water.

During drought periods, the reservoir owners are intentionally saving water to conserve water supplies for the following year so the storage space available for accruals the following year is physically limited. Some reservoir owners are also increasing reservoir carry-over amounts to serve other beneficial uses such as fishery or recreational purposes. HDR’s structural and non-structural recommendations are based on the water storage analysis performed on the reservoirs storing for irrigation purposes above Pathfinder Reservoir exclusive of Seminoe Reservoir. The implementation of one or more of the stated alternatives could assist Wyoming in maximizing the annual accrual quantities.

Constructing new reservoirs or enlarging existing irrigation reservoirs are challenging projects to implement. The siting of new reservoirs would require the need to evaluate suitable reservoir sites and consider the environmental effects of each site to address the environmental permitting requirements. Water supply alternative analysis evaluations would also be a National Environmental Policy Act (NEPA) requirement for a reservoir enlargement project. The permitting process will require NEPA compliance for the issuance of federal permits or required right-of-way agreements on federal lands. Wyoming’s compliance with the Platte River Recovery Implementation Program (PRRIP) and Wyoming’s Depletions Plan will need to be considered for either alternative. A new irrigation reservoir would require the need for a local sponsor that could provide a share of the overall capital costs.

A potential non-structural recommendation is to facilitate the coordination of storage accruals amongst the reservoir owners. Coordination with reservoir owners on an annual basis could occur that would allow maximizing storage accruals occurring in Wyoming in any one year. This approach requires cooperation between the SEO and the entities responsible for coordinating the individual reservoir owners. The reservoir owners of the largest reservoirs with measuring device equipment may be the most amenable to this coordination approach based on their previous coordination with the State of Wyoming. The largest reservoirs represent the most efficient entities to accomplish this cooperation alternative due to their size and the practicality of coordinating with fewer reservoir owners.

Another potential non-structural alternative is to consider the reservoir storage water right and its function of serving irrigation purposes. A portion of the active reservoir storage in the larger reservoirs could be better defined and modified within a Wyoming Board of Control change of use petition process to eliminate the requirement and the need to track the storage under the Modified Decree requirements. For example, the portion of storage that is for the purposes of meeting fishery or recreation beneficial uses could be formally designated for that purpose within the reservoir storage water right. The portion of the storage water right for in-place environmental or recreation uses should not be included in the SEO reporting or storage water dedicated to meeting irrigation purposes.

Graphic summaries of water usage in the Platte River Basin are presented in **Figures 3.1.1 – 3.1.8**.

> **"It is life, I think, to watch the water. A man can learn so many things."**
>
> - Nicholas Sparks

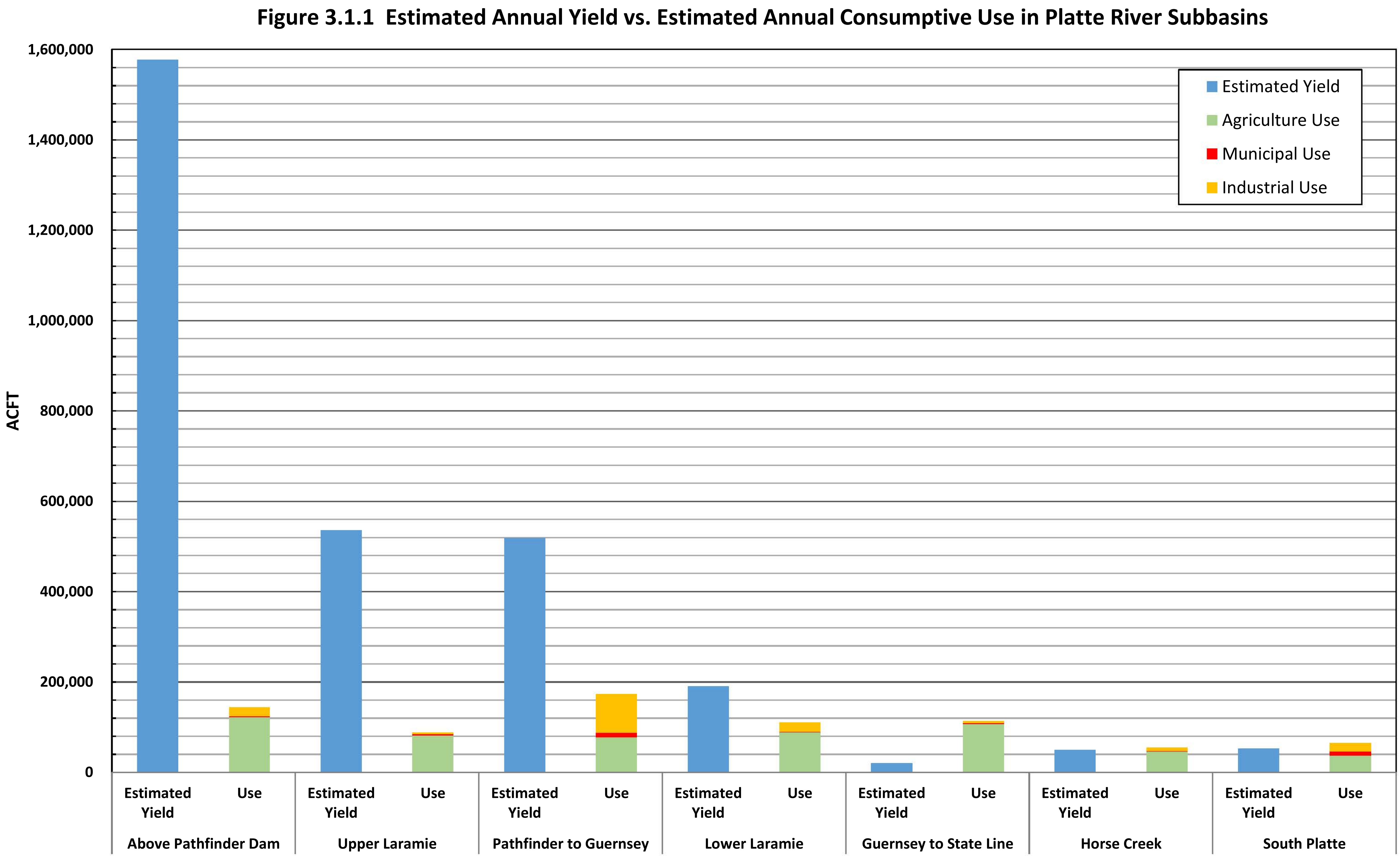
Figure 3.1.1 Estimated Annual Yield vs. Estimated Annual Consumptive Use in Platte River Subbasins
1,600,000
1,400,000
1,200,000
1,000,000
800,000
600,000
400,000
200,000
0
ACFT
Estimated Yield
Agriculture Use
Municipal Use
Industrial Use
Estimated Yield
Use
Above Pathfinder Dam
Upper Laramie
Pathfinder to Guernsey
Lower Laramie
Guernsey to State Line
Horse Creek
South Platte

# Figure 3.1.2
# Overall Water Use Profile within the Above Pathfinder Subbasin

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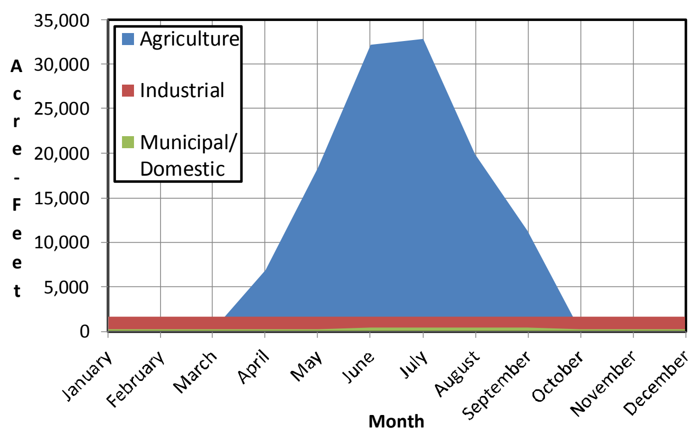
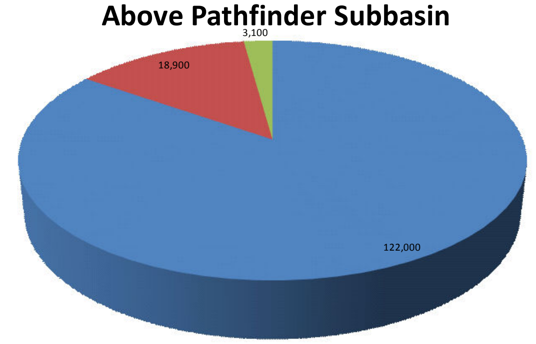
**Estimated Monthly Consumptive Use in an Average Year in Acre Feet**
**Above Pathfinder Subbasin**

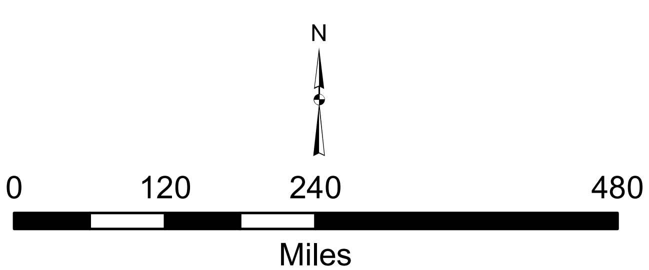


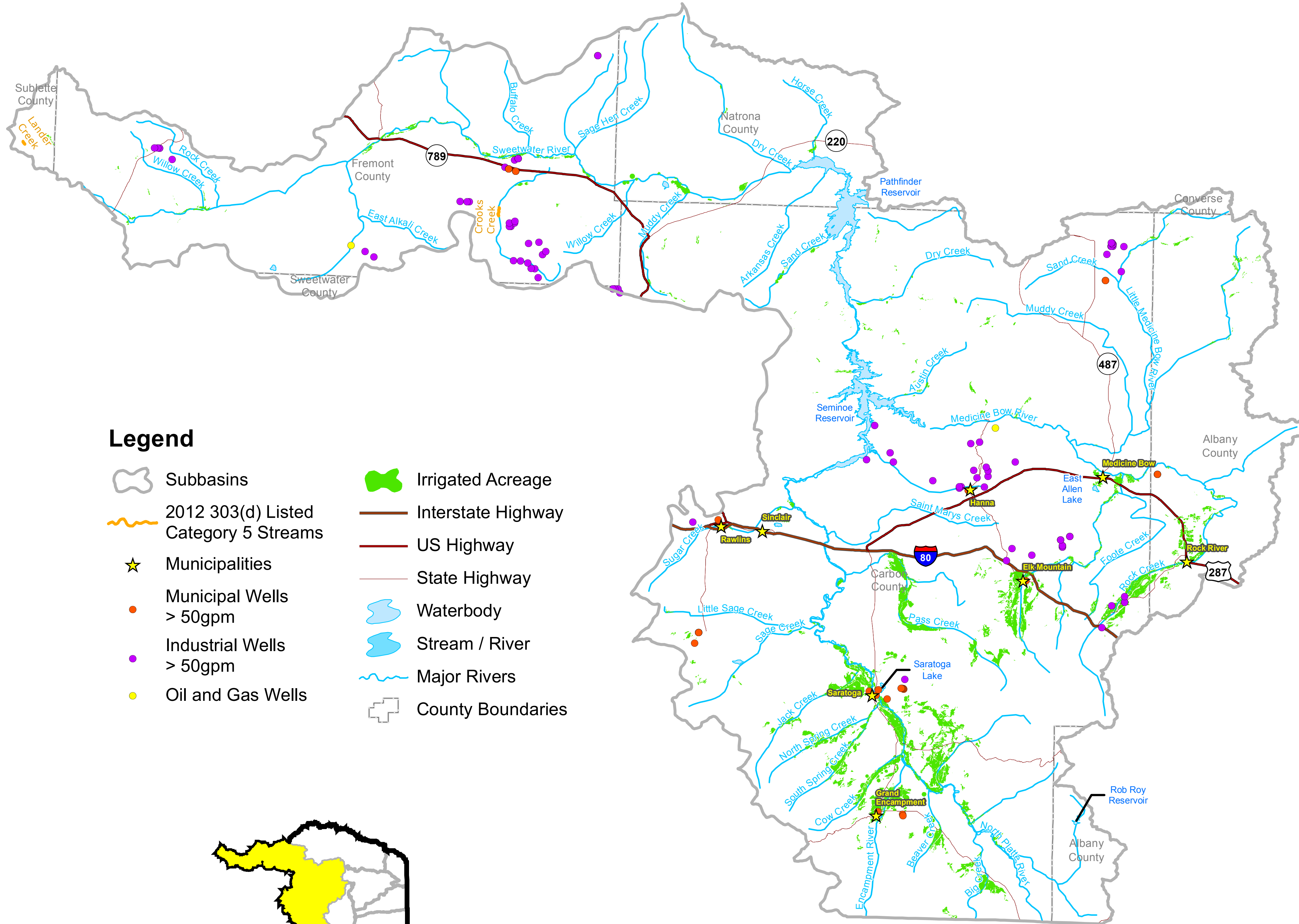

**Total Annual Consumptive Use in Acre Feet in an Average Year**
**Above Pathfinder Subbasin**




Total of All uses = 144,000 Acre Feet
2012 Irrigated Acreage = 123,651 Acres

Agriculture Industrial Municipal/Domestic

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# Figure 3.1.3
# Overall Water Use Profile within the Pathfinder to Guernsey Subbasin

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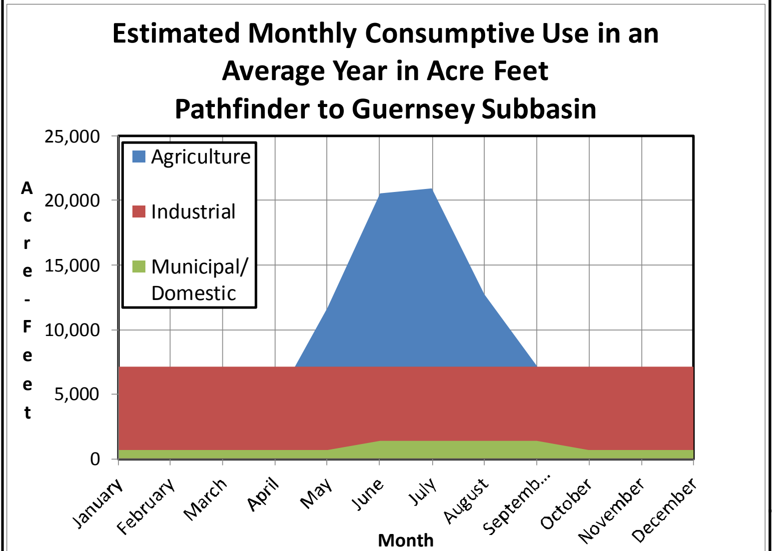


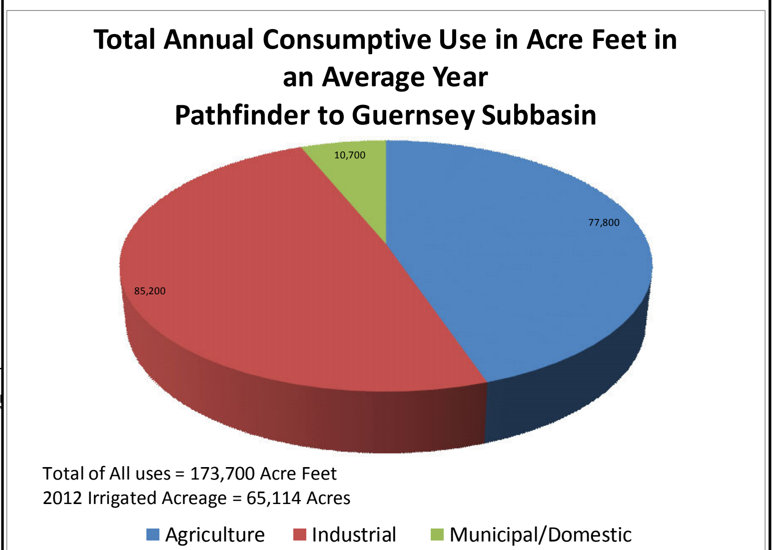


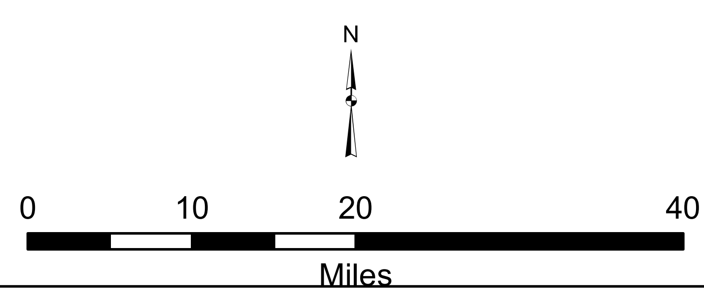


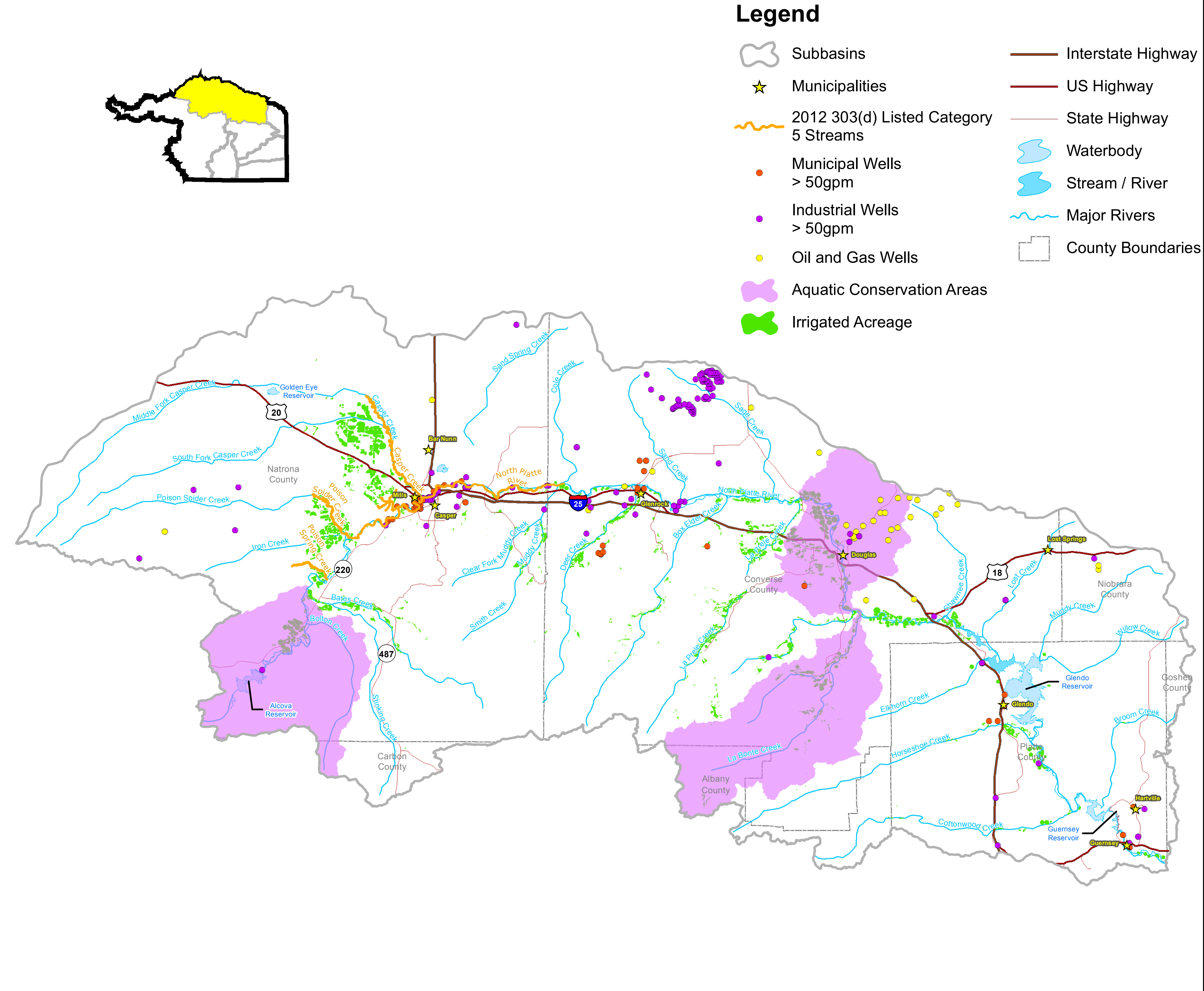


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# Figure 3.1.4
# Overall Water Use Profile in the Guernsey to State Line Subbasin

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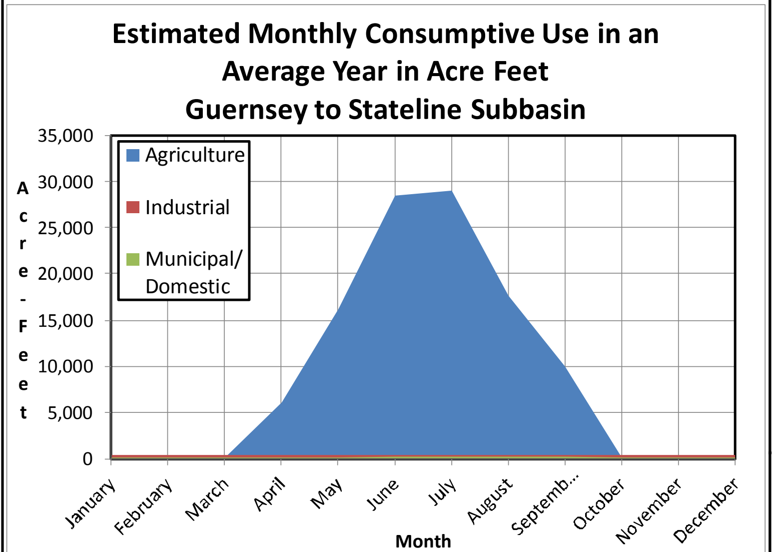


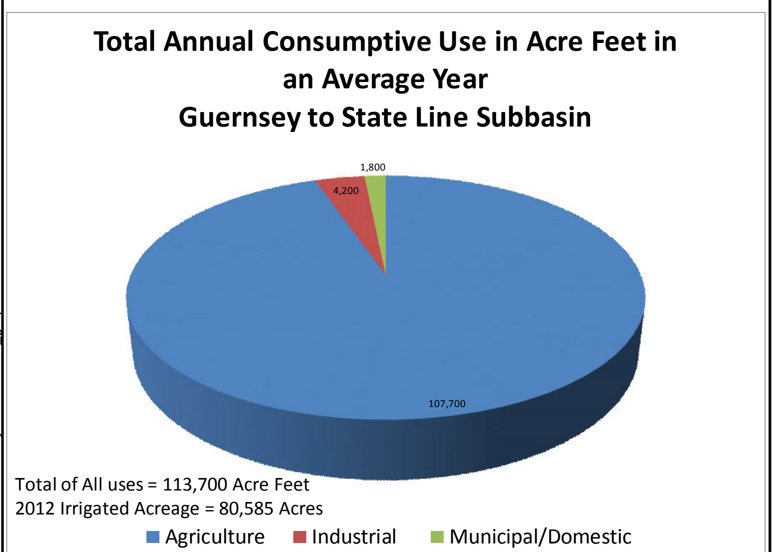


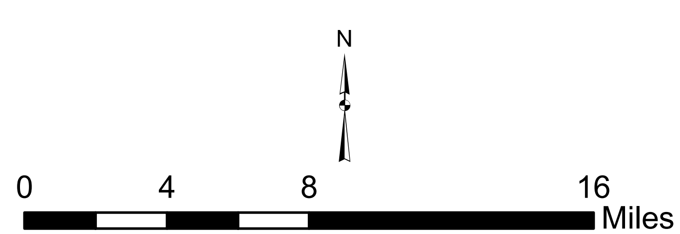


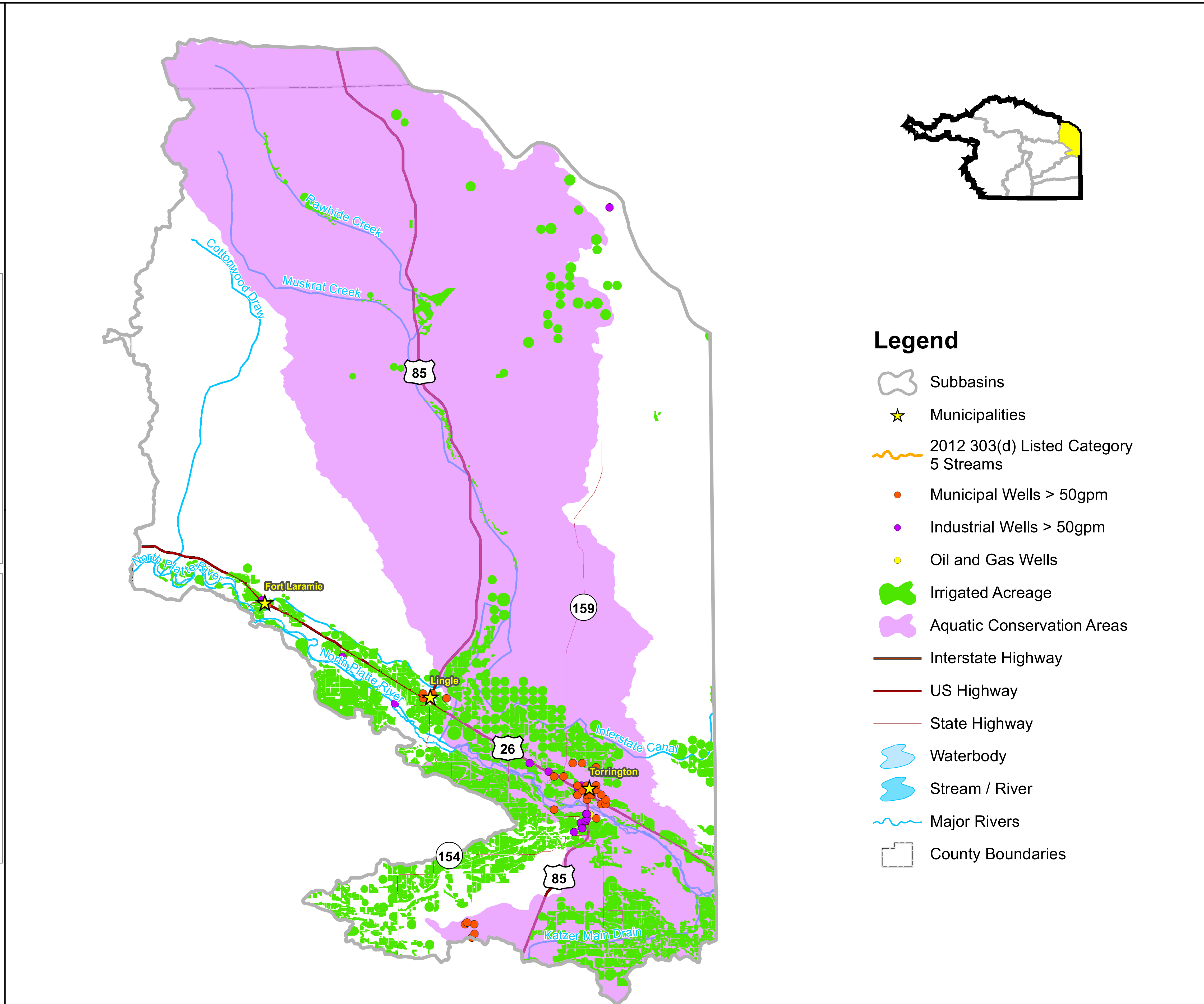

# Figure 3.1.5
## Overall Water Use in the Upper Laramie Subbasin

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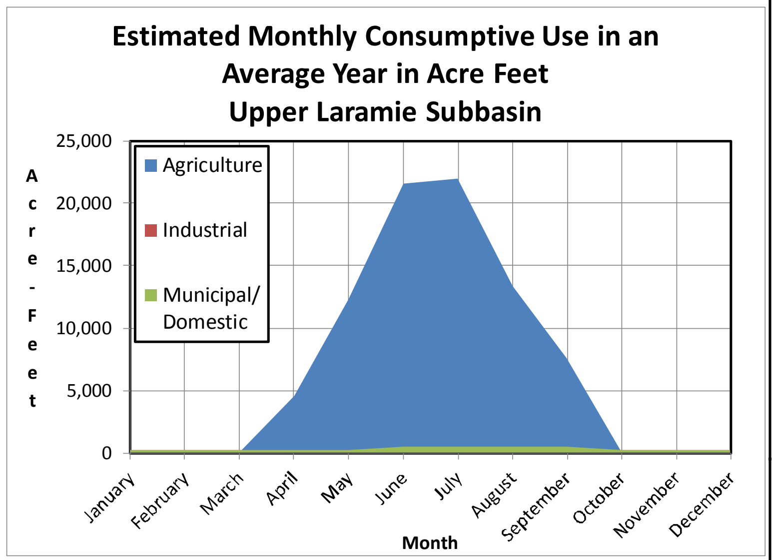


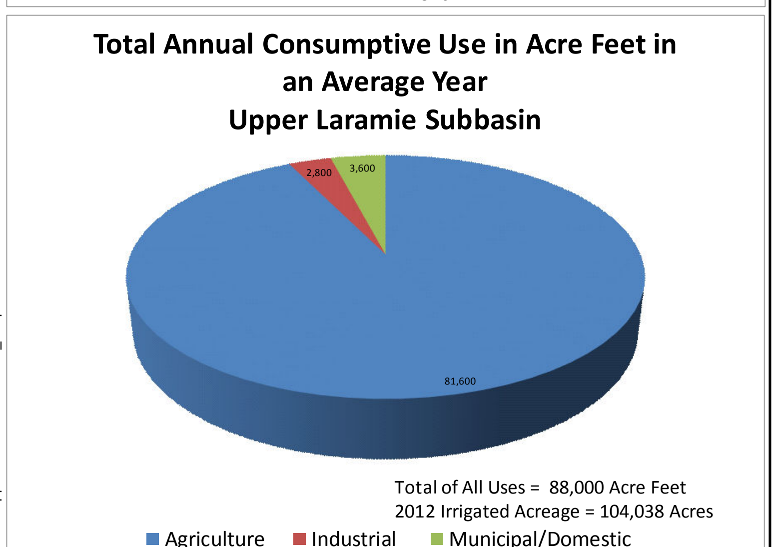


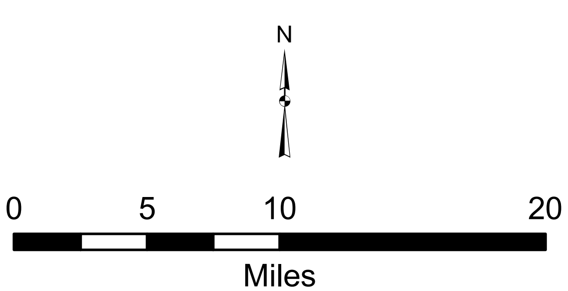


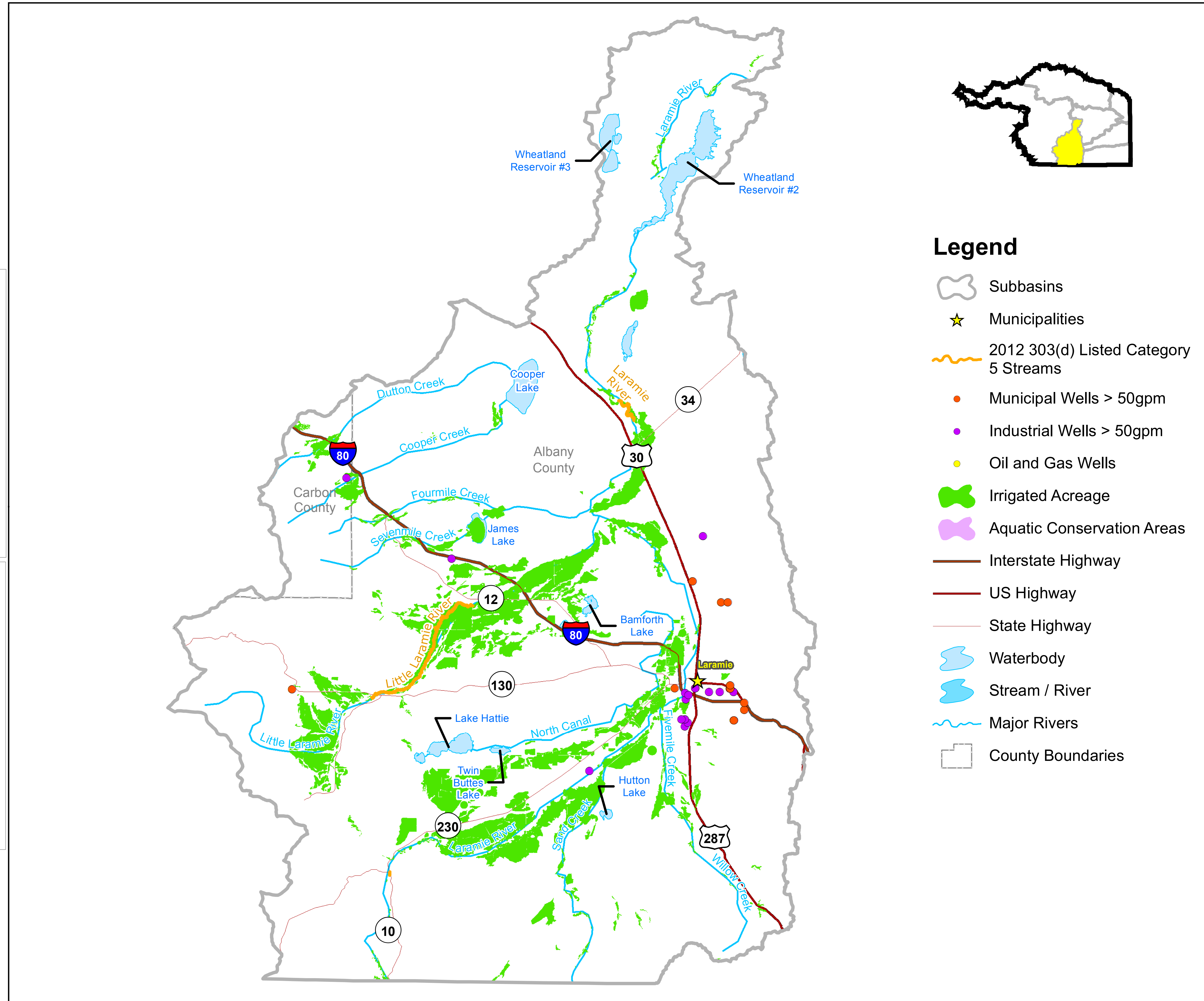


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# Figure 3.1.6
# Overall Water Use Profile within the Lower Laramie Subbasin

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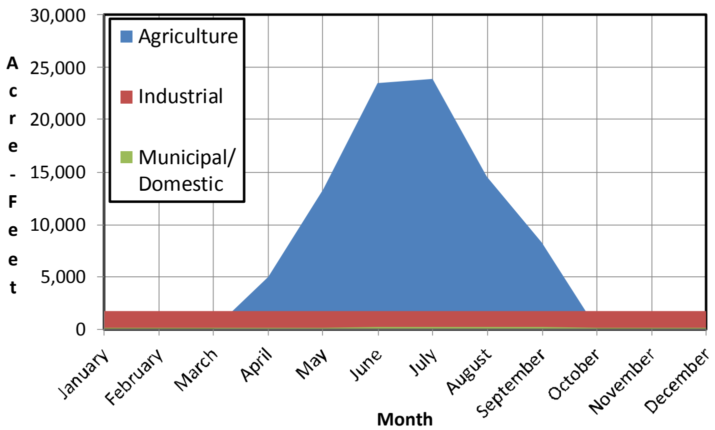
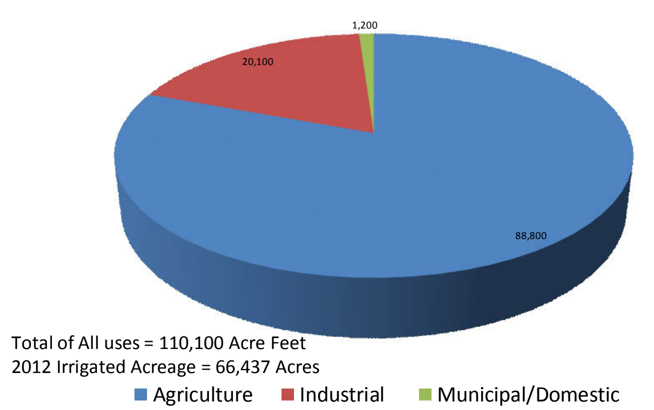
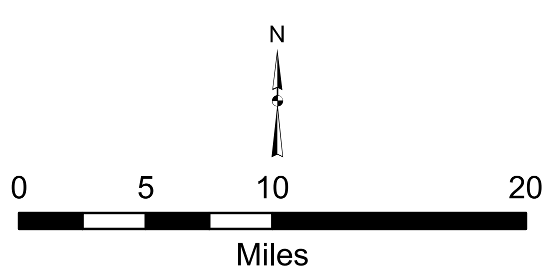
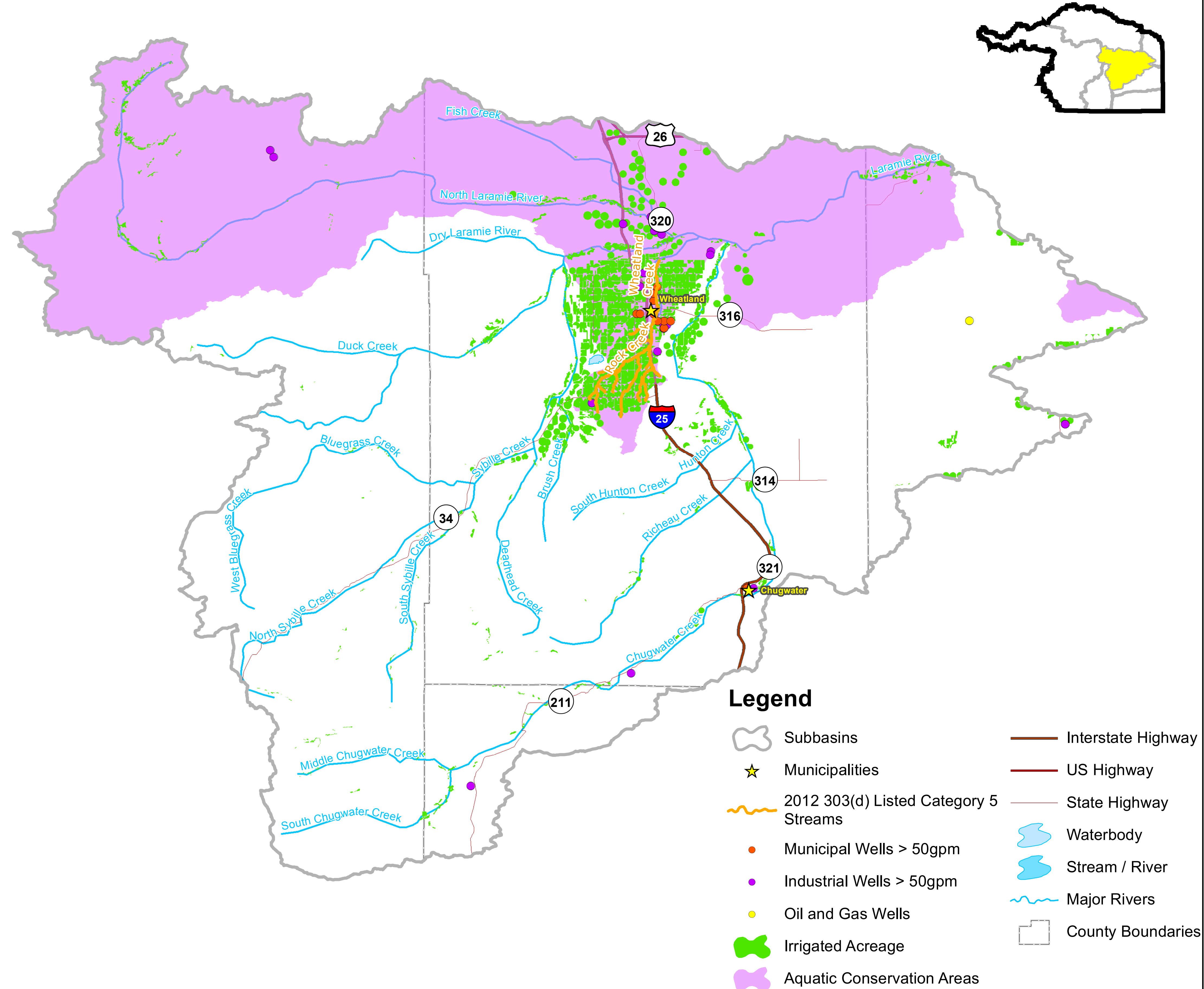
**Estimated Monthly Consumptive Use in an Average Year in Acre Feet**
**Lower Laramie Subbasin**




**Total Annual Consumptive Use in Acre Feet in an Average Year**
**Lower Laramie Subbasin**

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# Figure 3.1.7
# Overall Water Use Profile within the Horse Creek Subbasin

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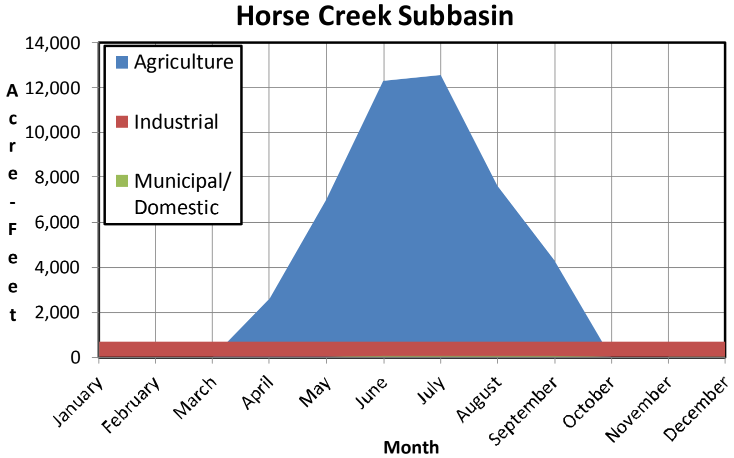
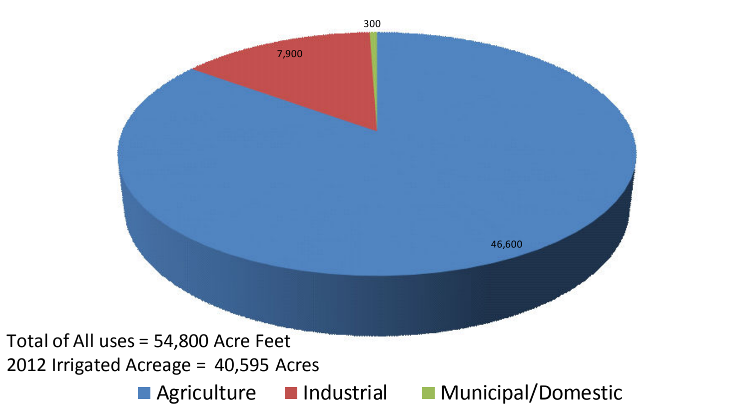
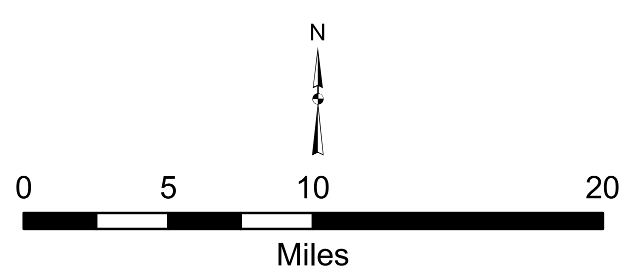
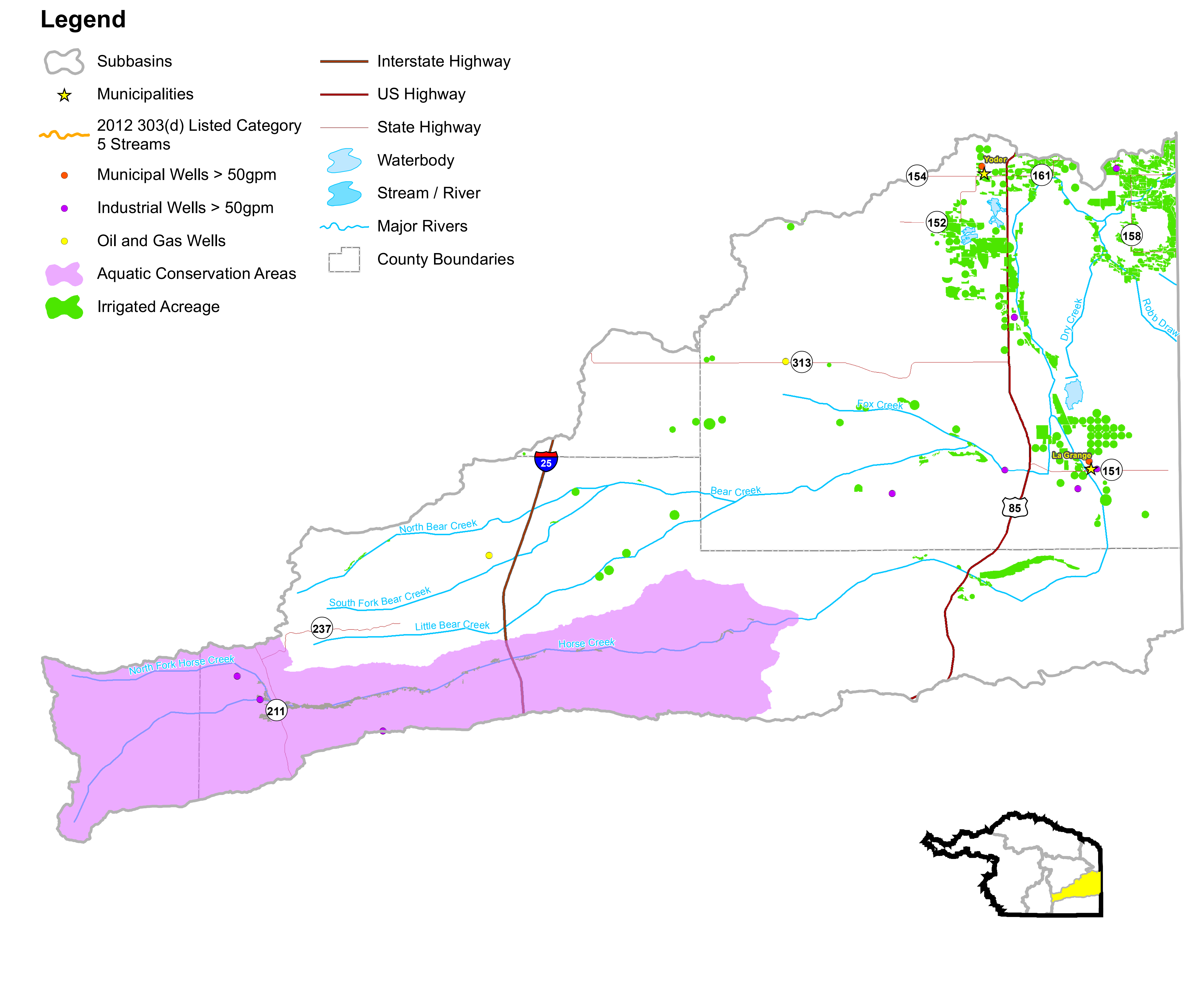
**Estimated Monthly Consumptive Use in an Average Year in Acre Feet Horse Creek Subbasin**




**Total Annual Consumptive Use in Acre Feet in an Average Year Horse Creek Subbasin**

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# Figure 3.1.8
# Overall Water Use Profile within the South Platte Subbasin

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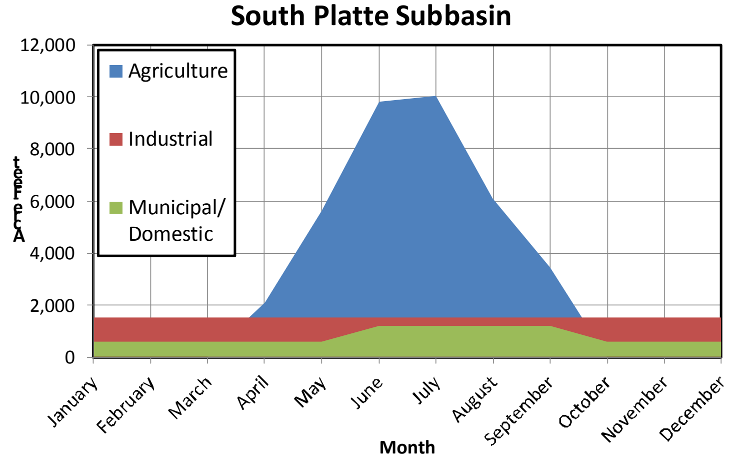
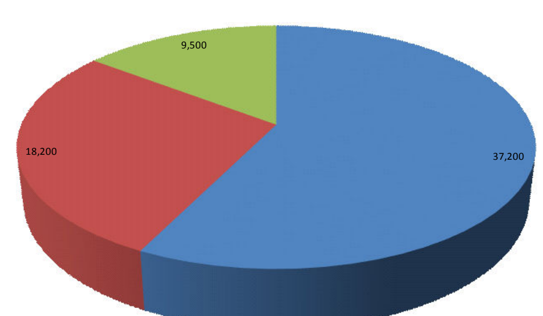
**Estimated Monthly Consumptive Use in an Average Year in Acre Feet South Platte Subbasin**

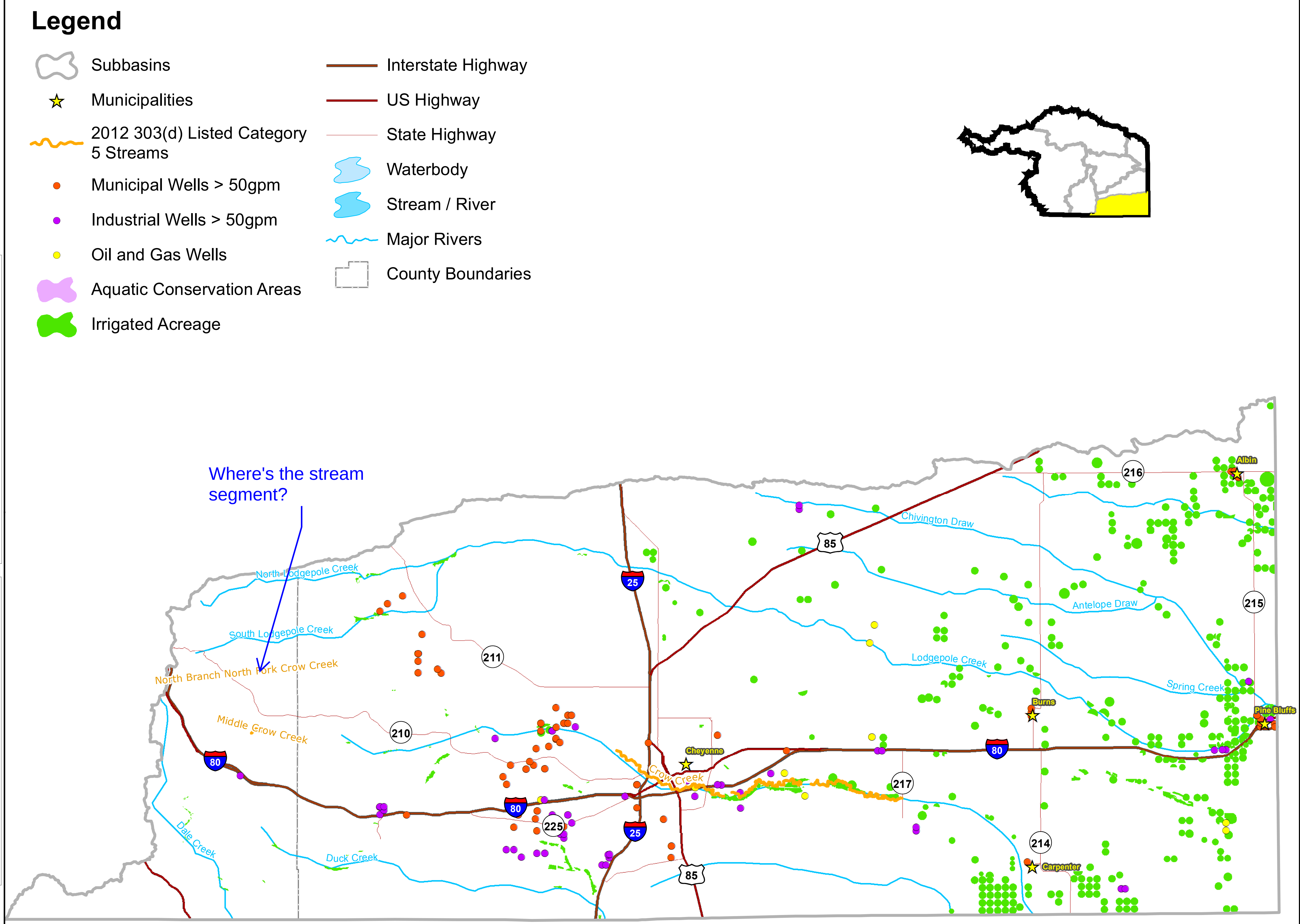


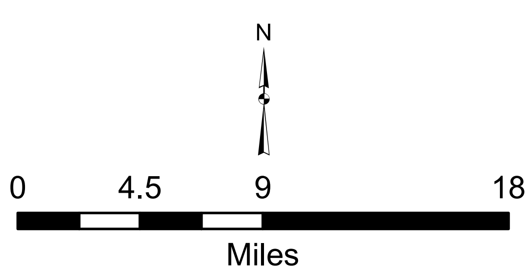

**Total Annual Consumptive Use in Acre Feet in an Average Year South Platte Subbasin**




Total of All uses = 64,900 Acre Feet
2012 Irrigated Acreage = 43,223

Agriculture | Industrial | Municipal/Domestic

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## 3.2 AGRICULTURE USE

### 3.2.1 Introduction

Section 3.2 presents an update on the agricultural use within the Platte River Basin of Wyoming. The principal focus of this update to the Platte River Basin Plan (Trihydro, 2006) has been a revision to the irrigated lands mapping and the consumptive use estimates associated with irrigated agriculture in the basin. This update relied heavily on information developed and maintained by the SEO for the Wyoming Depletions Plan.

### 3.2.2 Irrigation Systems

Trihydro (2006) provided a comprehensive overview of the irrigation systems established within each subbasin of the Platte River Basin in Technical Memorandum 2.1.3. The locations of the irrigation districts within the Platte River Basin are shown on **Figure 3.2.1**. Since the completion of that report, master plan studies have been completed through the WWDC for both the Goshen Irrigation District (Anderson Consulting Engineers, 2008) and Wheatland Irrigation District (Anderson Consulting Engineers, 2011). Briefly, these reports noted that significant infrastructure improvements were needed to various structures and conveyances to improve overall irrigation system efficiency.

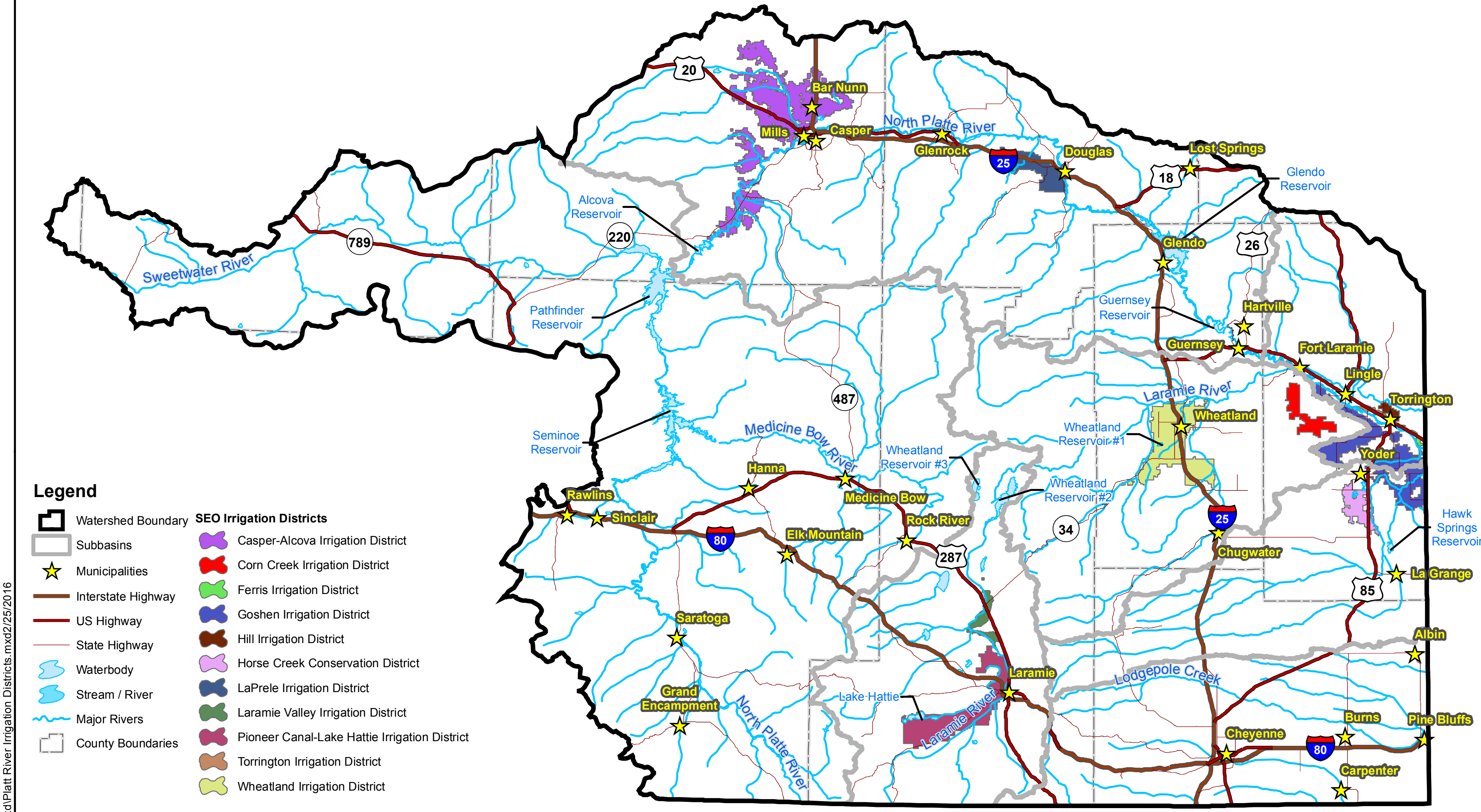
In addition to the aforementioned reports, the WWDC's Irrigation System Survey Report (2012) was reviewed for the purpose of identifying irrigation systems in need of repairs. **Appendix 3-A,** Table 1 lists the irrigation systems within each subbasin, and presents a comparison of the issues that were noted during the original basin plan and now.

### 3.2.3 Platte River Basin Irrigated Acreage Update

Trihydro (2006) completed an irrigated lands map of the Platte River Basin that was based on several data sources spanning 1995-2001. Since 2006, the SEO has been completing annual inventories of the irrigated lands with the portions of the Platte River Basin that are subject to the Modified North Platte Decree of 2001. The SEO has not specifically delineated irrigated acreages with the following areas: South Platte Subbasin, Horse Creek Subbasin, the Casper Alcova Irrigation District, any closed surface water basins not tributary to the North Platte River, and any Glendo contract water (Hoobler, 2014). The irrigated lands within these areas were delineated and added to those identified by the SEO for 2012, the date of the most recent aerial photography dataset that could be used. Irrigated acreages from the previous Basin Plan (TriHydro, 2006) formed the basis of comparison for this study.

The current irrigated lands mapping for 2012 was composited from data acquired from several sources. These data sources included the following:

1. GIS mapped irrigated acreages for decree areas from 2011-2013 from the SEO (Hoobler, 2014).
2. GIS mapped agricultural acreages (irrigated and dryland) for Laramie County supplied by the Laramie County Assessor (Pavlica, 2014).
3. GIS mapped irrigated acreage from the Casper Alcova Irrigation District (Anderson Consulting, 2014).
4. Lidstone & Associates, a Wenck Company (LA), delineated acreages in the Horse Creek, Pathfinder to Guernsey, and South Platte subbasins using ArcGIS and US Department of Agriculture aerial photos (USDA, 2014).




## Figure 3.2.1
## Irrigation Districts in the Platte Basin

### 3.2.4 GIS Mapped Irrigated Acreages, 2012

LA delineated irrigated agricultural lands in areas that the SEO had not based on whether they were being actively irrigated in 2012 from aerial imagery (USDA, 2014). The LA specific GIS delineations included the entire South Platte subbasin, the Horse Creek subbasin outside of the Goshen Irrigation District, the Dutton Creek closed basin, and the Casper Alcova Irrigation District in the Pathfinder to Guernsey subbasin. Hoobler (2014) noted that the acreages related to Glendo contract water are small and therefore LA did not delineate those minor areas. Results of the irrigated land delineation are summarized by subbasin and county, and are presented in **Table 3.2.1**. The locations of the irrigated lands identified in 2012 are presented by subbasin on **Figures 3.2.2 through 3.2.8**.

**Table 3.2.1: GIS-derived Platte River Basin Irrigated Agricultural Land Organized by Subbasin for 2012**

| Platte River Subbasin | County | Area (acres) | Percent of Total Per Subbasin |
|---|---|---|---|
| Above Pathfinder | Albany | 8,586 | 6.9 |
| | Carbon | 106,692 | 86.3 |
| | Converse | 52 | 0.0 |
| | Freemont | 4,918 | 4.0 |
| | Natrona | 3,102 | 2.5 |
| | Sublette | 303 | 0.2 |
| | **Total** | **123,651** | **100** |
| Pathfinder to Guernsey | Albany | 209 | 0.3 |
| | Converse | 32,423 | 49.8 |
| | Natrona | 28,565 | 43.9 |
| | Platte | 3,917 | 6.0 |
| | **Total** | **651,14** | **100** |
| Guernsey to State Line | Goshen | 80,585 | 100 |
| | **Total** | **80,585** | **100** |
| Upper Laramie | Albany | 101,537 | 97.6 |
| | Carbon | 2,501 | 2.4 |
| | **Total** | **104,038** | **100** |
| Lower Laramie | Albany | 2,627 | 4.0 |
| | Goshen | 4,316 | 6.5 |
| | Laramie | 695 | 1.0 |
| | Platte | 58,799 | 88.5 |
| | **Total** | **66,437** | **100** |
| Horse Creek | Goshen | 34,505 | 85 |
| | Laramie | 5,420 | 13.3 |
| | Platte | 670 | 1.7 |
| | **Total** | **40,595** | **100** |
| South Platte | Albany | 195 | 0.5 |
| | Laramie | 43,028 | 99.5 |
| | **Total** | **43,223** | **100** |
| **Note:** All data has been projected in the NAD1983 datum. | | | |

**Figure 3.2.9** presents a direct comparison of the irrigated acreage among the different subbasins of the Platte River Basin. The Above Pathfinder, Upper Laramie, and Guernsey to Stateline subbasins account for 59% of the irrigated acreage in the riverbasin while the remaining 41% is split between the other four subbasins.

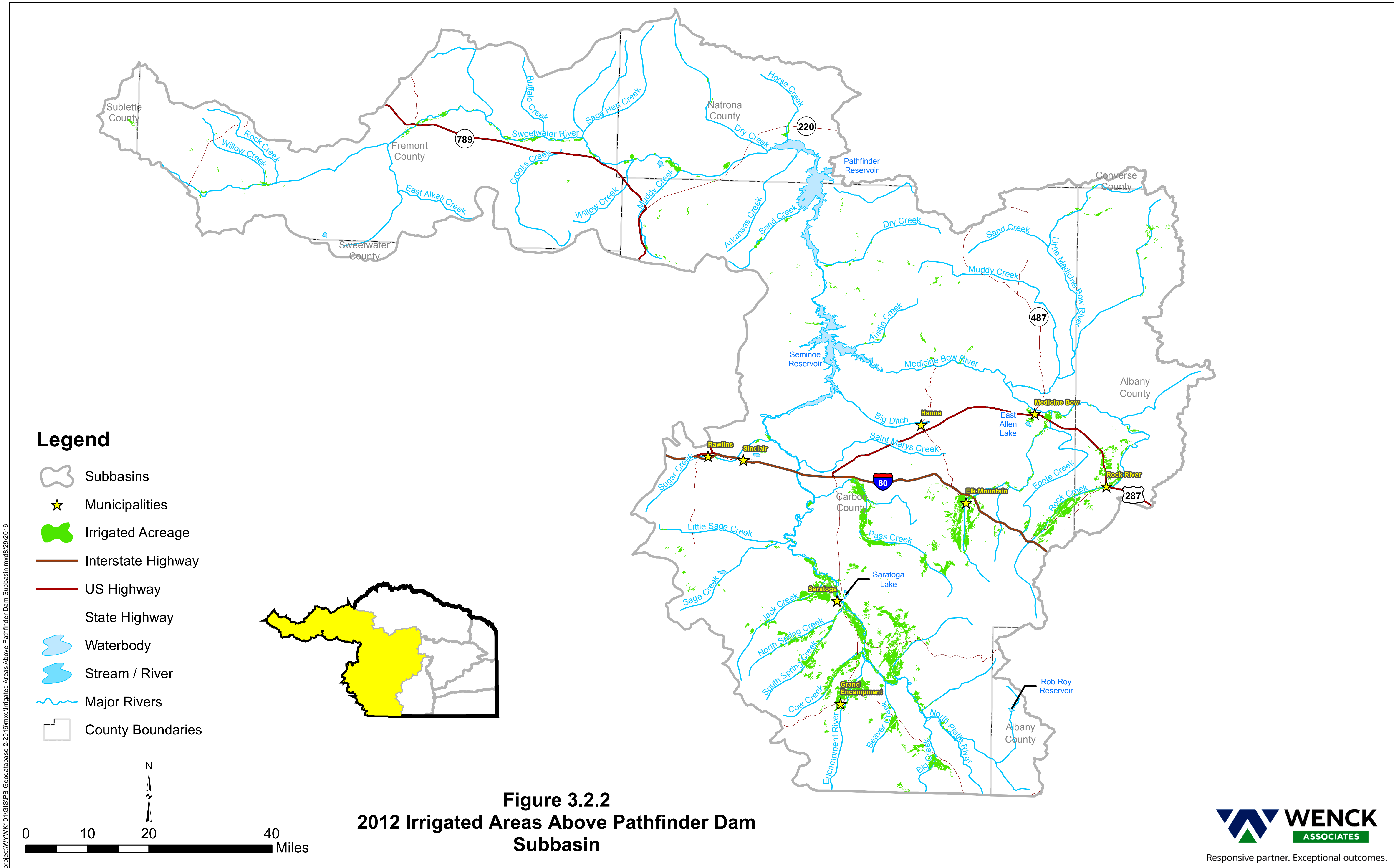



**Figure 3.2.2**
**2012 Irrigated Areas Above Pathfinder Dam Subbasin**

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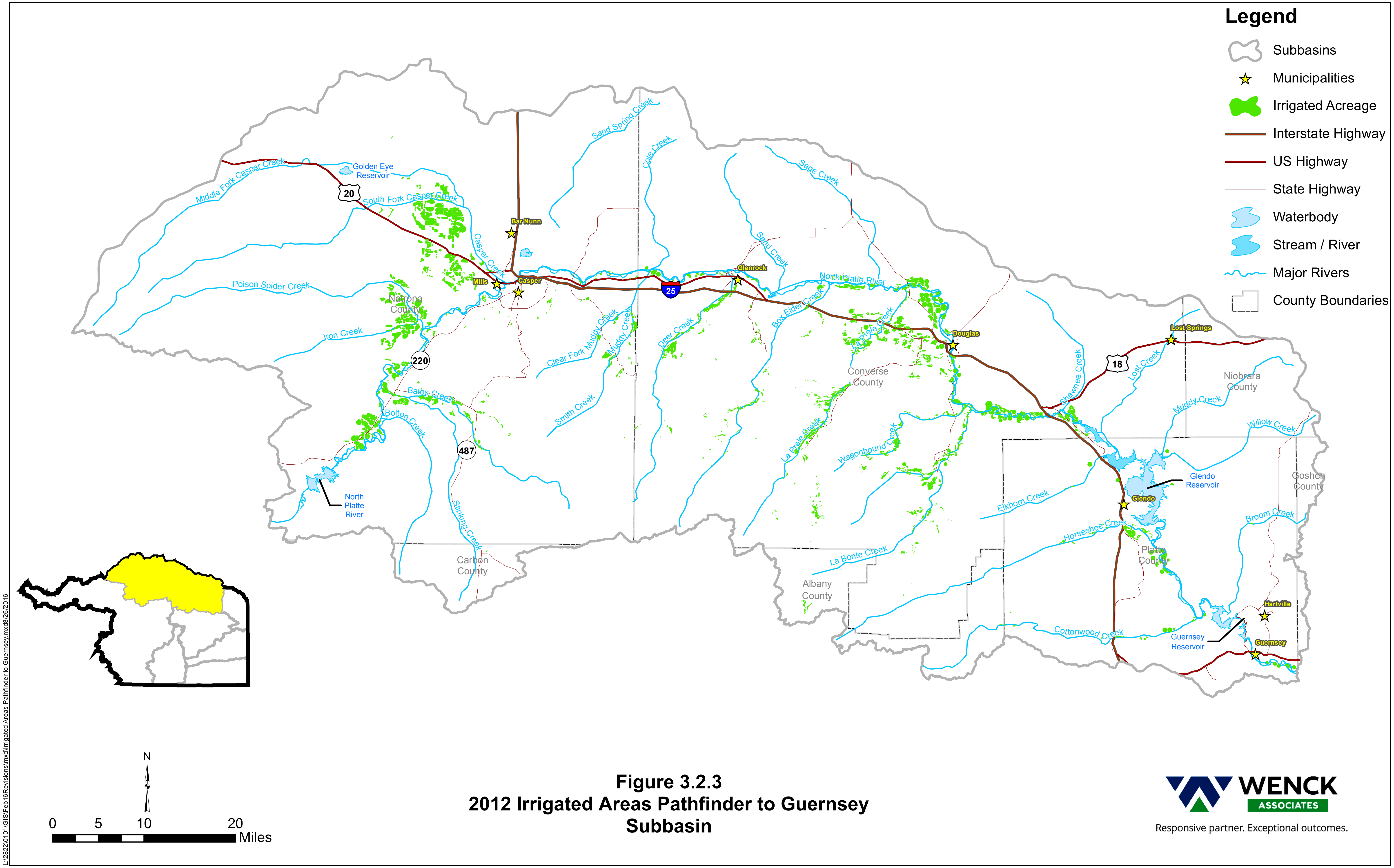


**Figure 3.2.3**
**2012 Irrigated Areas Pathfinder to Guernsey Subbasin**

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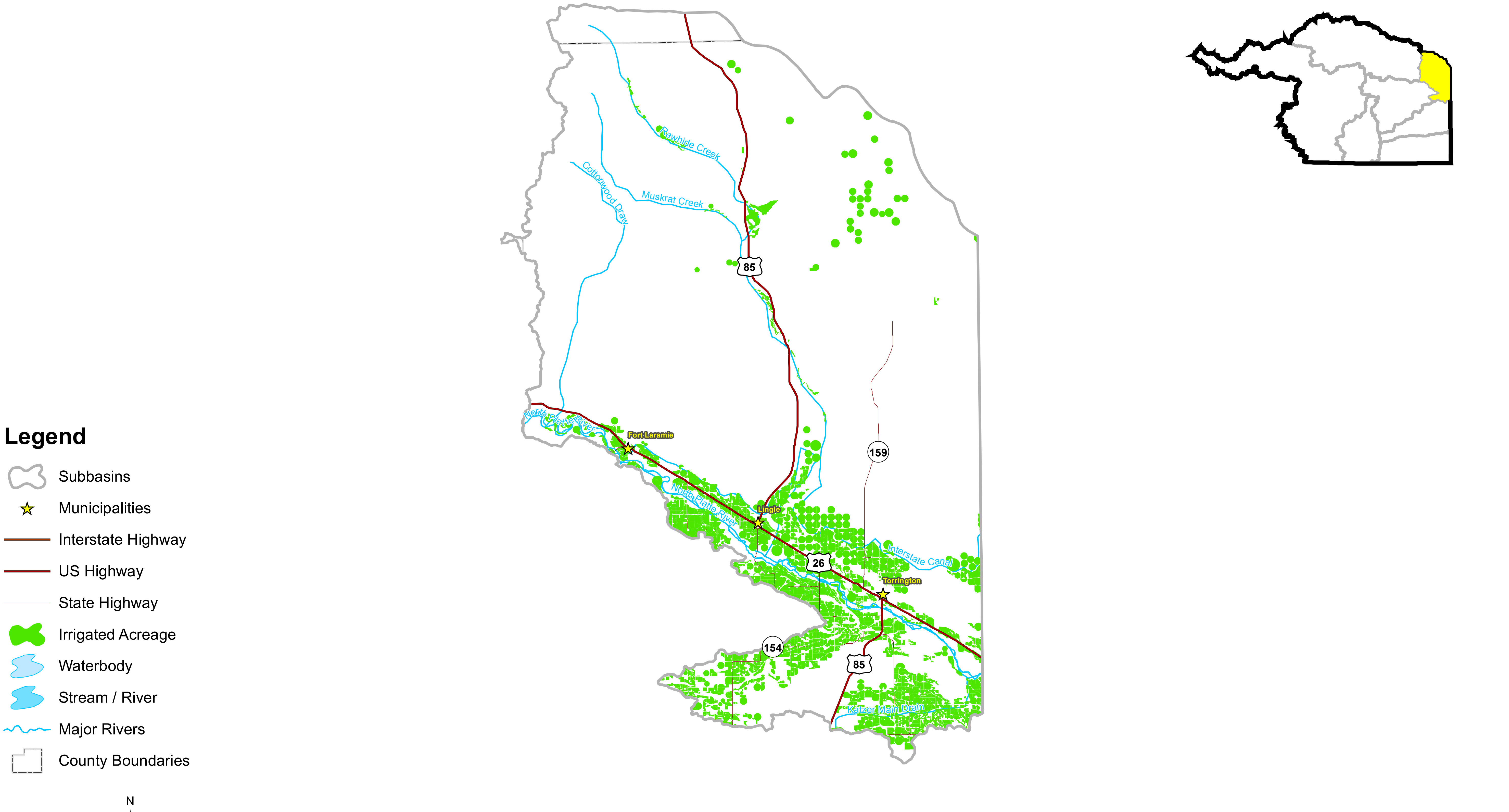


**Figure 3.2.4**
**2012 Irrigated Areas Guernsey to State Line Subbasin**

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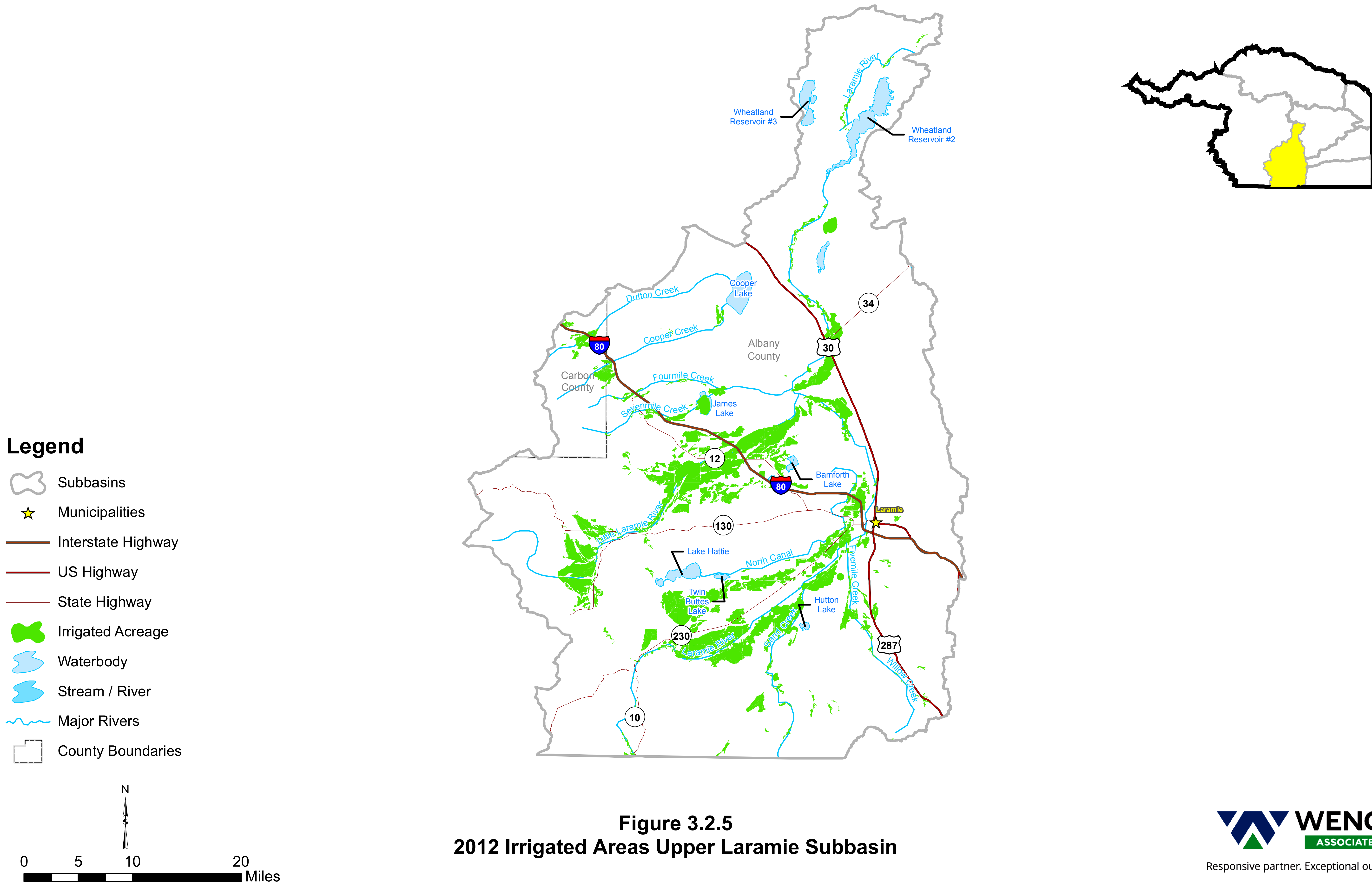


**Figure 3.2.5**
**2012 Irrigated Areas Upper Laramie Subbasin**

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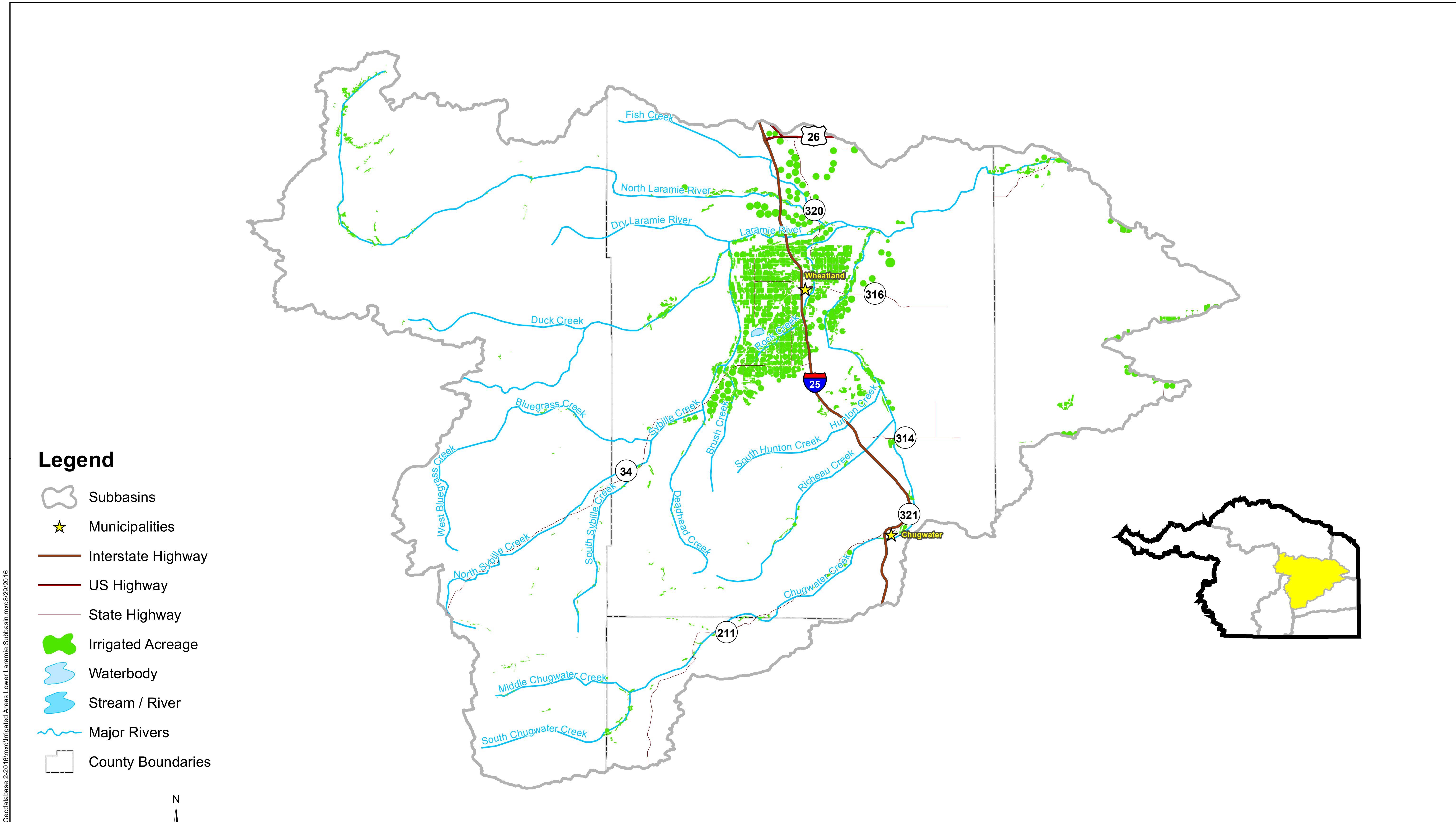


**Figure 3.2.6**
**2012 Irrigated Areas Lower Laramie Subbasin**

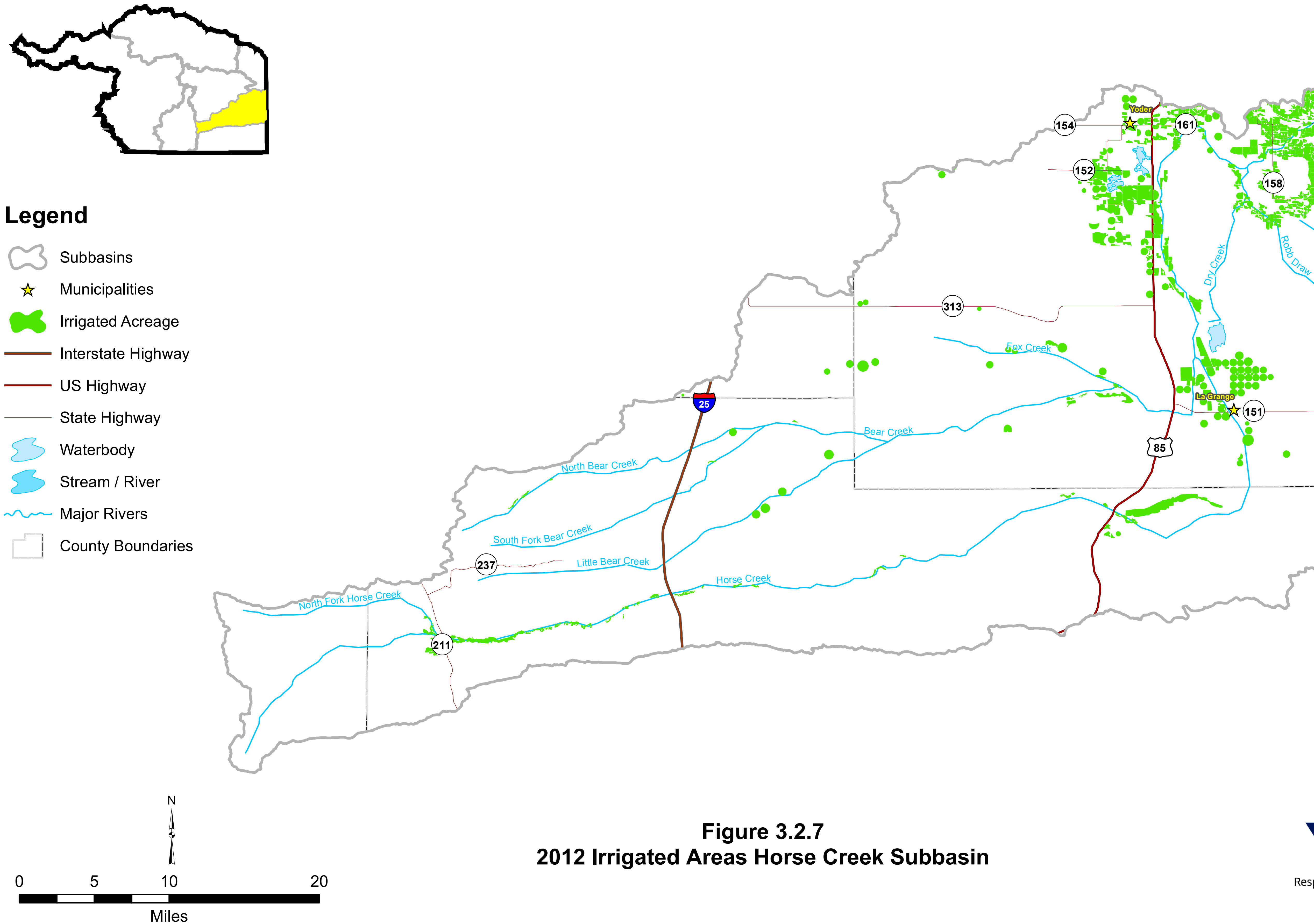


**Figure 3.2.7**
**2012 Irrigated Areas Horse Creek Subbasin**

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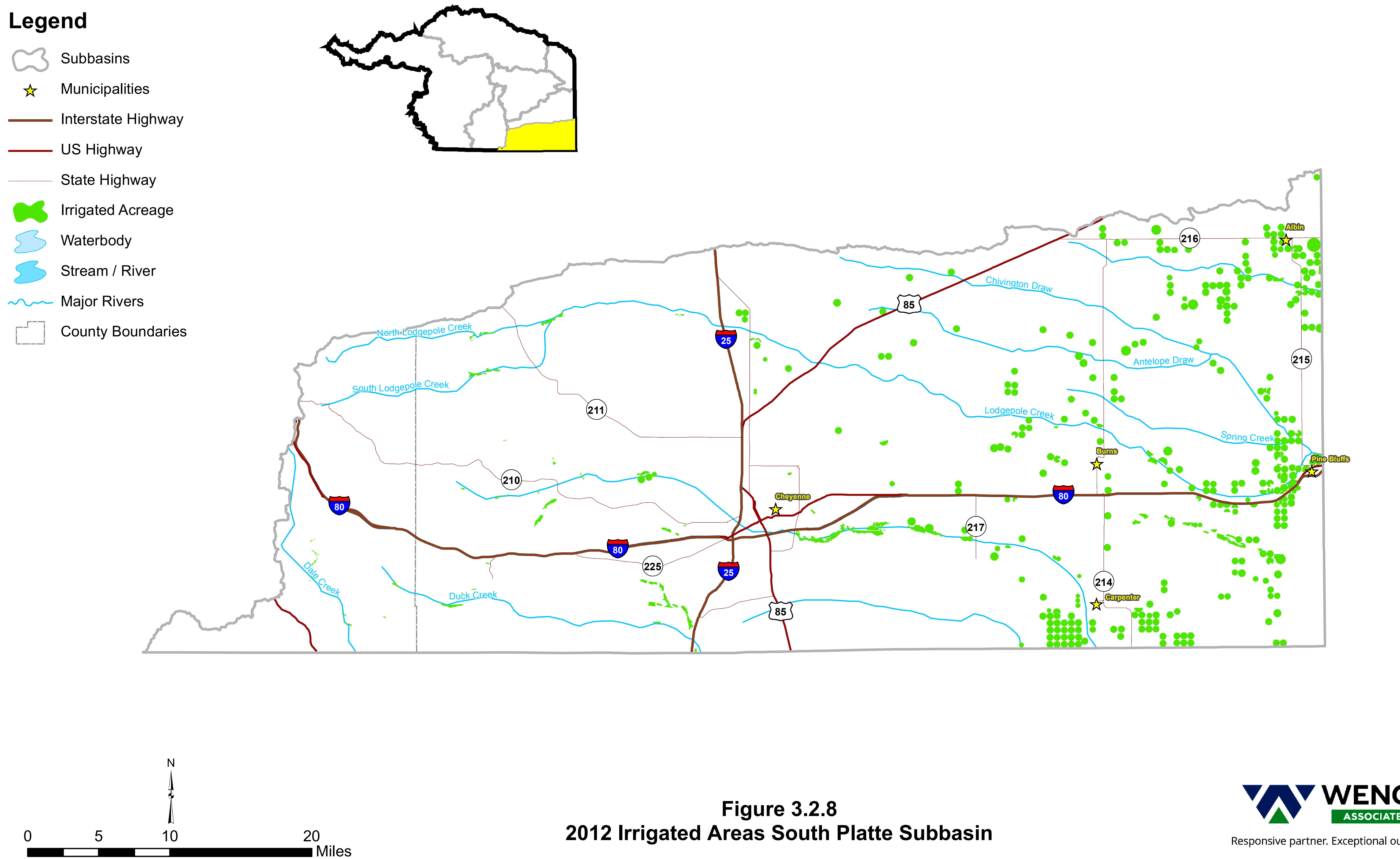


**Figure 3.2.8**
**2012 Irrigated Areas South Platte Subbasin**

WENCK ASSOCIATES
Responsive partner. Exceptional outcomes.

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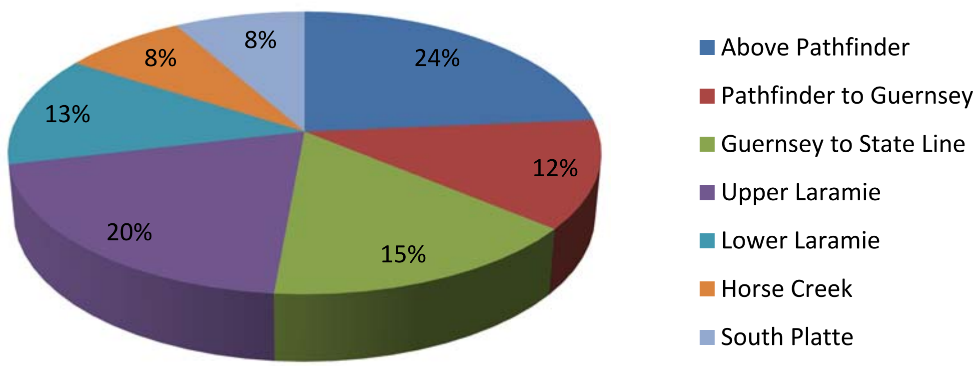
**Figure 3.2.9: Percent of Total Irrigated Acres by Subbasin in 2012**




### 3.2.5 Irrigated Acreage Comparison and Variation in Irrigated Acreage

The irrigated acreages that were delineated for 2012 for the entire Platte River Basin were compared to those from the original basin plan report. **Appendix 3-A,** summarizes the GIS delineated acreages and notes the percent differences between the irrigated lands maps. All Platte River subbasins, with the exception of the Upper Laramie, experienced an overall decrease in irrigated acreages between the two mapping periods. The subbbasins that experienced the largest reduction in irrigated acreage were Horse Creek (-32%), Pathfinder to Guernsey (-28%), and the Lower Laramie (-23%). Generally, the substantial reduction in irrigated acreages can be attributed to the below average water year of 2012, when water supplies were stressed. The only subbasin with an observed increase in irrigated acreage was the Upper Laramie (+13%). Overall, 14% fewer irrigated acres were identified through the most recent irrigated lands mapping in the Platte River Basin. Overall, as shown in **Table 3.2.2**, mapped acreage in 2012 was 14% less than reported in the period from 1995 to 2001.

**Table 3.2.2: Comparison of Original Basin Plan and 2012 Mapped Irrigated Acreages**

| Platte River Subbasin | 1995-2001 Mapped Acreages[1] | 2012 Mapped Acreages | Percent Difference |
|---|---|---|---|
| Above Pathfinder | 150,186 | 123,651 | -18 |
| Pathfinder to Guernsey | 90,028 | 65,114 | -28 |
| Guernsey to State Line | 88,034 | 80,585 | -8 |
| Upper Laramie | 92,186 | 104,038 | 13 |
| Lower Laramie | 86,380 | 66,437 | -23 |
| Horse Creek | 59,521 | 40,595 | -32 |
| South Platte | 45,454 | 43,223 | -5 |
| **Total** | **611,789** | **523,644** | **-14** |

**Note:**
1. Irrigated acres from Table 2-3 of the Platte River Basin Plan Final Report (Trihydro,2006).

To further assess the variability in irrigated acreage with water availability, the irrigated acreages identified by the SEO within the decree areas only for 2011, 2012, and 2013 were compared. Hoobler (2014) reported that 2011 was an above average water year, while 2012 was below average and 2013 was an average year. **Table 3.2.3** presents a comparison of the irrigated acreage the SEO delineated for those years. It is important to note that the discrepancy between mapped acreages shown in **Table 3.2.2** and **Table 3.2.3** is attributable to the fact that the SEO did not delineate all the irrigated acreage in the Platte River Basin in 2012 and this is reflected in **Table 3.2.3** (Hoobler, 2014). Therefore, the methodologies used to calculate irrigated acreage in the Platte River Basin differed between the analysis performed by Wenck and the SEO.

**Table 3.2.3: Irrigated Acreage Identified by the SEO within Platte River Basin Decree Areas**

| Decree Area | 2012 Mapped Acreages (below)[1] | 2013 Mapped Acreages (average)[2] | 2011 Mapped Acreages (above)[3] | Percent Difference (below) | Percent Difference (above) |
|---|---|---|---|---|---|
| Above Guernsey[4] | 169,059 | 171,696 | 203,599 | 1.5 | 18.6 |
| Guernsey to State Line | 78,533 | 72,344 | 78,389 | -8.6 | 8.4 |
| Upper Laramie | 77,440 | 68,018 | 80,294 | -13.9 | 18.0 |
| Lower Laramie | 52,370 | 54,516 | 64,095 | 3.9 | 17.6 |

**Notes:**
1. Acreage from Wyoming Depletions Report – Water Year 2012 (SEO, 2012)
2. Acreage from Wyoming Depletions Report – Water Year 2013 (SEO, 2013)
3. Acreage from Wyoming Depletions Report – Water Year 2011 (SEO, 2011)
4. Acreage above Guernsey excludes Casper Alcova Irrigation District/Kendrick Project

Based on the data presented in **Table 3.2.4**, water usage and irrigated acreages varies considerably between subbasins. The Above Guernsey area experienced an 18.6% increase in irrigated acreage in an above average water year, and decreased only 1.5% in a below average water year. This area appears to be far more dependent upon surface water flow for irrigation supplies. Similarly, water use and associated irrigated land usage in the Upper and Lower Laramie subbasins increased 18% and 17.6%, respectively, in an above average water year. During a below average water year, irrigated lands in Lower Laramie decreased 3.9%, while those in the Upper Laramie increased almost 14%. The reason for this specific increase between these years is unknown, but the limited number of years used for comparison likely has an effect. In contrast, the Guernsey to State Line area exhibited less significant swings in irrigated land of approximately 8% during above and below average years. The stability of this area could be attributed to pumping from triangle groundwater wells and/or regulation in favor of this area.

**Table 3.2.4: Estimated Percentage of Acres Irrigated by Center Pivot Irrigation System in 2012**

| Subbasin | Pivot Acres | Total Irrigated Acres in 2012 | Estimated Pivot Irrigation % |
|---|---|---|---|
| Above Pathfinder | 3,203 | 123,651 | 3 |
| Pathfinder to Guernsey | 25,018 | 64,870 | 39 |
| Guernsey to State Line | 38,093 | 80,585 | 47 |
| Upper Laramie | 1,662 | 104,038 | 2 |
| Lower Laramie | 37,682 | 66,437 | 57 |
| Horse Creek | 17,344 | 40,597 | 43 |
| South Platte | 38,667 | 43,221 | 89 |
| **Platte Basin Total** | **161,669** | **523,400** | **31** |

Notes:
1. Irrigated area was based on 2012 irrigated lands coverages from SEO North Platte modified Decree Area irrigated land inventory.
2. Pivot irrigation was estimated based on 2012 NAIP aerial imagery.

### 3.2.6 Crop Distribution

Trihydro (2006) previously summarized the distribution of crops grown in the Platte River Basin by county in Table 2-2 and by subbasin in Table 2-4 of their final report. The National Agricultural Statistics Service (NASS) 2012 Census of Agriculture for Wyoming (USDA, 2015) was reviewed to evaluate crop distribution for the irrigated lands for each of the seven Platte River subbasins. Based on that review, there is insufficient data for 2012 to complete a thorough update to the work previously completed. The principal reasons for the incomplete data sets are lack of responses from the agricultural community and privacy concerns. However, Table 4.9 in Volume 4 summarizes crop acreage for the entire Platte River Basin.

### 3.2.7 Water Use and Consumptive Use

Surface water and groundwater are both used for irrigation purposes in the Platte River Basin. Trihydro (2006) and The Wyoming Geological Survey tabulated the quantities of permitted irrigation groundwater rights. Total annual average groundwater withdrawals for irrigation were estimated to be 206,745 acre-feet (Taucher and others, 2013). Assuming surface water is applied at a rate of 1 cfs per 70 acres, total surface water use during the irrigation season based on the number of irrigated acres in 2012 would be approximately 2.4 million acre-feet.

The annual consumptive use of irrigation water for 2012 was estimated on the basis of the unit consumptive use rates and the irrigated acreages that were delineated. These rates of irrigation water use ($CU_w$) for irrigated acreage were established in the 2006 Platte River Basin Plan, and were calculated on the basis of calibrated crop coefficients derived from the supreme court (2001) consumptive use data (Trihydro, 2006). Based on the same methodologies used in the original basin plan, AMEC (2014) developed a $CU_w$ of 0.93 for Laramie County that was based on 18 years of data and encompassed a wide range of meteorologic variability. The $CU_w$ value from the AMEC study (2014) was deemed acceptable for the purposes of estimated consumptive use in this analysis, given that 99.5% of the 2012 irrigated acreage in the South Platte subbasin resides within Laramie County.

**Table 3.2.5** summarizes the 2012 consumptive use calculations, and is organized on the basis of subbasins. Overall this usage is very similar to that provided by Trihydro (2006) for a low streamflow year. The most significant increase in water use was observed in the Upper Laramie.

**Table 3.2.5: Consumptive Use of Irrigation Water by Platte River Subbasin**

| Platte River Subbasin | Annual Unit Consumptive Use ($CU_w$) Value (acre-feet/acre)[1] | 2012 Consumptive Use (acre-feet)[2] | Average Low Streamflow Consumptive Use (acre-feet)[3] |
|---|---|---|---|
| Above Pathfinder | 0.74 | 91,502 | 85,920 |
| Pathfinder to Guernsey | 1.04 | 67,719 | 63,323 |
| Guernsey to State Line | 1.32 | 106,373 | 112,895 |
| Upper Laramie | 0.79 | 82,190 | 43,696 |
| Lower Laramie | 1.31 | 87,033 | 102,937 |
| Horse Creek | 1.16 | 47,090 | 61,281 |
| South Platte | 0.93[1] | 40,197 | 43,314 |
| **Total** | ---- | **522,103** | **513,366** |

**Notes:**

1. Annual consumptive use unit values taken from Trihydro (2006), with the exception of the South Platte Subbasin that was obtained from AMEC (2014).
2. Consumptive use equal to annual unit consumptive use multiplied by the 2012 irrigated acreage for each respective subbasin from **Table 3.2.2**.
3. Consumptive use during average low streamflow years from Trihydro (2006) in Technical Memorandum 2.1.4.

### 3.2.8 Livestock Water Use within the Platte River Basin

Trihydro (2006) provided maps showing the locations of stock water wells in the basin plan and provided an overview on livestock population. To supplement this information and provide a current estimate of water use by the various types of livestock in the basin, the 2012 Census of Agriculture prepared by the U.S. Department of Agriculture (USDA, 2012) was reviewed to determine the populations of livestock. The USDA prepared profiles in 2012 for each of the counties located within the Platte River Basin that included inventories for each livestock type, including cattle, sheep, horses, layers (poultry), and buffalo among others. With the exceptions of Sublette and Sweetwater Counties, the county populations for each livestock type were multiplied by the percentage of each county within the Platte Basin to estimate the basin population. The 2012 livestock population estimates are presented in **Table 3.2.6**. In Volume 4, Harvey Economics (HE) used more recent 2015 data rather than the 2012 data used in the Volume 3 analysis. Therefore, the livestock population numbers for cattle and sheep reported in Volume 4, Table 4.9 are greater than those presented in **Table 3.2.6**. It is worth noting that the water directly consumed by livestock is insignificant when compared to the use by irrigated crops.

Annual water use by livestock type for 2012 was estimated from these populations and established livestock watering requirements. Unit water usage data for different types of livestock were obtained from the 2010 Wyoming Livestock Water and Pipeline Handbook (USDA, 2010). These values were multiplied by the total estimated population of the respective livestock type to estimate total water use. As shown in **Table 3.2.6** total livestock water use in 2012 has been estimated to be approximately 8,494 acre-feet. Of that total, approximately 95% is attributed to cattle raised in the basin, while 3% was attributed to horses.

### 3.2.9 References

AMEC Environment & Infrastructure Inc., 2014, Hydrogeologic Study of the Laramie County Control Area: Consultant's report prepared for Wyoming State Engineer's Office in collaboration with Hinckley Consulting and HDR Engineering.

Anderson Consulting Engineers, 2008, Goshen Irrigation District Master Plan, Level I Study: Consultant's report prepared for the Wyoming Water Development Commission.

Anderson Consulting Engineers, 2011, Wheatland Irrigation District Master Plan, Level I Study: Consultant's report prepared for the Wyoming Water Development Commission.

Anderson Consulting Engineers, 2014, Personal Communication.

Hoobler, M., 2014, Wyoming State Engineer's Office. Personal Communication. Cheyenne, WY.

United States Department of Agriculture. 2014. National Agriculture Imagery Program. Wyoming 2012, 1 meter imagery. Accessed 11/4/2014. http://gis.apfo.usda.gov/arcgis/services/NAIP/Wyoming_2012_1m_NC/ImageServer

Pavlica, J., 2014, Wyoming Water Development Office. Personal Communication. Cheyenne, WY.

Trihydro Corporation, 2006, Platte River Basin Plan Final Report: Consultant's report prepared for the Wyoming Water Development Commission in collaboration with Lidstone and Associates, Inc., Harvey Economics, and Water Rights Services LLC

**Table 3.2.6: Estimated Livestock Water Use in the Platte River Basin in 2012**

| Livestock Category | Livestock Population by County | | | | | | | | | Livestock Totals by Type | Unit Daily Water Use by Livestock Type (gal/day) | Estimated Annual Water Use by Livestock Type (Acre-feet) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Albany | Laramie | Platte | Goshen | Carbon | Natrona | Converse | Fremont | Niobrara | | | |
| Cattle and Calves | 68,725 | 83,455 | 78,634 | 108,355 | 63,732 | 29,167 | 29,529 | 15,282 | 3,192 | 480,072 | 15 | 8,066 |
| Sheep and Lambs | 2,762 | 29,749 | 417 | 1,273 | 7,203 | 12,664 | 27,234 | 3,027 | 190 | 84,519 | 1.5 | 142 |
| Horses and Ponies | 2,687 | 3,358 | 1,374 | 2,420 | 1,884 | 1,397 | 882 | 2,231 | 84 | 16,318 | 15 | 274 |
| Layers | 1,727 | - | 790 | 1,571 | 172 | 723 | 549 | 584 | 18 | 6,135 | 1.5 | 10 |
| Buffalo | - | NR | - | - | NR | - | - | - | 52 | 52 | 20 | 1 |
| Goats | - | - | - | - | - | - | 104 | - | - | 104 | 1.5 | 0.2 |
| Hogs and Pigs | NR | NR | NR | - | - | - | - | - | - | NR | | NR |
| County % in Platte River Basin | 100% | 100% | 100% | 96% | 70% | 57% | 50% | 19% | 7% | | Total = | 8,494 |

**Notes:**
NR – Present
- Indicates not present in county.
County percentages estimated using GIS and Platte Basin Watershed boundary. Sublette (1.1%) and Sweetwater (0.3%) Counties were not included due to their low county percentage within the Platte River Basin.
Livestock type and number obtained from 2012 USDA Census by county at the following address: http://www.aqcensus.usda.gov/Publications/2012/Online_Resources/County_Profiles/Wyoming
Livestock population for each county estimated by multiplying 2012 USDA Census county data for each livestock category by county percentage within the Platte River Basin.
Estimated daily unit livestock water requirements from Wyoming Livestock Water and Pipeline Handbook, 2010.

United States Department of Agriculture, 2014, 2012 Census of Agriculture, Wyoming, Volume 1: National Agricultural Statistics Service Geographic Area Series, Part 50, AC-12-A-50.

Wyoming State Engineer's Office, 2011, Wyoming Depletions Report – Water Year 2011: State Engineer's report to the Governance Committee of the Platte River Recovery Implementation Program.

Wyoming State Engineer's Office, 2012, Wyoming Depletions Report – Water Year 2012: State Engineer's report to the Governance Committee of the Platte River Recovery Implementation Program.

Wyoming State Engineer's Office, 2013, Wyoming Depletions Report – Water Year 2013: State Engineer's report to the Governance Committee of the Platte River Recovery Implementation Program.

Taucher, P., Bartos, T.T., Taboga, K.G., Hallberg, L.L, Clark, M.L., Stafford, J., Gracias, T., Hinckley, B., Worman, B., Clarey, K., Lindemann, L., Quillinan, S.A., Copeland, D., Hays, R., and Thompson, M., 2013, Available Groundwater Determination Technical Memorandum, WWDC Platte River Basin Water Plan Update, Level I (2009-2013), Wyoming State Geological Survey, Laramie, Wyoming.

Wyoming Water Development Commission, 2003, State of Wyoming Irrigation System Survey Report: Report obtained from the following URL: http://wwdc.state.wy.us/surveys/surveys.html

Wyoming Water Development Commission, 2012, State of Wyoming Irrigation System Survey Report: Report obtained from the following URL: http://wwdc.state.wy.us/surveys/surveys.html

## 3.3 MUNICIPAL AND DOMESTIC USE

### 3.3.1 Introduction

This section presents an update on the municipal and domestic use of water within the Platte River Basin of Wyoming. The basin consists of the six subbasins of the North Platte River and the South Platte Subbasin. The principal focus of this update to the Platte River Basin Plan (Trihydro, 2006) has been a revision to the amounts of water used for municipal and domestic purposes on both an annual and a monthly basis, with a review of how that usage changes between above and below average water years. This update relied heavily on information developed and maintained by the SEO and the WWDC.

### 3.3.2 Municipal Use

Trihydro (2006) presented a comprehensive overview of the 54 community public water systems located within the subbasins of the Platte River Basin in Technical Memorandum 2.2. Since the completion of the 2006 Basin Plan, much new water usage data have been developed through master planning projects sponsored by the WWDC, the SEO's annual municipal water use surveys for subbasins within the North Platte River drainage, and the WWDC's public water system surveys. These data sources are listed in the references section at the end of this section. Water usage data were either compiled on a monthly or an annual basis and provide sufficient information for evaluating water usage changes both seasonally within a given year and annual changes in available water.

Actual water usage data are not typically available for many smaller community public water systems. For these systems, average and peak use were calculated as done in the Basin Plan by taking the average and peak usage values of entities who participated in the WWDC's 2002 survey, 226 and 575 gallons per capita per day (gpcpd), respectively, and multiplying this value by the respective entity's population. The following sections present the current water usage data.

### 3.3.3 New High Capacity Wells

Since January 1, 2004, 30 new wells or enlargements have been filed with the SEO for municipal use. Typically, these wells produce more than 50 gallons per minute (gpm), although the towns of Yoder and Glendo completed wells with smaller yields during the time period. The location, depth, and appropriation of these wells are listed in **Appendix 3-B,** Table 1. The locations of these wells are shown along with those identified by Trihydro (2006) on **Figure 3.3.1**. This documentation demonstrates that several municipalities have identified and developed new water sources as they have attempted to keep pace with water demand.

The new municipal wells include the following:

- Five North Park Aquifer wells for the Town of Saratoga, which has transitioned from a surface water only system to a groundwater only system;
- Two Lance/Fox Hills Aquifer wells for the Town of Pine Bluffs, which has lost several Brule Aquifer wells due to declining water levels;
- Two High Plains Aquifer wells for the City of Cheyenne, which has been evaluating various groundwater development options at its Belvoir Ranch including the Casper Aquifer;
- Two High Plains Aquifer wells for the Town of Albin; and,
- One Lance/Fox Hills Aquifer well for the Town of Yoder.

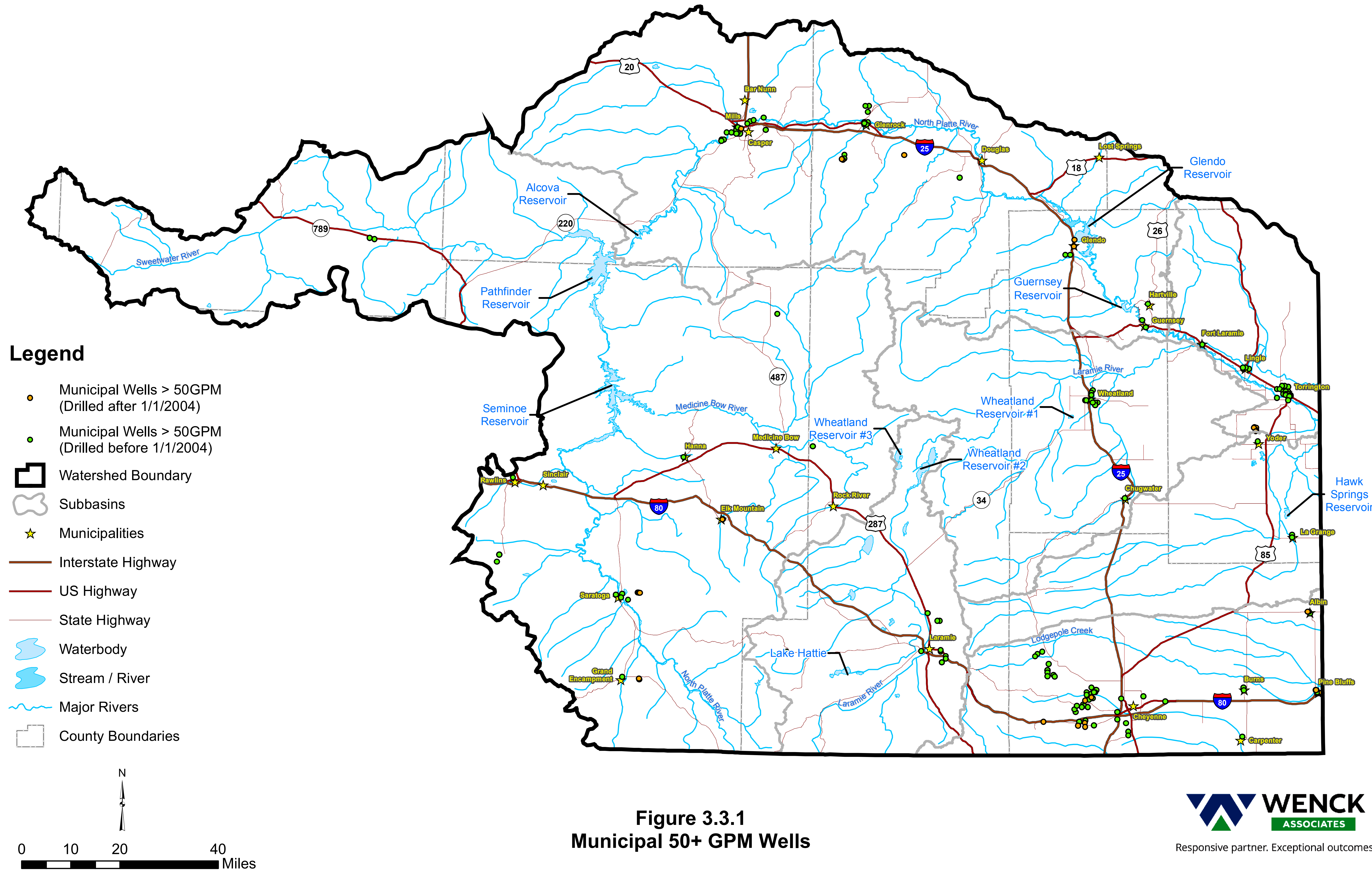



Figure 3.3.1
Municipal 50+ GPM Wells

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These new wells indicate that groundwater remains a significant source of supply for many municipalities within the Platte River Basin. The fact that these wells have also been drilled to depths ranging up to 2,926 feet, completed in new aquifers, and used to replace surface water indicates the measure of the municipalities resolve to continue providing quality drinking water to Wyoming's residents.

### 3.3.4 Annual Rural Domestic and Municipal Water Usage and Usage Variations

Water usage data for the community public water systems in each subbasin were compiled from the WWDC's 2013 Public Water System Survey Report and various master plans to compare changes in water usage between 2002 as noted in the original Basin Plan (Trihydro, 2006) and 2013. **Tables 3.3.1 through 3.3.7** present the water source, average day use, and peak daily use in gallons per day (gpd) for each of the respective entities in the various subbasins. Total annual water usage for each community public water system is shown for the recent 2013 dataset. Usage data were estimated for those systems that were not included or did not provide recent information.

Comparison of these data on an individual basis indicates that water usage changes vary, likely for different reasons. With respect to the municipalities serving a population of 500 or more, average daily water usage increased for the following municipalities: Hanna, Evansville, Casper, Douglas, Wheatland, and Cheyenne; while average daily water usage declined for the following municipalities: Saratoga, Rawlins, Guernsey, Glenrock, Mills, Lingle, Torrington, Laramie, and Pine Bluffs. Most of these changes correspond to changes in population. Wheatland's increase is likely due to a reporting error from 2002. The magnitude of the other changes can be obtained from reviewing the respective tables.

For entities within subbasins of the North Platte River, the total annual usage reported by the WWDC in **Tables 3.3.1 through 3.3.7** can be compared with that obtained from the SEO for 2013 in **Table 3.3.8**. This table lists the total annual diversion or usage of each municipality within the North Platte River subbasins as reported to the SEO for water years 2011 through 2013. These data were obtained from the Wyoming Depletions Reports (SEO, 2011-2013) associated with each of these water years.

**Table 3.3.8** can also be used to evaluate changes in water usage related to water availability. While 2013 was an average water year, 2011 was an above average water year and 2012 was a below average water year. Based on these data, water usage across the subbasins of the North Platte River generally decreased during an above average water year, and increased during a below average water year. Water use increased 6.5% during a below average water year, and decreased 8.6% during an above average water year. Previously, municipalities had reported changes in usage ranging from 0 to 20% (Trihydro, 2006). Water usage between the various subbasins varied. During a below average water year, water usage increased 9% to 22% in the following subbasins: Pathfinder to Guernsey, Guernsey to State Line, Lower Laramie, and Horse Creek, while those in the other subbasins decreased slightly. During an above average water year, water usage decreased 8.5% to 20% in the following subbasins: Above Pathfinder, Pathfinder to Guernsey, Upper Laramie, and Horse Creek, while water use in the Lower Laramie and Guernsey to State Line subbasins decreased less than 3%.

**Appendix 3-B** presents detailed information on new water wells and summaries of water usage for community water systems in the Platte River Basin.

**Table 3.3.1: Summary of Rural Domestic Water Use in the Above Pathfinder Dam Subbasin, Wyoming**

| 2006 Platte Basin Plan | | | | | | |
|---|---|---|---|---|---|---|
| **County** | **Number of Domestic Wells** | **Area (sq mi)** | **Housing Density (people per house)[1]** | **Rural Population** | **Estimated Minimum Water Use (gpd)[2]** | **Estimated Average Water Use (gpd)[3]** |
| Albany | 290 | 1,027 | 2,44 | 708 | 106,140 | 212,280 |
| Carbon | 1,105 | 5,425 | 2.46 | 2,718 | 407,745 | 815,490 |
| Converse | 3 | 20 | 2.63 | 8 | 1,184 | 2,367 |
| Fremont | 247 | 1,749 | 2.61 | 645 | 96,7-1 | 193,401 |
| Natrona | 35 | 809 | 2.52 | 88 | 13,230 | 26,460 |
| Sublette | 2 | 55 | 2.52 | 5 | 756 | 1,512 |
| Sweetwater | 0 | 35 | 2.74 | 0 | 0 | 0 |
| **Totals** | **1,682** | | | **4,172** | **625,800** | **1,251,600** |

**Notes:**
1. From 2000 U.S. Census county population data.
2. Assumed 150 gpd per capita multiplied by rural population.
3. Assumed 300 gpd per capita multiplied by rural population.
4. Water use values reflect total demand but do not necessarily reflect consumptive use.

| Platte Basin Plan Update | | | |
|---|---|---|---|
| **City / Town Service Area** | **Population Served[1]** | **Estimated Minimum Water Use (gpd)[2]** | **Estimated Average Water Use (gpd)[4]** |
| **Total Subbasin Population[1] – 15,220** | | | |
| Encampment/Riverside | 593 | | |
| Saratoga | 1,761 | | |
| Hanna | 827 | | |
| Rawlins | 9,416 | | |
| Sinclair | 432 | | |
| Rock River | 249 | | |
| Elk Mountain | 211 | | |
| Medicine Bow | 315 | | |
| **Total Municipal Population** | **13,804** | **Total =** | **Total =** |
| **Rural Population[2]** | **1,416** | **212,400** | **424,800** |

**Notes:**
1. From Wyoming Department of Administration and Information, and Wyoming SEO (2013).
2. Rural population = total subbasin population – total municipal population.
3. Assumed 150 gpd per capita multiplied by rural population.
4. Assumed 300 gpd per capita multiplied by rural population.

**Table 3.3.2: Summary of Rural Domestic Water Use in the Pathfinder Dam to Guernsey Subbasin, Wyoming**

| 2006 Platte Basin Plan | | | | | | |
|---|---|---|---|---|---|---|
| County | Number of Domestic Wells | Area (sq mi) | Housing Density (people per house)[1] | Rural Population | Estimated Minimum Water Use (gpd)[2] | Estimated Average Water Use (gpd)[3] |
| Albany | 82 | 146.46 | 2.44 | 200 | 30,012 | 60,024 |
| Carbon | 4 | 75.11 | 2.46 | 10 | 1,476 | 2,952 |
| Converse | 1,681 | 2,103.58 | 2.63 | 4,421 | 663,155 | 1,326,309 |
| Goshen | 5 | 51.24 | 2.42 | 12 | 1,815 | 3,630 |
| Natrona | 2,685 | 2,285.06 | 2.52 | 6,766 | 1,014,930 | 2,029,860 |
| Niobrara | 47 | 157.80 | 2.33 | 110 | 16,427 | 32,853 |
| Platte | 388 | 812.23 | 2.43 | 943 | 141,426 | 282,852 |
| **Totals** | **4,892** | | | **12,462** | **1,869,300** | **4,738,600** |

**Notes:**

1. From 2000 U.S. Census county population data.
2. Assumed 150 gpd per capita multiplied by rural population.
3. Assumed 300 gpd per capita multiplied by rural population.
4. Water use values reflect total demand but do not necessarily reflect consumptive use.

| Platte Basin Plan Update | | | |
|---|---|---|---|
| City / Town Service Area | Population Served[1] | Estimated Minimum Water Use (gpd)[2] | Estimated Average Water Use (gpd)[4] |
| **Total Subbasin Population[1] – 97,148** | | | |
| Mills | 3,568 | | |
| Casper | 68,284 | | |
| Evansville | 3,162 | | |
| Glenrock | 2,727 | | |
| Rolling Hills | 450 | | |
| Douglas | 6,742 | | |
| Glendo | 204 | | |
| **Total Municipal Population** | **85,137** | **Total =** | **Total =** |
| **Rural Population[2]** | **12,011** | **1,801,650** | **3,603,300** |

**Notes:**

1. From Wyoming Department of Administration and Information, and Wyoming SEO (2013).
2. Rural population = total subbasin population – total municipal population.
3. Assumed 150 gpd per capita multiplied by rural population.
4. Assumed 300 gpd per capita multiplied by rural population.

**Table 3.3.3: Summary of Rural Domestic Water Use in the State Line Subbasin, Wyoming**

| 2006 Platte Basin Plan | | | | | | |
|---|---|---|---|---|---|---|
| **County** | **Number of Domestic Wells** | **Area (sq mi)** | **Housing Density (people per house)[1]** | **Rural Population** | **Estimated Minimum Water Use (gpd)[2]** | **Estimated Average Water Use (gpd)[3]** |
| Goshen | 1,471 | 1,064,04 | 2.42 | 3,560 | 533,973 | 1,067,946 |
| Niobrara | 4 | 25.26 | 2.33 | 9 | 1,398 | 2,796 |
| Platte | 0 | 0.92 | 2.43 | 0 | 0 | 0 |
| **Totals** | **1,475** | | | **3,569** | **535,350** | **1,070,700** |

**Notes:**
1. From 2000 U.S. Census county population data.
2. Assumed 150 gpd per capita multiplied by rural population.
3. Assumed 300 gpd per capita multiplied by rural population.
4. Water use values reflect total demand but do not necessarily reflect consumptive use.

| Platte Basin Plan Update | | | |
|---|---|---|---|
| **City / Town Service Area** | **Population Served[1]** | **Estimated Minimum Water Use (gpd)[2]** | **Estimated Average Water Use (gpd)[4]** |
| **Total Subbasin Population[1] – 12,296** | | | |
| Guernsey | 1,184 | | |
| Hartville | 63 | | |
| Fort Laramie | 240 | | |
| Lingle | 503 | | |
| Yoder | 467 | | |
| Torrington | 7,331 | | |
| **Total Municipal Population** | **9,788** | **Total =** | **Total =** |
| **Rural Population[2]** | **2,508** | **376,200** | **752,400** |

**Notes:**
1. From Wyoming Department of Administration and Information, and Wyoming SEO (2013).
2. Rural population = total subbasin population – total municipal population.
3. Assumed 150 gpd per capita multiplied by rural population.
4. Assumed 300 gpd per capita multiplied by rural population.

**Table 3.3.4: Summary of Rural Domestic Water Use in the Upper Laramie Subbasin, Wyoming**

| 2006 Platte Basin Plan | | | | | | |
|---|---|---|---|---|---|---|
| County | Number of Domestic Wells | Area (sq mi) | Housing Density (people per house)[1] | Rural Population | Estimated Minimum Water Use (gpd)[2] | Estimated Average Water Use (gpd)[3] |
| Albany | 1,980 | 1,859 | 2.44 | 4,831 | 724,680 | 1,449,360 |
| Carbon | 41 | 72 | 2.46 | 101 | 15,129 | 30,258 |
| **Totals** | **2,021** | | | **4,932** | **739,800** | **1,479,600** |

**Notes:**
1. From 2000 U.S. Census county population data.
2. Assumed 150 gpd per capita multiplied by rural population.
3. Assumed 300 gpd per capita multiplied by rural population.
4. Water use values reflect total demand but do not necessarily reflect consumptive use.

| Platte Basin Plan Update | | | |
|---|---|---|---|
| City / Town Service Area | Population Serviced[1] | Estimated Minimum Water Use (gpd)[2] | Estimated Average Water Use (gpd)[4] |
| **Total Subbasin Population[1] – 36,558** | | | |
| Laramie | 31,874 | | |
| **Total Municipal Population** | **31,874** | **Total =** | **Total =** |
| **Rural Population[2]** | **4,684** | **702,600** | **1,405,200** |

**Notes:**
1. From Wyoming Department of Administration and Information, and Wyoming SEO (2013).
2. Rural population = total subbasin population – total municipal population.
3. Assumed 150 gpd per capita multiplied by rural population.
4. Assumed 300 gpd per capita multiplied by rural population.

**Table 3.3.5: Summary of Rural Domestic Water Use in the Lower Laramie Subbasin, Wyoming**

| 2006 Platte Basin Plan | | | | | | |
|---|---|---|---|---|---|---|
| County | Number of Domestic Wells | Area (sq mi) | Housing Density (people per house)[1] | Rural Population | Estimated Minimum Water Use (gpd)[2] | Estimated Average Water Use (gpd)[3] |
| Albany | 193 | 959 | 2.44 | 471 | 70,638 | 141,276 |
| Goshen | 124 | 324 | 2.42 | 300 | 40,012 | 90,024 |
| Laramie | 20 | 125 | 2.54 | 51 | 7,620 | 15,240 |
| Platte | 1,118 | 1,244 | 2.43 | 2,717 | 407,511 | 815,022 |
| **Totals** | **1,455** | | | **3,539** | **530,850** | **1,061,700** |

**Notes:**
1. From 2000 U.S. Census county population data.
2. Assumed 150 gpd per capita multiplied by rural population.
3. Assumed 300 gpd per capita multiplied by rural population.
4. Water use values reflect total demand but do not necessarily reflect consumptive use.

| Platte Basin Plan Update | | | |
|---|---|---|---|
| City / Town Service Area | Population Served[1] | Estimated Minimum Water Use (gpd)[2] | Estimated Average Water Use (gpd)[4] |
| **Total Subbasin Population[1] – 6,808** | | | |
| Wheatland | 3,820 | | |
| Chugwater | 214 | | |
| **Total Municipal Population** | **4,034** | **Total =** | **Total =** |
| **Rural Population[2]** | **2,774** | **416,100** | **832,200** |

**Notes:**
1. From Wyoming Department of Administration and Information, and Wyoming SEO (2013).
2. Rural population = total subbasin population – total municipal population.
3. Assumed 150 gpd per capita multiplied by rural population.
4. Assumed 300 gpd per capita multiplied by rural population.

**Table 3.3.6: Summary of Rural Domestic Water Use in the Horse Creek Subbasin, Wyoming**

| 2006 Platte Basin Plan | | | | | | |
|---|---|---|---|---|---|---|
| **County** | **Number of Domestic Wells** | **Area (sq mi)** | **Housing Density (people per house)[1]** | **Rural Population** | **Estimated Minimum Water Use (gpd)[2]** | **Estimated Average Water Use (gpd)[3]** |
| Albany | 8 | 86 | 2.44 | 20 | 2,928 | 5,865 |
| Goshen | 520 | 709 | 2.42 | 1,258 | 188,760 | 377,520 |
| Laramie | 149 | 740 | 2.54 | 378 | 56,769 | 113,538 |
| Platte | 17 | 52 | 2.43 | 41 | 6,197 | 12,393 |
| **Totals** | **694** | | | **1,698** | **254,700** | **509,400** |

**Notes:**
1. From 2000 U.S. Census county population data.
2. Assumed 150 gpd per capita multiplied by rural population.
3. Assumed 300 gpd per capita multiplied by rural population.
4. Water use values reflect total demand but do not necessarily reflect consumptive use.

| Platte Basin Plan Update | | | |
|---|---|---|---|
| **City / Town Service Area** | **Population Served[1]** | **Estimated Minimum Water Use (gpd)[2]** | **Estimated Average Water Use (gpd)[4]** |
| **Total Subbasin Population[1] – 1,910** | | | |
| LaGrange | 455 | | |
| **Total Municipal Population** | **455** | **Total =** | **Total =** |
| **Rural Population[2]** | **2,455** | **218,250** | **436,500** |

**Notes:**
1. From Wyoming Department of Administration and Information, and Wyoming SEO (2013).
2. Rural population = total subbasin population – total municipal population.
3. Assumed 150 gpd per capita multiplied by rural population.
4. Assumed 300 gpd per capita multiplied by rural population.

**Table 3.3.7: Summary of Rural Domestic Water Use in the South Platte Subbasin, Wyoming**

| 2006 Platte Basin Plan | | | | | | |
|---|---|---|---|---|---|---|
| County | Number of Domestic Wells | Area (sq mi) | Housing Density (people per house)[1] | Rural Population | Estimated Minimum Water Use (gpd)[2] | Estimated Average Water Use (gpd)[3] |
| Albany | 163 | 228 | 2.44 | 398 | 59,658 | 119,316 |
| Laramie | 6,444 | 1,820 | 2.54 | 16,368 | 2,455,164 | 4,910,328 |
| **Totals** | **6,607** | | | **16,766** | **2,514,900** | **5,029,800** |

**Notes:**
1. From 2000 U.S. Census county population data.
2. Assumed 150 gpd per capita multiplied by rural population.
3. Assumed 300 gpd per capita multiplied by rural population.
4. Water use values reflect total demand but do not necessarily reflect consumptive use.

| Platte Basin Plan Update | | | |
|---|---|---|---|
| City / Town Service Area | Population Served[1] | Estimated Minimum Water Use (gpd)[2] | Estimated Average Water Use (gpd)[4] |
| **Total Subbasin Population[1] – 95,548** | | | |
| Albin | 196 | | |
| Burns | 308 | | |
| Cheyenne | 73,836 | | |
| Pine Bluffs | 1,153 | | |
| **Total Municipal Population** | **75,493** | **Total =** | **Total =** |
| **Rural Population[2]** | **20,091** | **3,013,650** | **6,027,300** |

**Notes:**
1. From Wyoming Department of Administration and Information, and Wyoming SEO (2013).
2. Rural population = total subbasin population – total municipal population.
3. Assumed 150 gpd per capita multiplied by rural population.
4. Assumed 300 gpd per capita multiplied by rural population.

**Table 3.3.8: Total Annual Diversions in Million Gallons by Water Year for Municipal Water Systems**

| | 2011 (wet year) Million Gallons | 2012 (dry year) Million Gallons | 2013 (average year) Million Gallons | Percent difference (between 2012 and 2013 water years)[3] | Percent difference (between 2011 and 2013 water years)[3] |
|---|---|---|---|---|---|
| **Above Pathfinder Subbasin** | | | | | |
| Encampment | 27.50 | 27.50 | 27.50 | 0.0% | 0.0% |
| Sierra Madre Joint Powers Board | 7.09 | 8.98 | 8.74 | 2.7% | -18.9% |
| Saratoga | 142.16 | 168.80 | 180.20 | -6.3% | -21.1% |
| Hanna | 92.00 | 96.00 | 90.00 | 6.7% | 2.2% |
| Rawlins | 742.35 | 767.56 | 832.37 | -7.8% | -10.8% |
| Sinclair | 34.85 | 37.34 | 31.39 | 19.0% | 11.0% |
| Rock River | 48.55 | 35.88 | 21.50 | 66.9% | 125.8% |
| Elk Mountain | 7.52 | 10.82 | 11.23 | -3.7% | -33.0% |
| Medicine Bow | 38.00 | 53.00 | 43.00 | 23.3% | -11.6% |
| **Total =** | **1,140.02** | **1,205.88** | **1,245.93** | **-3.2%** | **-8.5%** |
| **Pathfinder to Guernsey Subbasin** | | | | | |
| Mills | 231.00 | 268.00 | 250.00 | 7.2% | -7.6% |
| Central Wyoming Regional Water | 4,705.51 | 5,649.20 | 5,156.13 | 9.6% | -8.7% |
| Evansville | 249.97 | 290.38 | 261.81 | 10.9% | -4.5% |
| Glenrock | 159.01 | 205.84 | 217.63 | -5.4% | -26.9% |
| Douglas | 530.79 | 620.60 | 591.10 | 5.0% | -10.2% |
| Glendo | 16.45 | 20.06 | 16.69 | 20.2% | -1.4% |
| **Total =** | **5,892.73** | **7,054.08** | **6,493.36** | 8.6% | -9.2% |
| **Guernsey to State Line Subbasin** | | | | | |
| Guernsey | 123.90 | 153.60 | 147.50 | 4.1% | -16.0% |
| Hartville[1] | 5.83 | 5.83 | 5.83 | 0.0% | 0.0% |
| Fort Laramie[2] | 33.26 | 33.26 | 18.77 | 77.2% | 77.2% |
| Lingle | 90.40 | 104.40 | 83.42 | 25.1% | 8.4% |
| Torrington | 558.14 | 684.22 | 583.02 | 17.4% | -4.3% |
| **Total =** | **811.53** | **981.31** | **838.54** | 17.0% | -3.2% |
| **Upper Laramie Subbasin** | | | | | |
| Laramie | 1,891.56 | 2,051.11 | 2,098.81 | -2.3% | -9.9% |
| **Total =** | **1,891.56** | **2,051.11** | **2,098.81** | -2.3% | -9.9% |
| | | | | | |
| **Lower Laramie Subbasin** | | | | | |
| Wheatland | 426.40 | 531.10 | 433.10 | 22.6% | -1.5% |
| Chugwater | 19.39 | 21.72 | 19.12 | 13.6% | 1.4% |
| **Total =** | **445.79** | **552.82** | **452.22** | 22.2% | -1.4% |

**Table 3.3.8: Total Annual Diversions in Million Gallons by Water Year for Municipal Water Systems**

| | 2011 (wet year) Million Gallons | 2012 (dry year) Million Gallons | 2013 (average year) Million Gallons | Percent difference (between 2012 and 2013 water years)[3] | Percent difference (between 2011 and 2013 water years)[3] |
|---|---|---|---|---|---|
| **Horse Creek Subbasin** | | | | | |
| LaGrange | 36.67 | 54.17 | 45.90 | 18.0% | -20.1% |
| **Total =** | **36.67** | **54.17** | **45.90** | 18.0% | -20.1% |
| | | | | | |
| **Total =** | **10,218.30** | **11,899.37** | **11,174.76** | **6.5%** | **-8.6%** |

**Notes:**

Total annual diversions obtained from the Wyoming Depletions Reports prepared by the Wyoming State Engineer's Office (2011, 2012, 2013).

1. Wyoming State Engineer's Office Estimated the amounts for all three years.
2. Wyoming State Engineer's Office estimated amounts for 2011 and 2012.
3. Positive percentage represents an increase in water use. Negative percentage indicates a decrease in water use.

### 3.3.5 Monthly Water Usage

Monthly water usage data from 28 of the community public water systems were compiled to evaluate seasonal use during the average water year of 2013, and in some instances, to estimate consumptive use. **Table 3.3.9** presents the monthly water usage data by municipality and subbasin, the total amount of water diverted from surface or groundwater sources, and where available, the amount of water returned to the surface stream monthly for each entity. Water from interbasin transfers is included in these figures. The locations of treated return flows are shown on **Figure 3.3.2** along with surface water intakes for the municipalities. These data were obtained from the Wyoming Depletions Report compiled by the SEO for 2013, and for entities in the South Platte subbasin, from recent master plan reports. The data presented generally do not include that used by independent raw water irrigation systems for those municipalities that utilize them.

For those systems that reported both diversions and return flows, consumptive use estimates range from 27% to 92%, and compare similarly to those reported by Trihydro (2006) that ranged from 26% to 65%. Aside from other groundwater systems, the Sierra Madre Joint Powers Board had the highest consumptive use at 92%. Of the systems for which consumptive use estimates were previously made, Cheyenne had the lowest consumptive use at 27%, compared with 65% previously; Laramie increased from 26% to 46%; Glenrock increased to 70% from 46%; and Torrington increased to 60% from 50%. Casper had an estimated consumptive use of 54%.

### 3.3.6 Rural Domestic Use

Excluding non-community public water systems, rural domestic water usage was estimated on the basis of the estimated rural population and the same assumed domestic usage values applied by Trihydro (2006). This approach is markedly different from that applied during the original Basin Plan that used housing density and the number of domestic wells completed in each subbasin. The Wyoming Department of Administration and Information (2015) provided estimates of the 2013 population for each subbasin. The estimated rural population was obtained by subtracting the population served by each municipality within its water service area from the total subbasin population. The following sections present the estimated water usage based on this approach.

#### New Domestic Wells

Between January 1, 2004 and January 26, 2015, 5,043 well permits were obtained and presumably completed within the subbasins of the Platte River Basin. The locations of these wells are shown along with those wells previously identified by Trihydro (2006) on **Figure 3.3.3**. **Figure 3.3.3** illustrates that most of these wells have been drilled in close proximity to existing areas of development, including east of Cheyenne; around Wheatland, Douglas, and Casper; and within the triangle near Torrington. More rural areas did not experience as much development.

#### Estimated Rural Domestic Water Use

Based on an assumed per capita usage rate of 150 to 300 gpd used in the Basin Plan, rural domestic water usage for each of the subbasins has been estimated. **Appendix 3-B,** Tables 2 through 8 present the minimum to average water usage estimates for the various subbasins. With a total rural population of approximately 20,000, the South Platte subbasin has the highest estimated usage at approximately 3.0 to 6.0 million gpd. The Pathfinder to Guernsey subbasin had the second highest usage estimated at 1.8 to 3.6 million gpd. With the lowest rural population, the Horse Creek subbasin had the lowest estimated usage at 0.2 to 0.4 million gpd.

**Table 3.3.9: Monthly Municipal Surface Water and Groundwater Diversions and Return Flow in Million Gallons**

| | Water Year 2013[1] | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Oct | Nov | Dec | Jan | Feb | Mar | Apr | May | June | July | Aug | Sep | Total | Total Groundwater Diversions (MG) | Total Surface Water Diversions (MG) | Total Diversions (MG) | Total Return Flow (MG) | Estimated Consumptive Use % | Remarks |
| **Above Pathfinder Dam Subbasin** | | | | | | | | | | | | | | | | | | | |
| **Encampment** | | | | | | | | | | | | | | | | | | | |
| Surface water diverted into primary supply / treatment system (MG) | 2.20 | 1.50 | 2.50 | 2.50 | 2.30 | 1.50 | 1.50 | 1.80 | 2.70 | 3.60 | 2.80 | 2.60 | 27.50 | | | | | | |
| | | | | | | | | | | | | | | 0.00 | 27.50 | 27.50 | Unknown | Unknown | |
| **Sierra Madre Joint Powers Board** | | | | | | | | | | | | | | | | | | | |
| Groundwater diverted into primary supply / treatment system (MG) | 0.55 | 0.31 | 0.31 | 0.24 | 0.29 | 0.23 | 0.35 | 0.58 | 1.67 | 1.98 | 1.29 | 0.95 | 8.74 | | | | | | |
| Water returned to river through wastewater system (MG) | 0.00 | 0.00 | 0.45 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.22 | 0.00 | 0.00 | 0.00 | 0.66 | | | | | | |
| | | | | | | | | | | | | | | 8.74 | 0.00 | 8.74 | 0.66 | 92% | |
| **Saratoga** | | | | | | | | | | | | | | | | | | | |
| Groundwater diverted into primary supply / treatment system (MG) | 9.70 | 8.70 | 9.50 | 11.40 | 10.60 | 12.00 | 11.80 | 16.70 | 26.00 | 25.20 | 22.80 | 15.80 | 180.20 | | | | | | |
| Water returned to river through wastewater system (MG) | 6.30 | 5.10 | 6.40 | 5.70 | 4.70 | 6.50 | 5.80 | 17.40 | 13.30 | 8.60 | 7.20 | 9.20 | 96.20 | | | | | | Excludes independent raw water irrigation. |
| | | | | | | | | | | | | | | 180.20 | 0.00 | 180.20 | 96.20 | 47% | |
| **Hanna** | | | | | | | | | | | | | | | | | | | |
| Surface water diverted into primary supply / treatment system (MG) | 5.00 | 4.00 | 5.00 | 4.00 | 4.00 | 5.00 | 5.00 | 6.00 | 9.00 | 10.00 | 10.00 | 7.00 | 74.00 | | | | | | |
| Surface water sold to users outside corporate limits (MG) | 1.00 | 1.00 | 0.00 | 0.00 | 0.00 | 0.00 | 1.00 | 2.00 | 3.00 | 3.00 | 3.00 | 2.00 | 16.00 | | | | | | |
| | | | | | | | | | | | | | | 0.00 | 90.00 | 90.00 | Unknown | Unknown | |
| **Rawlins** | | | | | | | | | | | | | | | | | | | |
| Surface water diverted into primary supply / treatment system (MG) | 41.82 | 42.54 | 36.25 | 38.59 | 37.86 | 43.39 | 35.17 | 65.57 | 106.10 | 114.94 | 103.09 | 59.64 | 724.96 | | | | | | |
| Groundwater diverted into primary supply / treatment system (MG) | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 7.20 | 34.56 | 31.25 | 33.48 | 32.40 | 138.89 | | | | | | |
| Water returned to river through wastewater system (MG) | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 31.97 | 42.53 | 44.97 | 0.00 | 0.00 | 0.00 | 119.47 | | | | | | |
| Surface water sold to Sinclair (MG) | 2.38 | 1.98 | 1.59 | 1.83 | 1.41 | 1.82 | 1.72 | 3.33 | 4.75 | 4.47 | 4.02 | 2.18 | 31.48 | 138.89 | 693.48 | 832.37 | 119.47 | 86% | Excludes golf course raw water irrigation. Surface water sold to Sinclair excluded from total diversion. |
| **Sinclair** | | | | | | | | | | | | | | | | | | | |
| Surface water from Rawlins (MG) | 2.38 | 1.98 | 1.58 | 1.73 | 1.41 | 1.82 | 1.72 | 3.33 | 4.67 | 4.47 | 4.02 | 2.28 | 31.39 | | | | | | |
| | | | | | | | | | | | | | | 0.00 | 31.39 | 31.39 | Unknown | Unknown | |
| **Rock River** | | | | | | | | | | | | | | | | | | | |
| Surface water diverted into primary supply / treatment system (MG) | 1.30 | 0.68 | 0.64 | 1.02 | 0.91 | 1.23 | 1.20 | 2.24 | 4.40 | 3.03 | 3.22 | 1.64 | 21.50 | | | | | | |
| | | | | | | | | | | | | | | 0.00 | 21.50 | 21.50 | Unknown | Unknown | |
| **Elk Mountain** | | | | | | | | | | | | | | | | | | | |
| Groundwater diverted into primary supply / treatment system (MG) | 0.81 | 0.74 | 0.64 | 0.58 | 0.52 | 0.52 | 0.47 | 0.78 | 1.72 | 1.87 | 1.72 | 0.87 | 11.23 | | | | | | |
| | | | | | | | | | | | | | | 11.23 | 0 | 11.23 | Unknown | Unknown | |

**Table 3.3.9: Monthly Municipal Surface Water and Groundwater Diversions and Return Flow in Million Gallons**

| | Water Year 2013[1] | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Oct | Nov | Dec | Jan | Feb | Mar | Apr | May | June | July | Aug | Sep | Total | Total Groundwater Diversions (MG) | Total Surface Water Diversions (MG) | Total Diversions (MG) | Total Return Flow (MG) | Estimated Consumptive Use % | Remarks |
| **Medicine Bow** | | | | | | | | | | | | | | | | | | | |
| Groundwater diverted into primary supply / treatment system (MG) | 3.00 | 2.00 | 4.00 | 3.00 | 3.00 | 3.00 | 3.00 | 4.00 | 4.00 | 5.00 | 5.00 | 4.00 | 43.00 | | | | | | |
| | | | | | | | | | | | | | | 43.00 | 0 | 43.00 | Unknown | Unknown | |
| **Pathfinder Dam to Guernsey Subbasin** | | | | | | | | | | | | | | | | | | | |
| **Mills** | | | | | | | | | | | | | | | | | | | |
| Surface and groundwater diverted into primary supply / treatment system (MG) | 15.00 | 13.00 | 14.00 | 16.00 | 13.00 | 15.00 | 14.00 | 24.00 | 35.00 | 34.00 | 32.00 | 25.00 | 250.00 | | | | | | |
| | | | | | | | | | | | | | | 250.00 | | 250.00 | Unknown | Unknown | Wastewater treated by City of Casper. |
| **Casper/Central Wyoming Regional Water System** | | | | | | | | | | | | | | | | | | | |
| Surface water diverted into primary supply / treatment system (MG) | 197.35 | 143.91 | 116.89 | 144.99 | 166.74 | 218.95 | 248.88 | 235.48 | 515.07 | 569.64 | 509.22 | 320.80 | 3387.92 | | | | | | |
| Groundwater diverted into primary supply / treatment system (MG) | 116.15 | 83.16 | 105.13 | 87.40 | 34.84 | 3.78 | 40.45 | 183.69 | 249.06 | 296.91 | 304.30 | 263.34 | 1768.20 | | | | | | |
| Water returned to river through wastewater system (MG) | 202.15 | 193.03 | 187.50 | 190.13 | 169.79 | 193.94 | 198.64 | 207.15 | 196.86 | 206.33 | 208.58 | 205.17 | 2359.27 | | | | | | |
| | | | | | | | | | | | | | | 1768.20 | 3387.92 | 5156.13 | 2359.27 | 54% | Excludes independent raw water irrigation. Consumptive use estimate affected by Mills and Evansville return flows. |
| **Evansville** | | | | | | | | | | | | | | | | | | | |
| Surface water diverted into primary supply / treatment system (MG) | 18.47 | 16.34 | 15.77 | 17.58 | 15.14 | 17.52 | 16.98 | 23.51 | 33.03 | 32.40 | 31.28 | 23.80 | 261.81 | | | | | | |
| | | | | | | | | | | | | | | 0.00 | 261.81 | 261.81 | Unknown | Unknown | Wastewater treated by City of Casper. |
| **Glenrock** | | | | | | | | | | | | | | | | | | | |
| Groundwater diverted into primary supply / treatment system (MG) | 9.37 | 7.59 | 9.58 | 11.51 | 9.88 | 10.09 | 9.90 | 20.04 | 35.87 | 40.25 | 32.06 | 21.50 | 217.63 | | | | | | |
| Water returned to river through wastewater system (MG) | 5.14 | 5.24 | 5.20 | 6.32 | 5.31 | 5.60 | 5.65 | 5.43 | 4.73 | 4.98 | 5.29 | 5.37 | 64.27 | | | | | | |
| | | | | | | | | | | | | | | 217.63 | 0.00 | 217.63 | 64.27 | 70% | Excludes independent raw water irrigation. |
| **Douglas** | | | | | | | | | | | | | | | | | | | |
| Surface water diverted into primary supply / treatment system (MG) | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 15.60 | 18.50 | 5.10 | 39.20 | | | | | | |
| Groundwater diverted into primary supply / treatment system (MG) | 38.00 | 25.80 | 28.90 | 29.20 | 25.90 | 29.30 | 30.20 | 51.40 | 78.10 | 83.20 | 72.20 | 59.70 | 551.90 | | | | | | |
| Total Return Flows (MG) | 19.50 | 19.00 | 19.00 | 18.90 | 16.90 | 17.90 | 18.40 | 29.20 | 31.80 | 27.50 | 33.10 | 27.70 | 278.90 | | | | | | |
| | | | | | | | | | | | | | | 551.90 | 39.20 | 591.10 | 278.90 | 53% | Excludes independent raw water irrigation. |
| **Glendo** | | | | | | | | | | | | | | | | | | | |
| Groundwater diverted into primary supply / treatment system (MG) | 1.22 | 0.52 | 0.53 | 1.25 | 0.46 | 0.52 | 0.72 | 1.28 | 2.70 | 3.56 | 2.48 | 1.45 | 16.69 | | | | | | |
| | | | | | | | | | | | | | | 16.69 | 0 | 16.69 | Unknown | Unknown | |
| **Guernsey** | | | | | | | | | | | | | | | | | | | |
| Groundwater diverted into primary supply / treatment system (MG) | 9.20 | 5.80 | 6.10 | 5.70 | 5.00 | 7.10 | 9.80 | 14.90 | 23.70 | 21.70 | 23.70 | 14.80 | 147.50 | | | | | | |
| | | | | | | | | | | | | | | 147.50 | 0 | 147.50 | Unknown | Unknown | |

**Table 3.3.9: Monthly Municipal Surface Water and Groundwater Diversions and Return Flow in Million Gallons**

| | Water Year 2013[1] | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Oct | Nov | Dec | Jan | Feb | Mar | Apr | May | June | July | Aug | Sep | Total | Total Groundwater Diversions (MG) | Total Surface Water Diversions (MG) | Total Diversions (MG) | Total Return Flow (MG) | Estimated Consumptive Use % | Remarks |
| **Hartville** | | | | | | | | | | | | | | | | | | | |
| Groundwater diverted into primary supply / treatment system (MG) | 0.23 | 0.27 | 0.47 | 0.18 | 0.20 | 0.23 | 0.34 | 0.37 | 0.60 | 0.92 | 1.10 | 0.92 | 5.83 | | | | | | |
| Water returned to river through wastewater system (MG) | 0.03 | 0.04 | 0.06 | 0.01 | 0.01 | 0.01 | 0.12 | 0.29 | 0.58 | 0.87 | 0.24 | 0.14 | 2.40 | | | | | | |
| | | | | | | | | | | | | | | 5.83 | 0 | 5.83 | 2.40 | 59% | |
| **Guernsey to State Line Subbasin** | | | | | | | | | | | | | | | | | | | |
| **Fort Laramie** | | | | | | | | | | | | | | | | | | | |
| Groundwater diverted into primary supply / treatment system (MG) | 1.05 | 0.79 | 0.78 | 0.68 | 0.66 | 0.77 | 0.81 | 2.00 | 3.11 | 3.51 | 2.78 | 1.82 | 18.77 | | | | | | Excludes independent raw water irrigation. |
| | | | | | | | | | | | | | | 18.77 | 0.00 | 18.77 | Unknown | Unknown | |
| **Lingle** | | | | | | | | | | | | | | | | | | | |
| Groundwater diverted into primary supply / treatment system (MG) | 7.14 | 2.64 | 1.81 | 1.87 | 2.18 | 1.95 | 3.35 | 6.04 | 11.15 | 14.88 | 16.28 | 14.13 | 83.42 | | | | | | |
| | | | | | | | | | | | | | | 0.00 | 83.42 | 83.42 | Unknown | Unknown | |
| **Torrington** | | | | | | | | | | | | | | | | | | | |
| Groundwater diverted into primary supply / treatment system (MG) | 38.15 | 25.20 | 26.56 | 29.10 | 26.57 | 31.54 | 28.72 | 50.78 | 81.98 | 91.56 | 87.26 | 65.60 | 583.02 | | | | | | |
| Water returned to river through wastewater system (MG) | 22.08 | 16.18 | 18.36 | 20.79 | 18.79 | 17.16 | 15.85 | 21.19 | 20.48 | 16.99 | 20.72 | 22.60 | 231.19 | | | | | | Excludes independent raw water irrigation. |
| | | | | | | | | | | | | | | 583.02 | 0 | 583.02 | 231.19 | 60% | |
| **Upper Laramie Subbasin** | | | | | | | | | | | | | | | | | | | |
| **Laramie** | | | | | | | | | | | | | | | | | | | |
| Surface water diverted into primary supply / treatment system (MG) | 58.30 | 41.30 | 36.06 | 37.06 | 54.47 | 91.76 | 71.93 | 96.57 | 156.07 | 140.24 | 148.46 | 98.30 | 1030.52 | | | | | | |
| Groundwater diverted into primary supply / treatment system (MG) | 66.49 | 65.45 | 63.15 | 74.29 | 72.67 | 82.31 | 80.75 | 98.09 | 143.45 | 136.79 | 109.57 | 75.28 | 1068.29 | | | | | | |
| Estimated return flows to river (MG) | 81.11 | 90.74 | 84.33 | 94.65 | 108.07 | 147.96 | 99.24 | 107.06 | 98.84 | 72.03 | 72.25 | 78.11 | 1134.39 | | | | | | |
| | | | | | | | | | | | | | | 1068.29 | 1030.52 | 2098.81 | 1134.39 | 46% | |
| **Lower Laramie Subbasin** | | | | | | | | | | | | | | | | | | | |
| **Wheatland** | | | | | | | | | | | | | | | | | | | |
| Groundwater diverted into primary supply / treatment system (MG) | 21.00 | 14.50 | 14.40 | 13.90 | 12.00 | 14.90 | 17.70 | 39.70 | 71.20 | 77.00 | 66.50 | 42.30 | 405.10 | | | | | | |
| Groundwater diverted into raw water irrigation system (MG) | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 3.00 | 6.00 | 7.00 | 8.00 | 4.00 | 28.00 | | | | | | |
| Estimated return flows to river (MG) | 4.76 | 4.76 | 4.76 | 4.76 | 4.76 | 4.76 | 4.76 | 4.76 | 4.76 | 4.76 | 4.76 | 4.76 | 57.12 | | | | | | Includes raw water irrigation. |
| | | | | | | | | | | | | | | 433.10 | 0 | 433.10 | 57.12 | 87% | |
| **Chugwater** | | | | | | | | | | | | | | | | | | | |
| Groundwater diverted into primary supply / treatment system (MG) | 1.00 | 0.68 | 0.61 | 0.72 | 0.94 | 0.38 | 0.61 | 1.04 | 2.94 | 4.39 | 3.71 | 2.10 | 19.12 | | | | | | |
| | | | | | | | | | | | | | | 19.12 | 0 | 19.12 | Unknown | Unknown | |
| **Horse Creek Subbasin** | | | | | | | | | | | | | | | | | | | |
| **LaGrange** | | | | | | | | | | | | | | | | | | | |
| Groundwater diverted into primary supply / treatment system (MG) | 2.87 | 1.86 | 0.93 | 1.19 | 1.02 | 1.08 | 0.84 | 4.58 | 8.48 | 9.25 | 8.66 | 5.14 | 45.90 | | | | | | |
| | | | | | | | | | | | | | | 45.90 | 0 | 45.90 | Unknown | Unknown | |

**Table 3.3.9: Monthly Municipal Surface Water and Groundwater Diversions and Return Flow in Million Gallons**

| | Water Year 2013[1] | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Oct | Nov | Dec | Jan | Feb | Mar | Apr | May | June | July | Aug | Sep | Total | Total Groundwater Diversions (MG) | Total Surface Water Diversions (MG) | Total Diversions (MG) | Total Return Flow (MG) | Estimated Consumptive Use % | Remarks |
| **South Platte Subbasin** | | | | | | | | | | | | | | | | | | | |
| **Cheyenne[2]** | | | | | | | | | | | | | | | | | | | |
| Groundwater pumped into treatment system (MG) | 88.72 | 63.00 | 66.65 | 82.26 | 51.74 | 62.03 | 69.00 | 108.81 | 170.28 | 239.72 | 223.20 | 159.39 | 1384.81 | | | | | | |
| Surface Water diverted into treatment system (MG) | 239.88 | 189.00 | 199.95 | 187.44 | 163.86 | 207.67 | 207.00 | 309.69 | 345.72 | 408.18 | 396.80 | 323.61 | 3178.79 | | | | | | |
| Water returned to river through wastewater system (MG) | 279.00 | 270.00 | 269.70 | 266.60 | 246.40 | 275.90 | 273.00 | 294.50 | 294.00 | 297.60 | 294.50 | 267.00 | 3328.20 | | | | | | |
| | | | | | | | | | | | | | | 1384.81 | 3178.79 | 4563.60 | 3328.20 | 27% | |
| **Pine Bluffs[3]** | | | | | | | | | | | | | | | | | | | |
| Groundwater delivered to customers (MG) | 7.19 | 3.04 | 3.17 | 2.90 | 2.87 | 2.94 | 6.02 | 11.49 | 12.03 | 17.20 | 16.00 | 13.47 | 98.32 | | | | | | |
| | | | | | | | | | | | | | | 98.32 | 0 | 98.32 | Unknown | Unknown | |
| **Burns[4]** | | | | | | | | | | | | | | | | | | | |
| Groundwater delivered to customers (MG) | 2.66 | 1.75 | 1.95 | 1.41 | 1.28 | 1.66 | 2.11 | 4.13 | 5.29 | 6.68 | 5.79 | 4.12 | 38.83 | | | | | | |
| | | | | | | | | | | | | | | 38.83 | 0 | 38.83 | Unknown | Unknown | |
| **Albin[5]** | | | | | | | | | | | | | | | | | | | |
| Groundwater delivered to customers (MG) | 3.00 | 1.16 | 0.74 | 1.38 | 1.57 | 1.68 | 1.29 | 1.85 | 2.48 | 4.09 | 3.29 | 4.12 | 26.65 | | | | | | |
| | | | | | | | | | | | | | | 26.65 | 0 | 26.65 | Unknown | Unknown | |

Notes:
(1) Based on 2013 Water Year Depletions Report from the Wyoming State Engineers Office (2013).
(2) Source: HDR, 2013 - Average monthly water demand between 2003 and 2012 (Chart 2-8 of Volume 2 and Figure 3-29 of Volume 3) and average monthly wastewaster discharge between 2005-2012 (Chart 2-23 of Volume 2)
(3) Source: Lidstone, 2015 - 2012-2013 water demand data
(4) Source: Lidstone, 2011 - Average monthly water demand between 2000 and 2009 (Figure 4)
(5) Source: Benchmark, 2005 - 2001 water demand data (Table 3.1)

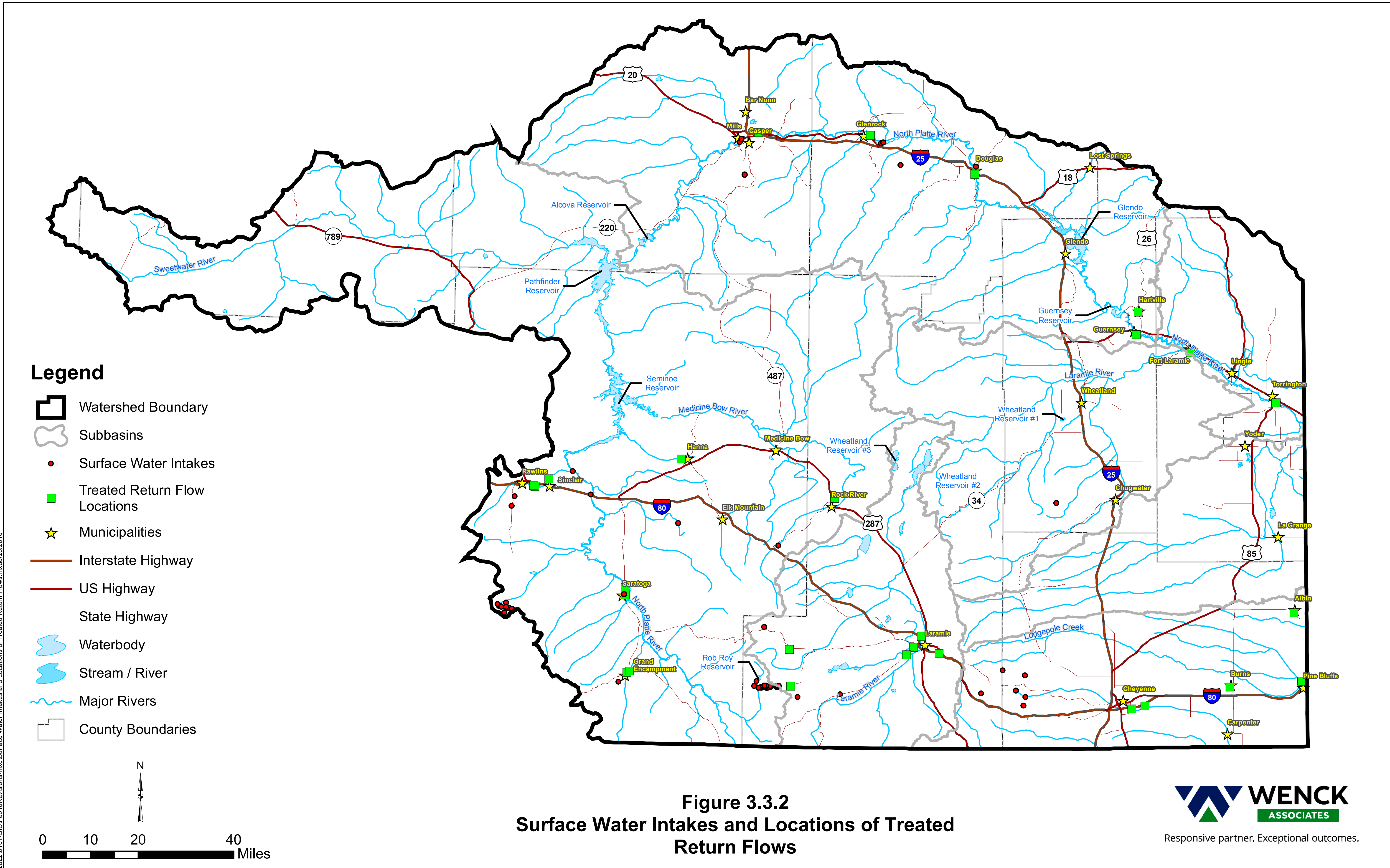


**Figure 3.3.2**
**Surface Water Intakes and Locations of Treated Return Flows**

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Source: SEO GIS Database

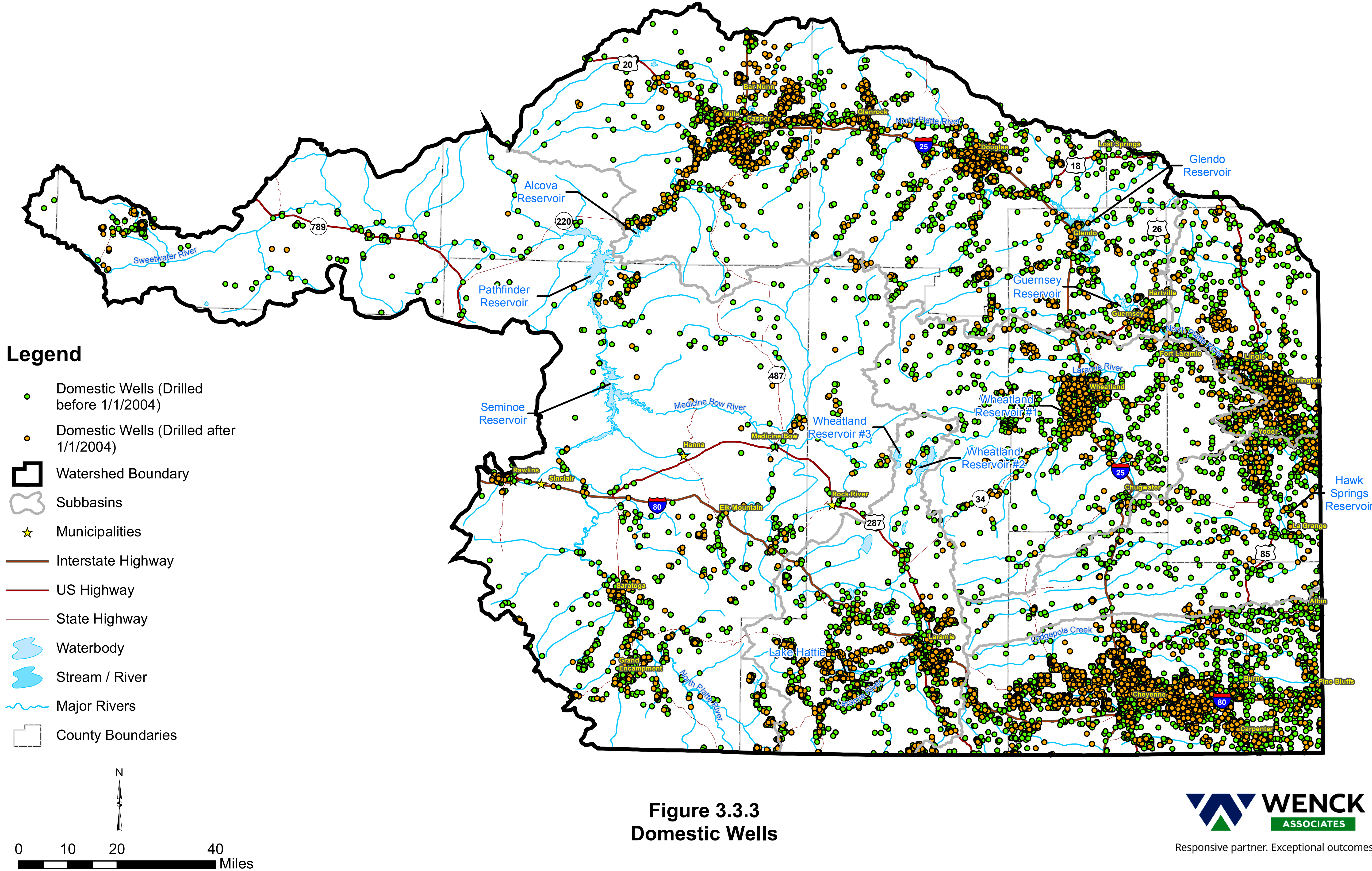


**Figure 3.3.3**
**Domestic Wells**

WENCK ASSOCIATES
Responsive partner. Exceptional outcomes.

L:\2822\0101\GIS\Feb16Revisions\mxd\Domestic Wells.mxd8/26/2016

Source: SEO GIS Database

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## 3.4 INDUSTRIAL USE (MODIFIED FROM THE INDUSTRIAL USE TECH MEMO)

### 3.4.1 Introduction

This section presents an update on the industrial use within the Platte River Basin of Wyoming. The Platte River Basin in Wyoming consists of the six subbasins of the North Platte River and the South Platte Subbasin. The principal focus of this update to the Platte River Basin Plan (Trihydro, 2006) has been to identify new groundwater and surface water industrial users not supplied through municipal systems, and to evaluate usage changes during above and below average water years. This update relied on information developed and maintained by the SEO. Because the original basin plan included data through 2003, this update covers the period between January 1, 2004 and September 30, 2014.

### 3.4.2 Platte River Basin Industrial Water Use Overview

A thorough inventory of industrial water use within the Platte River Basin for 1981 through 2000 is presented in Technical Memorandum 2.3 of the Platte River Basin Plan (Trihydro, 2006). The industries that have typically used the most water for industrial purposes in the Basin are oil and gas, coal, and uranium. Power generation, aggregate mining, cement production, chemical processing, and ethanol production have also played a role. Taucher and others (2013) provided updated data on industrial groundwater use through 2011. The SEO maintains annual water use records for some of the largest industrial water users in the basin.

Generally, the types of industries that use water in the Platte River Basin have not changed appreciably since the completion of the original plan, but the amount of use in some areas has increased based upon the number of groundwater water rights filed with the SEO since 2004. Over this same timeframe, no surface water diversion permits were issued by the SEO for industrial use.  Permits issued for various reservoirs of limited use are included in **Appendix 3-C.**

### 3.4.3 New High Capacity Wells and Water Wells for Oil and Gas Production

Since January 1, 2004, 167 new wells or enlargements have been filed with the SEO for industrial use. This total includes 95 wells that produce more than 50 gpm for industry, and 72 wells of any permitted rate that are utilized for oil and gas production. The location, owner, and permitted discharge rate for these new wells are listed in **Appendix 3-D**, Table 1 for industry and **Appendix 3-D**, Table 2 for oil and gas production. The locations of the 50+ gpm industrial wells are shown along with those identified by Trihydro (2006) in **Appendix 3-D**, Tables 1 and 2. The locations of the water wells associated with oil and gas production in the basin are shown in **Appendix 3-D**, Table 2.

### 3.4.4 Annual Usage and Usage Variations

Water usage data for several of the major industrial water users within the Platte River Basin were obtained from the Wyoming Depletion Reports (SEO, 2011-2013). These reports include both annual diversion and depletion information for the following industrial water users: Sinclair Refinery, Sinclair Casper Refinery, Texaco Refinery, BP Products Refinery, Dave Johnston Power Plant, and Western Ethanol. The locations of these users are shown in the basin in **Appendix 3-D**, Table 1.  Of these users, the Texaco Refinery and BP Products Refinery shown in **Appendix 3-D**, Table 1 are no longer active, and their usage has not been reported here for that reason. The Texaco Refinery ceased operations in August 1982. The SEO identifies evaporation and irrigation of the Veteran's Cemetery as industrial use because it is conducted with the water rights of the former refinery. BP Products has some shallow wells that pump near the river and divert directly into the river. At the time BP

Products was active, from 1957 to 1990, the SEO was mainly concerned with their diversion of process water into Soda Lake. Shown on **Figure 3.4.1** near Torrington, the Western Ethanol Plant has closed due to a drop in corn and crude prices and expiration of a state tax credit (Casper Star Tribune, 2015).

New industrial reservoirs have been permitted in the Platte River Basin by the SEO since 2006. A total of approximately 53 industrial reservoirs have been permitted basin-wide and are shown in **Appendix 3-D**, Table 3

Data from 2011 through 2013 were obtained from the SEO permit records to assess how industrial water usage changed between average, wet, and dry years. The data generally seem to indicate that industrial water use for these established users varies little but mask the variability with lower volume users. While 2013 was an average water year, 2011 was an above average water year and 2012 was a below average water year. The data from these years for the respective industries are summarized in **Table 3.4.1**. The tabulated results in **Table 3.4.1** indicate that overall water use increased only 3.9% from average during the dry year of 2012. Similarly, there was an overall decrease in water use of 2.7% from average during the wet year of 2011. The Dave Johnston Power Plant shown on **Figure 3.4.1** east of Glenrock accounted for the majority of the industrial water usage reported by the SEO, or roughly 60 billion gallons annually. The high volume usage (diversion) of this plant also accounts for the limited variation in the total water use of the four users listed in **Table 3.4.1.** The Power Plant water usage varied within 4% from average between wet and dry years. Industrial water usage among the refineries and ethanol plant generally diminished during the wet water year, and increased during the dry water year. While the refineries usage was up 8.3% to 9.2% during the dry year, Western Ethanol's usage diminished approximately 1.9%. Water usage by the refineries and ethanol plant during the wet year was reduced between 2.5% and 21.5%.

**Table 3.4.1: Total Diversions to Million Gallons by Water Year for Industrial Water Users**

| | 2001 (wet year) (million gallons) | 2012 (dry year) (million gallons) | 2013 (average year) (million gallons) | Percent Difference (between 2012 and 2013 water years[1]) | Percent difference (between 2011 and 2013 water years[1]) |
|---|---|---|---|---|---|
| **Above Pathfinder Subbasin** | | | | | |
| Sinclair Refinery | 905.5 | 1,014.1 | 929.0 | 9.16% | -2.53% |
| **Subtotal** | **905.5** | **1,014.1** | **929.0** | **9.16%** | **-2.53%** |
| **Pathfinder to Guernsey Subbasin** | | | | | |
| Sinclair Casper Refinery | 236.4 | 271.9 | 251.0 | 8.33% | -5.82% |
| Pacific Corp/Dave Johnston Power Plant | 60,359.2 | 64,315.0 | 61,932.2 | 3.85% | -2.54% |
| **Subtotal** | **60,595.6** | **64,586.9** | **62,183.2** | **3.87%** | **-2.55%** |
| **Guernsey to State Line Subbasin** | | | | | |
| Western Sugar Coop./Western Ethanol | 407.3 | 509.3 | 519.2 | -1.92% | -21.56% |
| **Subtotal** | **407.3** | **509.3** | **519.2** | **-1.92%** | **-21.56%** |
| | | | | | |
| **Total** | **61,908.4** | **66,110.3** | **63,631.4** | **3.90%** | **-2.71%** |

**Notes:**
Total Annual diversions obtained from Wyoming Depletion Reports prepared by the Wyoming State Engineer's Office (2011, 2012 and 2013).

1. Positive percentage represents an increase in water use. Negative percentage indicates a decrease in water use.

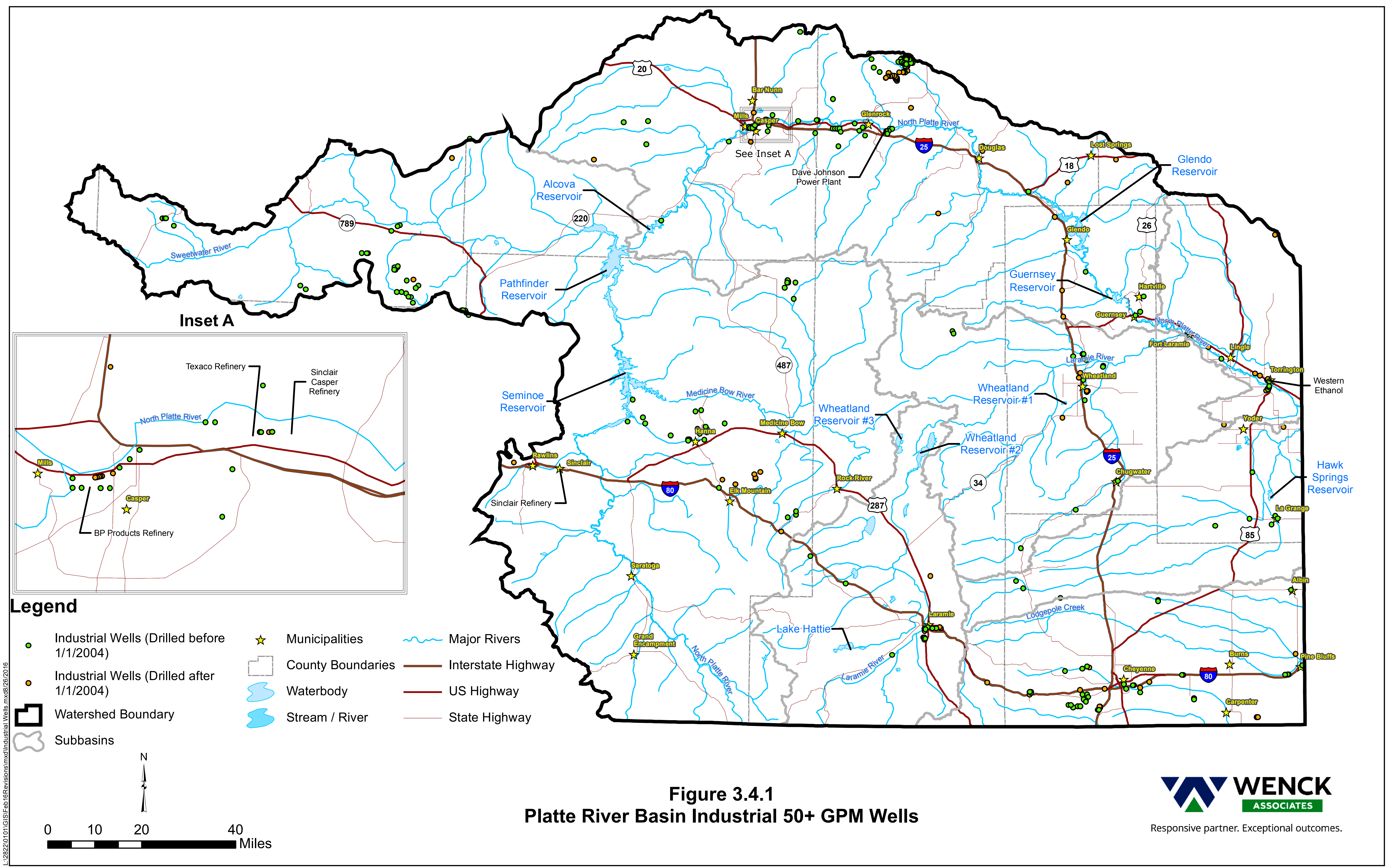


**Figure 3.4.1**
**Platte River Basin Industrial 50+ GPM Wells**

### 3.4.5 Monthly Water Usage

Monthly water usage data for the four industrial water users were compiled to evaluate seasonal use within the 2011, 2012, and 2013 water years, and in some instances, to estimate consumptive use. **Table 3.4.2** presents the monthly water usage data by user and subbasin, the total amount of water diverted from surface water sources, and where available, the amount of water returned to the surface stream monthly for each entity. These data were obtained from the Wyoming Depletions Report compiled by the SEO for 2011, 2012, and 2013.

Monthly and consumptive use appeared to vary little for the Dave Johnston Power Plant over this time period. Water usage by the refineries and ethanol plant varied seasonally and on an annual basis. Water usage by the refineries tended to increase during the summer months. Western Ethanol used very little water during the late spring through summer months, and used most water between the fall and winter months. Water use for the Dave Johnston Power Plant was fairly uniform throughout the year. Based on the reported return flows, the refineries and ethanol plant consumptively use 100% of the water they divert. The Dave Johnston Power Plant consumptively uses approximately 4% of its diverted flows and returns the rest to the North Platte River.

### 3.4.6 Recent Industrial Water Use within the Platte River Basin

The following sections describe the various industries and companies that have acquired groundwater permits from the SEO for water supply to begin or supplement their respective industrial practices. The use associated with these permits is presented by subbasin, and only for those particular industrial sectors for which permitting activity had been reported. The industries presented include: Mining and Mine Reclamation; Oil Exploration, Refining and Reclamation; Road and Bridge Construction and Maintenance; Power Generation; Aggregate, Cement, and Concrete Production; and Miscellaneous Industrial Water Use. Unless noted otherwise, details on the permits and associated uses were identified from review of the groundwater permits on file with the SEO (Various). **Table 3.4.3** presents an update of Table 2-6 from the 2006 basin plan.

#### Above Pathfinder Subbasin Industrial Water Use

Within the Above Pathfinder Subbasin, new groundwater rights were filed for mining and oil development, but have not resulted in much additional water use to date. As shown on **Figures 3.4.1 and 3.4.2**, new permits were filed for wells located near Elk Mountain and south of Jeffery City. Details on the individual permits referenced are included in **Appendix 3-D**, Tables 1 and 2.

**Mining and Mine Reclamation.** Five new permits were issued for uranium mining and mine dewatering to Energy Fuels, Arch of Wyoming, and Kennecott. Energy Fuels Wyoming, Inc. has permits totaling 2,000 gpm. This water will be obtained from dewatering of the Sheep Mountain underground workings and be used for the heap leaching of uranium at their Sheep Mountain Mine. This project has been in the permitting phase with the Nuclear Regulatory Commission (NRC) and the Wyoming Land Quality Division (LQD) since 2010, and is not currently consuming water. A secondary use of the water for this project is for culinary supply within a shop and warehouse. Energy Fuels anticipates the project will start up sometime between late 2016 and 2017.

Arch of Wyoming (Arch Coal) intends to use their 2,300 gpm of water rights for mine dewatering and dust suppression in mining coal at the Saddleback Hills Mine near Elk Mountain. According to a letter to the SEO dated October 16, 2014, this mine has yet to be developed due to market demand; therefore, there has been no use of the permitted wells to date.

**Table 3.4.2: Monthly Industrial Water Diversions and Return Flow in Million Gallons**

| User | Water Year[1] | Diversion / Return Flow | Oct | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Total | Total Surface Water Diversions (MG) | Total Return Flow (MG) | Estimated Consumptive Use % |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | (Reported Monthly Diversion, MG) | | | | | | | | | | | | | | | |
| **Above Pathfinder Subbasin** | | | | | | | | | | | | | | | | | | |
| Sinclair Refinery | 2011 | Surface water diversions | 74.5 | 71.9 | 64.9 | 62.8 | 63.3 | 80.9 | 78.0 | 85.0 | 81.9 | 93.4 | 89.0 | 59.9 | 905.5 | | | |
| | | Water returned to river | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 905.5 | 0.0 | 100.0 |
| | 2012 | Surface water diversions | 70.9 | 67.2 | 64.9 | 70.3 | 70.4 | 81.0 | 78.3 | 90.6 | 117.2 | 109.5 | 108.2 | 85.8 | 1,014.2 | | | |
| | | Water returned to river | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 1,014.2 | 0.0 | 100.0 |
| | 2013 | Surface water diversions | 77.3 | 78.4 | 70.1 | 76.9 | 69.1 | 77.6 | 73.7 | 82.6 | 79.9 | 74.2 | 90.2 | 79.2 | 929.0 | | | 100.0 |
| | | Water returned to river | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 929.0 | 0.0 | |
| **Pathfinder to Guernsey Subbasin** | | | | | | | | | | | | | | | | | | |
| Sinclair Casper Refinery | 2011 | Surface water diversions | 22.9 | 20.4 | 20.5 | 20.0 | 10.7 | 10.2 | 20.1 | 20.9 | 19.8 | 24.3 | 24.6 | 22.0 | 236.4 | | | |
| | | Water returned to river | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 236.4 | 0.0 | 100.0 |
| | 2012 | Surface water diversions | 24.8 | 21.9 | 21.3 | 21.5 | 20.5 | 22.3 | 22.6 | 22.2 | 22.9 | 23.9 | 24.8 | 23.2 | 271.9 | | | |
| | | Water returned to river | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 271.9 | 0.0 | 100.0 |
| | 2013 | Surface water diversions | 23.0 | 20.4 | 22.0 | 21.4 | 18.1 | 8.9 | 20.6 | 22.3 | 22.6 | 24.1 | 24.6 | 23.0 | 251.0 | | | |
| | | Water returned to river | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 251.0 | 0.0 | 100.0 |
| Pacific Corp / Dave Johnston Power Plant | 2011 | Surface water diversions | 5,158.8 | 4,992.0 | 5,170.8 | 5,164.8 | 4,661.4 | 5,152.8 | 4,779.0 | 4,588.0 | 4,725.0 | 5,152.8 | 5,170.8 | 5,643.0 | 60,359.2 | | | |
| | | Water returned to river | 4,965.8 | 4,833.0 | 4,995.1 | 4,987.2 | 4,507.0 | 4,981.1 | 4,608.8 | 4,384.5 | 4,496.1 | 4,914.4 | 4,911.1 | 5,407.3 | 57,991.4 | 60,359.2 | 57,991.4 | 3.9 |
| | 2012 | Surface water diversions | 5,170.8 | 5,022.0 | 5,344.4 | 5,170.8 | 4,670.4 | 5,125.8 | 4,920.0 | 5,147.2 | 5,630.3 | 6,106.5 | 6,083.7 | 5,923.1 | 64,315.0 | | | |
| | | Water returned to river | 4,961.9 | 4,853.4 | 5,158.1 | 4,979.1 | 4,506.0 | 4,986.0 | 4,827.6 | 4,925.0 | 5,360.9 | 5,831.8 | 5,813.2 | 5,610.2 | 61,813.2 | 64,315.0 | 61,813.2 | 3.9 |
| | 2013 | Surface water diversions | 5,859.4 | 5,050.9 | 5,198.3 | 5,213.7 | 4,704.3 | 5,183.0 | 5,042.3 | 5,361.2 | 5,059.0 | 4,970.7 | 5,242.4 | 5,047.0 | 61,932.2 | | | 4.8 |
| | | Water returned to river | 5,611.6 | 4,828.0 | 4,992.2 | 4,993.8 | 4,498.5 | 4,981.5 | 4,829.5 | 5,136.7 | 4,762.0 | 4,650.4 | 4,910.4 | 4,781.0 | 58,975.6 | 61,932.2 | 58,975.6 | |
| **Guernsey to Stateline Subbasin** | | | | | | | | | | | | | | | | | | |
| Western Sugar Coop. / Western Ethanol | 2011 | Surface water diversions | 90.3 | 104.0 | 74.6 | 64.9 | 54.7 | 8.8 | 0.9 | 0.2 | 0.0 | 0.8 | 1.7 | 6.5 | 407.3 | | | |
| | | Water returned to river | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 407.3 | 0.0 | 100.0 |
| | 2012 | Surface water diversions | 58.7 | 72.7 | 96.9 | 91.1 | 86.6 | 44.0 | 0.7 | 1.0 | 1.0 | 0.9 | 2.0 | 53.7 | 509.3 | | | |
| | | Water returned to river | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 509.3 | 0.0 | 100.0 |
| | 2013 | Surface water diversions | 103.3 | 90.4 | 83.7 | 98.6 | 81.1 | 35.6 | 0.6 | 0.2 | 0.3 | 0.6 | 1.3 | 23.5 | 519.2 | | | 100.0 |
| | | Water returned to river | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 519.2 | 0.0 | |

**Notes:** 1. Based on 2011, 2012, & 2013 Water Year Depletions Report from the Wyoming State Engineers Office

**Table 3.4.3: Summary of Industrial Permitted Water Rights and Actual Water Use within Wyoming's Platte River Basin**

| Industry – Ranked in Descending Order by Total Industrial Water Use | Gallons per minute (gpm) | | | | | | | | | | | | | | | | | Percent of Total Water Use by Industry |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Subbasin – Ranked in Descending Order by Total Industrial Water Use | | | | | | | | | | | | | | Water Use by Industry | | | |
| | Pathfinder to Guernsey | | Above Pathfinder | | Lower Laramie | | South Platte | | Horse Creek | | Upper Laramie | | Guernsey to State Line | | Subtotal of Water Use by Industry | | Total of Water Use by Industry | |
| | GW | SW | GW | SW | GW | SW | GW | SW | GW | SW | GW | SW | GW | SW | GW | SW | GW & SW | |
| Oil exploration, refining and reclamation | 8,896 | 1,921 | 8,640 | 752 | 485 | | 1,168 | | 300 | | 50 | | 500 | | 20,039 | 2,674 | 22,713 | 25 |
| Mining and mine reclamation | 4,683 | 449 | 16,974 | 2 | 0 | | | | | | | | | | 21,657 | 451 | 22,108 | 24 |
| Power generation | 5,215 | | | | 960 | 10,303 | 200 | | | | | | | | 6,375 | 10,303 | 16,678 | 18 |
| Miscellaneous | 1,830 | 2,886 | 275 | 1,580 | 100 | | 2,383 | | 4,485 | 100 | | | 1,432 | | 10,505 | 4,566 | 15,071 | 16 |
| Aggregate, cement and concrete production | 8,740 | | 50 | | 275 | | 2,585 | | 25 | | 870 | 583 | | | 12,545 | 583 | 13,128 | 14 |
| Road and bridge construction and maintenance[1] | | 197 | | 592 | | 395 | 50 | 197 | | | | 592 | | | 50 | 1,974 | 2,024 | 2 |
| Subtotal, gpm | 29,364 | 5,454 | 25,939 | 2,926 | 1,820 | 10,698 | 6,386 | 197 | 4,180 | 100 | 920 | 1,176 | 1932 | | 71,171 | 20,552 | 91,723 | |
| Subbation Total, gpm | 34,818 | | 28,865 | | 12,518 | | 6,583 | | 4,910 | | 2,096 | | 1,932 | | | | | |
| Platte River Basin Total, gpm | 91,723 | | | | | | | | | | | | | | | | | |
| Platte River Basin Total, ac-ft/yr | 147,950 | | | | | | | | | | | | | | | | | |
| Percent of total water use by subbasin | 38.0 | | 31.5 | | 13.6 | | 7.2 | | 5.4 | | 2.3 | | 2.1 | | | | | |
| Percent of total water use by subbasin **(Original Basin Plan)** | 36.4 | | 35.0 | | 13.4 | | 6.1 | | 5.7 | | 2.3 | | 1.1 | | | | | |

**Notes:**
Permitted water use data was used where information on actual industrial water use was not available.
GW – Groundwater SW = Surface Water
1. Water is used when construction and/or maintenance activities are in progress.

**Oil Exploration, Refining, and Reclamation.** Six new groundwater well permits have been issued for oil related industry in the subbasin, but only four of those permits are significant in terms of potential usage. Medicine Bow Fuel and Power, LLC (DKRW Energy) filed for four 1,000 gpm permits to use the water from the Mesaverde Aquifer for converting coal to liquid fuel. Mr. Bill Gathmann (2015) of DKRW Energy indicated that only one well permit was issued, and also explained that the facility has not yet been constructed. Hence, there has been no consumptive use to date. Once the facility is operational, it will consume approximately 300 gpm with zero return on a 24/7 operational basis. Construction of the facility is anticipated to take up to four years to complete once initiated.

**Road and Bridge Construction and Maintenance.** One new permit was issued to McMurry Ready Mix to use water for dust control and compaction operations for a Wyoming Department of Transportation (WYDOT) project on U.S. Highway 287. The estimated project duration was two years based on the SEO permit.

**Aggregate, Cement, and Concrete Production.** One new 50 gpm permit was issued to WYDOT for dust control and for crushing operations for the reconstruction of a 10.34 mile section of U.S. Highway 287 between Rawlins and Muddy Gap in Carbon County (State project SCP-SL13-N211056). The water source is groundwater from the Brokaw Pit. The permit has a 15-year limit for operations.

**Miscellaneous Industrial Use**. Two new permits were issued to Arch of Wyoming, LLC and Wyoming State Game & Fish Department with a primary use for stock watering. Arch of Wyoming's secondary use is dust abatement and reclamation. Both permits total 275 gpm.

### Pathfinder to Guernsey Subbasin Industrial Water Use

Within the Pathfinder to Guernsey Subbasin, new groundwater rights were principally filed for uranium mining and oil development. The expansion of these industries involved significant additional water use in the subbasin. As shown on **Figures 3.4.1 and 3.4.2**, new permits were filed for wells located principally north of Glenrock and northeast of Douglas. Details on the individual permits referenced are included in **Appendix 3-D**, Tables 1 and 2.

**Mining and Mine Reclamation.** Of the 57 new 50+ gpm groundwater permits issued, 47 were issued for uranium recovery and processing operations in the southern Powder River Basin. Cameco Resources dba Power Resources owns 43 of the permits with a total permitted yield of 34,900 gpm. The remaining four mining related permits accounted for a total of 670 gpm. Cameco has been in operation since 1987 at their Smith Ranch/Highland Mine which has four operating plants and mines uranium via the in situ recovery process. Each of the four plants can use up to 4,200 gpm of water, but consumptively uses only 1% of the volume that is pumped as 99% is reinjected and further utilized for mining uranium. While the actual groundwater production volume varies, it can range up 16,800 gpm with a consumptive use of only 168 gpm.

**Oil Exploration, Refining, and Reclamation.** An additional 47 permits for industrial water supply wells were issued for oil related operations, seven of which were for enlargements on existing wells. Most of the permits, 34, were issued for oil exploration and refining while the remaining 13 permits were issued for reclamation purposes. Chesapeake Operating Inc. obtained permits for 15 water wells for a total appropriation of 2,740 gpm. The wells are all located near Douglas. The water is used for the construction and preparation of drill sites, and hydraulic fracturing of oil wells. Another 3,016 gpm is permitted for oil and gas exploration by several other companies.

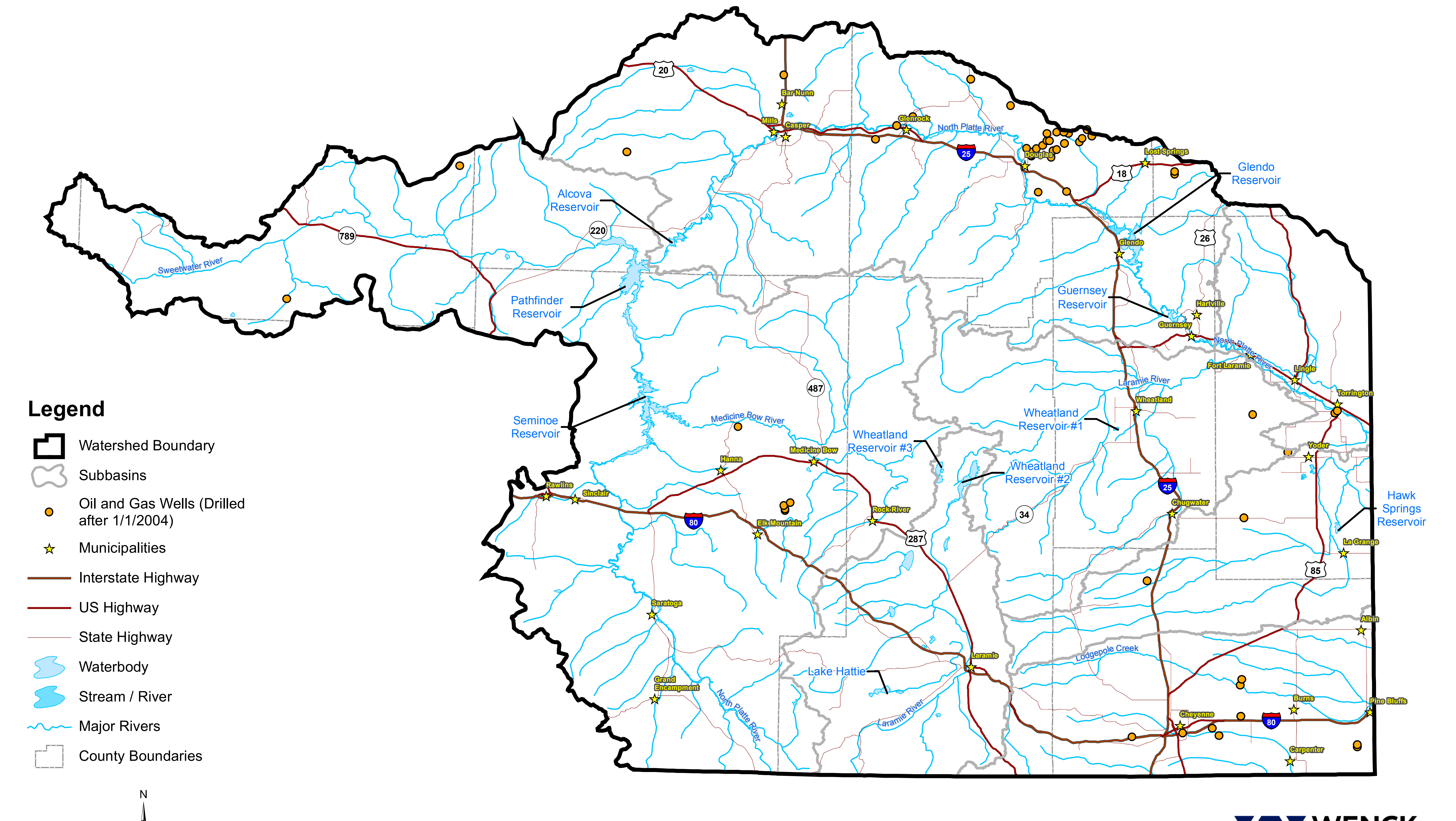


**Figure 3.4.2**
**Platte River Basin Oil and Gas Production Wells**

Mr. Kyle Bradley (2015), a Regulatory Analyst for Chesapeake Energy Corp., provided water usage data for several recent years and indicated that active drilling did not commence until 2009. Chesapeake Energy Corp. has surface water contracts to purchase water from the U.S. Bureau of Reclamation (USBR) for hauling water during years of excess water on the North Platte River, and also purchases water from irrigators via Temporary Water Use Agreements. Mr. Bradley (2015) provided groundwater usage data for 2013, 2014, and 2015. In addition to their own permits, Chesapeake Energy Corp. has agreed to handle reporting to SEO for some well permits that are privately held. In some instances, the well owner has sold water to other oil and gas operators or other parties needing fresh water. Due to this fact, the total water use reported may not always reflect what Chesapeake Operating, LLC has actually put to beneficial use in their operations. According to Mr. Bradley, a total of 166.85 MG, 95.80 MG, and 99.57 MG were used in 2013, 2014, and 2015, respectively.

Two companies, Texaco Downstream Properties, Inc. and BP Products North America use water for hydrocarbon recovery and reclamation at former refinery sites in Casper. Combined they have 13 permits that have total permitted water rights of 1,150 gpm.

**Road and Bridge Construction and Maintenance.** WYDOT was issued three permits totaling 350 gpm for construction purposes related to the reconstruction of a 3.32 mile section of Interstate 25 north of Wheatland and 3.57 miles of Wyoming 319, for a combined length of 6.89 miles.

**Aggregate, Cement, and Concrete Production.** GGH Aggregate LLC was issued a permit at a production rate of 1,000 gpm. The water is to be used for dust suppression, construction, and sanitary uses. Croell Redi-Mix Inc. has two permits on one well that provides 500 gpm to the Elkhorn Sand & Gravel Pit. The water is used to wash sand from the aggregate resource and for dust abatement related to mining operations.

**Miscellaneous Industrial Water Use.** Two miscellaneous permits for a total of 125 gpm were issued. The main use of the water is for washing down of equipment, while secondary uses include irrigation, dust suppression, and restrooms.

### Guernsey to State Line Subbasin Industrial Water Use

Within the Guernsey to Stateline Subbasin, new groundwater rights were filed for oil development and miscellaneous industrial purposes. As shown on **Figures 3.4.1 and 3.4.2**, these permits were filed for wells located primarily near Torrington. Details on the individual permits referenced are included in **Appendix 3-D**, Tables 1 and 2.

**Oil Exploration, Refining, and Reclamation.** One permit was issued to John's Pump Service for 500 gpm for oil exploration. This well provides water to a loading facility where water is hauled to the well sites.

**Miscellaneous Industrial Water Use.** The SEO issued five permits totaling 560 gpm of water rights. The water is mainly for agricultural purposes such as mixing of liquid fertilizer and pesticides, washing equipment, and some irrigation. Wyoming Ethanol LLC has three permits totaling 765 gpm. The water is used for boiler feed and process water at an ethanol production facility. This facility recently closed.

### Industrial Water Use in the Upper Laramie Subbasin

Within the Upper Laramie Subbasin, a new groundwater right was filed for aggregate industrial purposes. As shown on **Figure 3.4.1**, this permit was filed for a well located north of Laramie. Details on the individual permit referenced are included in **Appendix 3-D**, Table 1.

**Aggregate, Cement, and Concrete Production.** One new permit was issued to Pete Lien & Sons, Inc. at a production rate of 500 gpm. The well is used at a batch plant for aggregate crushing, concrete and asphalt production, dust abatement, and domestic purposes.

### Lower Laramie Subbasin Industrial Water Use

Within the Lower Laramie Subbasin, new groundwater rights were filed for oil development, power generation, and miscellaneous industrial purposes. As shown on **Figures 3.4.1 and 3.4.2**, these permits were filed for wells located in and around Wheatland. Details on the individual permits referenced are included in **Appendix 3-D**, Tables 1 and 2.

**Oil Exploration, Refining, and Reclamation.** The SEO issued three new permits for wells for oil and gas industrial development, which included a total of 485 gpm. The main use of the water is for the construction of drill sites, dust abatement, and oil and gas exploration. Secondary uses include stock watering and domestic use.

**Power Generation.** Basin Electric Power Cooperative added one well with a permitted water right of 950 gpm for use at the Laramie River Station, a steam power electric generation plant. The water is used for cooling water, process water, and fire protection.

**Aggregate, Cement, and Concrete Production.** One well permit with a production rate of 50 gpm was issued for use at a concrete batch plant.

**Miscellaneous Industrial Use.** Flying H Land and Cattle was issued one well permit for 100 gpm for a 6,000 head feed lot. Another permit was issued for 100 gpm for stock and irrigation purposes.

### Horse Creek Subbasin Industrial Water Use

Within the Horse Creek Subbasin, a few new groundwater rights were filed for oil development and miscellaneous industrial purposes. As shown on **Figures 3.4.1 and 3.4.2**, these permits were filed for wells located primarily near Yoder. Details on the individual permits referenced are included in **Appendix 3-D**, Tables 1 and 2.

**Oil Exploration, Refining, and Reclamation.** The SEO issued two new well permits with a total permitted yield of 200 gpm for oil exploration. Both wells are for loading facilities where water is hauled to the well sites.

**Miscellaneous Industrial Use.** One permit was issued for a commercial feedlot. The well is permitted for 85 gpm.

### Industrial Water Use in the South Platte Subbasin

Within the South Platte Subbasin, new groundwater rights were filed for oil development, power generation, and miscellaneous industrial purposes. As shown on **Figures 3.4.1 and 3.4.2**, these permits were filed for wells located primarily near Cheyenne. Details on the individual permits referenced are included in **Appendix 3-D**, Tables 1 and 2.

**Oil Exploration, Refining, and Reclamation.** Ten new permits for water wells were issued for oil and gas exploration. One of the wells was an enlargement where the water was used for hydrostatic testing of a 16-inch diameter crude oil pipeline. The largest permit was issued to Texas American Resources Co. at a production rate of 2,500 gpm. A total 5,215 gpm was permitted for oil exploration operations.

**Road and Bridge Construction and Maintenance.** Two permits were issued for WYDOT highway construction projects. Both wells were permitted for 50 gpm.

**Power Generation.** Generation Development Company, LLC was issued a permit for a production rate of 400 gpm for use at the Cheyenne Prairie Generating Station. The water is used as an alternate supply for make-up water for the cooling tower which cools water from the circulating water system. Coolant water is primarily obtained from the nearby Dry Creek Wastewater Reclamation Facility.

**Aggregate, Cement, and Concrete Production.** Three permits were issued for dust control and for crushing and screening operations. Two of the sources are wells while the other source is an open pit. Two 200 gpm permits were issued to Jebco Inc. for domestic, sanitary facilities, washing, landscaping, and steam production to feed boilers at an asphalt plant. New permits for aggregate and batch plants totaled 650 gpm.

**Miscellaneous Industrial Water Use.** One new permit was issued to Cheyenne-Laramie County Corp for Economic Development at the Swan Ranch facility south of Cheyenne. The water is used for landscaping, potable, sanitary and construction purposes.

Burnett Land & Livestock LTD LLLP was issued three well permits each at 60 gpm for a total 180 gpm. These wells are used to provide stock water for a dairy operation near Carpenter.

### 3.4.7 Industrial Water Use Summary in the Platte River Basin

Since 2004, the types of industrial water use have not changed appreciably in the Platte River Basin. The principal industrial users continue to include oil and gas, coal and uranium as well as power generation, aggregate mining, cement production, chemical processing and ethanol production. Overall, annual industrial water use is estimated to be approximately 147,950 acre-feet in the Platte River Basin as indicated in **Table 3.4.3**. Increases in industrial water use were limited to a few areas. As summarized in **Table 3.4.3**, the Pathfinder to Guernsey Subbasin experienced the most robust increase in industrial water use with additional groundwater production to serve the oil and gas industry near Douglas and uranium mining near Glenrock. This activity increased the subbasin's percentage of total water use in the Platte River Basin from 36.4% to 38.0%. The South Platte Subbasin also witnessed an increase in industrial water use with the addition of a new power plant, dairy, and oil and gas development. This industrial activity raised the subbasin's percentage of total water use from 6.1% to 7.2%.

### 3.4.8 References

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## 3.5 RECREATIONAL AND ENVIRONMENTAL USE

### 3.5.1 Introduction

This section provides detailed information and mapping related to the E&R water uses in the Platte Basin of Wyoming. Although this work is part of a larger effort to update the original Platte River Basin Plan that was completed in 2006, the methodology used for this particular task is considerably different from the original plan memorandum and resultant demand estimates. Further, this section presents specifics as to how the new methodology was utilized in developing current water use patterns for E&R water use and the relationship between current use and traditional, permitted uses. It also provides a detailed analysis of the current uses and how they interact with those permitted uses in each of the subbasins. Within this framework, the appropriate E&R uses will be included in the current and future demand projections, while other uses will be discussed but not included in projections. The methodology for developing these data is discussed below.

### 3.5.2 Development of the New Methodology

After completing River Basin Plans for the seven Basins in Wyoming, the WWDC desired a more uniform methodology for non-consumptive E&R water uses. HE and Hinckley Consulting were engaged to develop a new methodology that would more accurately explain how the water for these non-consumptive uses related to traditional, permitted uses. The resulting work began with an overview of approaches from the existing Basin plans and identification of the inconsistencies and perceived shortcomings of those plans as related to non-consumptive water use. The HE team, in coordination with WWDC, developed a new methodology and a Handbook for implementing that methodology, the basics of which are described below. The complete study can be found at: http://library.wrds.uwyo.edu/wwdcrept/Wyoming/Wyoming-Environmental_and_Recreational_Water_Use_Study-Final_Report-2012.html.

The initial steps of the process outlined in the Handbook and utilized for this update are:

- Identification and mapping of E&R water uses
- Locating traditional, divertible uses
- Categorization of recreational and environmental uses (described below)
- Assimilation of recreational and environmental uses

The categorization of the E&R water uses places them in context relative to traditional uses. This allows planners to more fully understand the role of these non-consumptive uses under existing conditions and their relative vulnerability in the future. The following categories were developed for the Handbook and have been applied to existing E&R uses in the Platte Basin in this report:

1) ***Protected water uses*** – These are water uses which are both recognized and protected in some way from incursions by traditional water uses. The obvious example is an instream flow water right. However, protected wetlands, protected bypass flows, or any environmental water uses protected by Federal agencies through permit or water right, fall into the protected category. In addition, protected water uses may have a senior traditional water use diverter in a location which ensures the continuation of that non-divertible use.

   *Example*: If the most senior water right downstream is larger than or equal to the recreational or environmental water use immediately above that senior water diversion in the stream system, that recreational water use is protected and should be recognized as such in the Basin planning process.

2) ***Complementary water uses*** – These E&R water uses exist without explicit protection, but exist and will continue to exist typically by virtue of their location or linkage with a traditional water use. For instance, environmental water uses are often located at the highest reaches within a watershed, and intervening uses are very unlikely to occur. Environmental water uses which occur at high elevations or in a forest high in the watershed are unlikely to be disturbed by water users below. Without future intervening water uses, those complementary water uses are likely to continue and should be recognized as such in the river basin planning process.

   Another example or sub-category of complementary water use stems from the incidental linkage of certain environmental or recreation water uses to traditional uses. For example, fisheries and spawning habitat may be supported by subsurface irrigation return flows, which would be lost if irrigation stops or the method is changed. These incidentally linked water uses are without explicit protection and will expand or contract with the linked traditional use.

3) ***Competing uses*** – Competing uses are those environmental or recreational water uses which are in a location where other traditional water use diverters may constrain or eliminate the environmental or recreational use at any point in time. These water uses are incidental and subject to elimination. These uses should also be recognized in the Basin planning process, but with the explicit understanding that such water uses can and will disappear when future appropriators step forward.

Readers should note that this methodology does not include divertible E&R water demands, as recommended in the Handbook. Where diversions exist for a golf course, ski area, hot springs, wetlands or other permitted E&R diversion, those uses have been identified in specific terms and are aggregated as sub-elements of other uses. For example, golf course diversions may be classified as agricultural, municipal or recreational water by the SEO, and are included in the divertible demands for the appropriate category.

### 3.5.3 GIS Sources

Mapping for this work was provided by Wenck Associates. Geographic Information Systems (GIS) layers were combined to reveal the relationship between E&R water uses and traditional diversions. All diversions of 10 or more cfs which are extremely senior water rights were noted by Wenck if available. **Table 3.5.1** provides a list of sources used. Layers were acquired in late 2014 and early 2015.

#### Unique Characteristics of the Platte Basin

The Platte Basin is the most populous of all the Wyoming basins and has fully appropriated water rights. Further, water leaving the Basin is governed by the North Platte Decree and 2001 Modified Decree, which govern the amount of water from the Platte Basin that can be diverted for agriculture. The details of these Decrees as they apply to the Platte Basin, its water uses and diversions are discussed in other parts of the updated Basin Plan. The Compact and fully appropriated water rights within the Basin tend to limit or to some extent, impact, future water development prospects for the Basin. Current water uses can be changed with the appropriate approvals and as a result the situation is not static. However, changes are complicated by the various decrees and rules that govern the Basin

and required mitigation, making such changes expensive, time consuming and thus relatively uncommon.

The Platte River Basin encompasses 22,000 square miles, or about a quarter of the state, and covers a wide variety of landscapes (Wyoming Historical Society). The eastern part of the Basin is relatively flat, sparsely populated and well-suited to agriculture. To the west, the Laramie Mountains provide many recreational opportunities and environmental habitat. The North Platte River traverses the northern part of the Basin and provides a rich environment for fishing and other recreational activities. The close proximity of this Basin to Northern Colorado and its large population base, make it an attractive destination and likely puts additional pressure on recreational and environmental water uses.

The Platte River Basin encompasses many vital aspects of the Wyoming economy and culture. However, it is also the location of many important E&R uses, most notably along the North Platte River and its reservoirs, which provides a wealth of recreational opportunities and wildlife habitat, while providing irrigation waters to Basin farmers. This report will put these varied uses in the context of E&R water use to provide greater understanding for future planning efforts.

**Table 3.5. 1: GIS Data Sources for Environmental and Recreational Mapping in the Platte River Basin**

| Name | Source |
|---|---|
| Aquatic Habitat Priority Areas | Wyoming Game and Fish |
| Critical Streams Corridors | Wyoming Game and Fish |
| Elk Feed Grounds | Wyoming Game and Fish |
| Fishing Spots | WyGISC |
| Game and Fish Stream Classifications | Wyoming Game and Fish |
| Golf Courses | WyGISC |
| Instream Flows | WWDO, SEO, Wyoming Game and Fish |
| Lakes | WSGS |
| Landownership | BLM |
| Model Demand Nodes | WWDO |
| National Wetlands Inventory | Fish and Wildlife Service |
| Nature Conservancy Easements | The Nature Conservancy |
| Non-Nature Conservancy Easements | The Nature Conservancy |
| Scenic Highways and Byways | WyGISC and ESRI |
| Ski Areas | WyGISC |
| Streams | WSGS |
| Trout Unlimited Projects | Trout Unlimited |
| Wild and Scenic Rivers | WyGISC and SEO |
| Wilderness Areas | WyGISC |

### 3.5.4 Section Organization and Maps

This report first considers E&R water uses that fit within the Handbook framework and that will be included in the current water demand profile and demand projections for the Basin update. Specific E&R uses are mapped and discussed on a subbasin level.

Each subbasin is discussed individually in the following order:

- Above Pathfinder Dam
- Pathfinder to Guernsey
- Guernsey to State Line
- Upper Laramie
- Lower Laramie
- Horse Creek
- South Platte

For each subbasin, two maps were prepared for the analysis and categorization of water uses. That first map includes existing E&R water uses, along with traditional diversion locations, which are identified by their permitted cfs allocation. The second map includes dry land information, such as land ownership, campgrounds, electric generating facilities, etc. This land-use map provides context to the water-use map, separated to facilitate interpretation. Electronic versions of these maps will be available that will allow users to select map layers to view any combination of these elements as desired. As the Above Pathfinder Dam Subbasin is quite large and has many relevant uses to map, that subbasin was divided into two maps to improve readability, east and west, and thus there are four maps for this subbasin. The categorization of the E&R water uses is also analyzed separately for the east and west sections.

Wetlands are discussed for each subbasin, but not included on the maps to improve the readability of the maps. A more general discussion of wetlands and a Basin-wide map are provided after the subbasin analyses in a later section of this report. A map of all irrigated lands is also provided following the wetlands map.

There are some topics that are related, but less directly, to E&R use that do not lend themselves to the Handbook methodology because of their broad geographic reach and non-specific water use characteristics. These topics include threatened and endangered species and hunting, which are discussed generally; Basin-wide maps have been provided, following the subbasin analyses.

### Water Use Maps

Water use maps are provided for each subbasin. Traditional, permitted water uses are included on these maps, and the marker for each indicates the size of the allocation. As discussed above, the relationship between these water uses and E&R is the basis for this analysis. These maps also include existing E&R water uses, which were located using the GIS data layers discussed above. An effort was also made to acquire any unique Platte Basin uses. Legends for each subbasin map only include those items that are relevant to that subbasin. Recreational topics include:

- Fishing access points
- Whitewater rafting
- Trout streams - mapped by their classification, which is determined by the estimated total pounds of trout per mile (WGF, 2006): [1]
    - Blue Ribbon Streams – National importance, > 600 pounds per mile
    - Red Ribbon Streams – Statewide importance, 300 to 600 pounds per mile
    - Yellow Ribbon Streams – Regional importance, 50-300 pounds per mile

Mapped environmental elements include:

- Instream Flow Segments
- Crucial Stream Corridors
- Trout Unlimited Projects
- Aquatic Enhancement Priority Areas
- Designated or Protected Wetlands

### Land Use Maps

For each subbasin, a land use map follows the water use map. Mapped recreational elements include:

- Campgrounds

[1] Green Ribbon streams are of local importance <50 pounds per mile and include 63% of all stream miles in the state and are not included because of the large number and relative lack of importance.

- Natural Landmarks
- Scenic Highways and Byways
- National Historic and Scenic Trails

Mapped environmental elements include:

- Wilderness and Roadless Areas
- U.S. Forest Service Lands
- Other Land Ownership

NOTE: The GIS databases used in this mapping and analysis include:

1) WyGISC
2) SEO Water Rights Database
3) USFS Natural Resource Database
4) 2006 Platte River Basin Plan Database
5) American Whitewater Association Database

### 3.5.5 Subbasins

The seven subbasins of the Platte Basin are shown in **Figure 3.5.1** which also includes the approximate elevations.

#### Above Pathfinder Dam Subbasin

This is the largest of the Platte Basin subbasins with many recreational opportunities and varied landscapes. The entire subbasin is first described as a whole, but for the mapping analysis, this subbasin will be discussed in two sections. First is Above Pathfinder Dam Subbasin (East). Second is the area below Pathfinder Reservoir and Above Pathfinder Dam Subbasin (West), the area including and to the west of Pathfinder Reservoir. The East portion of the subbasin encompasses much of Carbon County, about 20% of Albany County and a very small portion of southern Converse County. The West portion includes the northwest area of Carbon County, southwest corner of Niobrara County, across the southern part of Freemont County and small portion of eastern Sublette County.

This mostly rural subbasin offers many opportunities for recreation including a long stretch of the North Platte River, the Sweetwater River and two major reservoirs. It is also home to much of the Medicine Bow National Forest and extensive environmentally sensitive areas.

The subbasin includes the highest elevations in the Basin, ranging from about 6,400 to more than 13,000 feet. About 23% of the Basin's irrigated lands are in this subbasin, mainly in the East Pathfinder Subbasin. However, since 2006, irrigated acreage has declined 18% with about 123,500 irrigated acres remaining as of 2012.

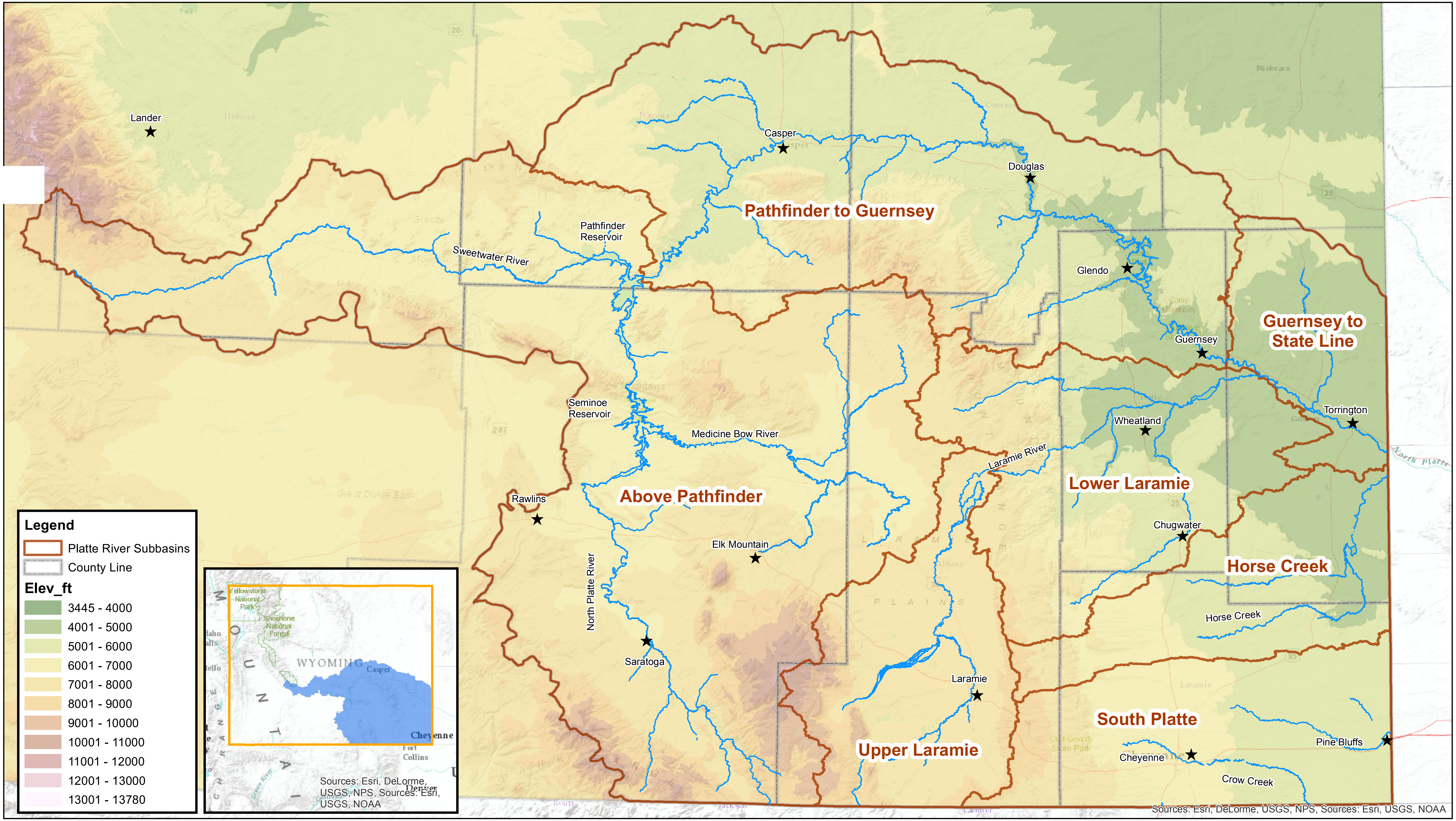


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**Figure 3.5.1 Approximate Elevation**

## Major Recreational Opportunities in the Above Pathfinder Dam Subbasin

**Seminoe Reservoir and State Park.** Seminoe State Park was established in 1965, and construction of Seminoe Dam was completed in 1939. Seminoe Dam is located on the North Platte River approximately 72 miles southwest of Casper and 34 miles north of Sinclair in Carbon County. The reservoir has an adjudicated capacity of 1,026,360 acre-feet. The Wyoming Department of State Parks and Cultural Resources manages the recreational facilities at Seminoe Dam for the USBR. Campgrounds and boat-launching facilities are provided to the public on a fee basis. The Morgan Creek drainage is located near the north end of the reservoir. This approximately 4,700-acre area has been designated by the Wyoming Game and Fish Department (WGFD) as winter range for elk and bighorn sheep.

**Kortes Reservoir / Miracle Mile Area.** This area is located in a narrow North Platte River canyon downstream of Seminoe Dam in Carbon County. The USBR manages Kortes Reservoir and the North Platte River reach below the dam known as the "Miracle Mile." No fish are stocked in Kortes, but rainbow trout are stocked annually in the Miracle Mile (USBR – Kortes, 2015). The dam was completed in 1951 primarily as a hydroelectric power generation project. The reservoir has an adjudicated capacity of 4,640 acre-feet. Due to frequent surges of water from Seminoe Dam, there are no boat facilities providing access to Kortes Reservoir. The Miracle Mile area extends approximately 5.5 miles downstream from the Kortes Dam to the southern management unit of the Pathfinder National Wildlife Refuge. Primitive camping areas are located in the Miracle Mile area. No fees are collected for recreational utilization of this area.

**Pathfinder Reservoir.** Pathfinder Reservoir is located on the North Platte River 47 miles southwest of Casper in Carbon and Natrona Counties. The reservoir was completed in 1909 and the adjudicated amount of water allotted to the reservoir is 1,070,000 acre-feet. The U.S. Bureau of Land Management (BLM) and the Natrona County Roads, Bridges and Parks Department manage the recreational facilities at Pathfinder Reservoir for the USBR. Camping and boat launching facilities are present at the site as well as an interpretive center and trail. The facilities are free to the public with the exception of a fee to utilize the campgrounds. Portions of the reservoir are included in the Pathfinder National Wildlife Refuge, which consists of 16,807 acres and 117 miles of shoreline. At low reservoir levels much of the refuge is a bare mud flat with some marsh adjacent to tributary stream inlets.

State Park visitor data for Seminoe State Park are shown in **Table 3.5.2**.

**Table 3.5.2: State Park Visitor Days, Five Year Average and 2014**

| State Park | Five Year Average (2009-2013) | 2014 |
|---|---|---|
| Seminoe | 22,329 | 24,466 |
| **Total** | | **24,466** |
| Source: Wyoming Division of State Parks, Historic Sites and Trails, Department of State Parks & Cultural Resources, *Visitor Use Program, 2014*. | | |

**Fishing.** Almost 170,000 angler days are estimated for this subbasin each year. Many trout species, including rainbow, brown and cutthroat, along with walleye can be found in the reservoirs and other locations. **Table 3.5.3** provides angler days for various locations throughout the subbasin.

**Table 3.5.3: Angler Days for the Above Pathfinder Dam Subbasin**

| Above Pathfinder Subbasin | Angler Days/Year |
|---|---|
| Kortes Reservoir, Miracle Mile, Pathfinder Reservoir | 46,827 |
| Seminoe Reservoir and Big Ditch Drainage | 33,200 |
| Platte River, North Seminoe to CO | 18,547 |
| Encampment River Drainage | 16,258 |
| Lake, Cedar, Elk Hollow Drainages | 14,191 |
| Upper Medicine Bow River Drainage | 10,465 |
| Seminoe and Ferris Mountains | 9,180 |
| Lower Medicine Bow River Drainage | 5,879 |
| Sweetwater River Drainage | NA |
| Jack and Spring Creeks | 3,975 |
| Beaver Creek and Big Creek Drainages | 3,292 |
| Pass Creek Drainage | 3,062 |
| Shirley Mountains | 1,157 |
| **Total** | **166,033** |

**Note:** Some of these data have not been updated in several years, but these are the latest available figures.
Source: Al Conder, Casper Regional Fisheries Supervisor, WGFD, December 2014 and Mike Snigg, Laramie Regional Fisheries Supervisor, WGFD, January 2015.

### Notable Environmental Factors in the Above Pathfinder Dam Subbasin

**Critical Habitat Areas.** The main stem of the North Platte River, and its tributaries, from the Colorado border to Sage Creek has been designated a Crucial Aquatic Habitat Area. The value of this habitat includes supporting wild trout fisheries and providing wetland habitat for amphibians. Residential and energy development are potential threats due to fragmentation of habitat. The boreal toad, beaver, brown trout, rainbow trout and brook trout are the focus of restorative action. Proposed solutions include conservation easements, creation of wetland habitats, fish passage and screening at irrigation diversions, and promotion of livestock grazing management practices to restore riparian habitat (WGF – Upper North Platte, 2014).

The North Platte River from Seminoe Reservoir to Pathfinder Reservoir, including the Miracle Mile blue ribbon fishery, has also been classified as a Crucial Habitat Area. This designated area continues to Alcova Dam in the Pathfinder to Guernsey Subbasin. This area received this designation due to its superior sport fisheries and wetlands. Brown trout, rainbow trout and walleye are species of concern. Proposed actions include enhancement of spawning habitat, working with USBR on minimum pool requirements and control of invasive species (WGF – Upper North Platte Reservoirs, 2014).

**Sweetwater Aquatic Enhancement Area.** This area has riparian habitat, aspen, true mountain mahogany and big sagebrush plant communities that have been degraded due to overgrazing, lack of beaver, trampled stream banks, stream bank erosion, channel degradations, sedimentation, reduced floodplain connectivity, low riparian woody plant regeneration, and conifer encroachment and lacks diversity. Remediation efforts are focused on rainbow trout, brown trout, cutthroat trout, brook trout, native non-game fish species and the Great Basin Spadefoot (toad). Proposed actions to improve this habitat include fencing, restoration of the beaver population, upgrades to road and culvert crossings that are detrimental to fish habitat and promotion of best management practices (WGF – Sweetwater, 2014).

**Trout Unlimited Project.** Encampment River Watershed Restoration Plan seeks to restore a segment of the Encampment River, which has degraded due to channelization, mine dredging and diversions, leaving the river banks highly unstable. It is also wide and shallow which warms the water causing stress to fish. The project is a partnership between WGF and the Wyoming Wildlife and Natural Resource Trust Fund, and the land owner. Many other groups have contributed funding. The project will narrow the channel to increase sediment flow, keep the water cool and reduce algae. A wetland area has also been created which will benefit the fishery by providing off-channel rearing habitat for young fish. (TU, 2015)

**Pathfinder National Wildlife Refuge**. This wildlife refuge was established in 1909, although its boundaries have been changed several times. It is generally located on the lands around Pathfinder Reservoir and is jointly managed by U.S. Fish and Wildlife Service (USFWS), the USBR, the WGFD, the BLM, and Natrona County Parks. Pathfinder Reservoir is attractive to water birds and the refuge provides open water wetlands, shrub and grasslands and alkali flats that support a diversity of wildlife. (USFWS, 2014)

**Minimum Release Reservoirs.** The only minimum release flow reservoir in this subbasin is located at the Kortes Dam. Authorized by Congress, a minimum flow of 500 cfs is maintained in the North Platte between Kortes and the normal headwater of Pathfinder Reservoir permits maintenance of the fishery in the Miracle Mile, discussed above. Details are provided in **Table 3.5.4.**

**Table 3.5.4: Minimum Release Reservoir in the Above Pathfinder Dam Subbasin**

| Structure | Owner | Minimum Release | Regulation |
|---|---|---|---|
| Kortes Dam | USBR | 500 cfs | U.S. Public Law 92-146 (85 Statute 414), Missouri Basin project |
| Source: USBR Annual Operating Plan, North Platte River Area, 2013-2014. | | | |

### Classification of Recreational and Environmental Water Uses in the Above Pathfinder Dam (East) Subbasin

As described in Section 3.5.1, an analysis of recreational and environmental water uses was performed utilizing GIS data and maps in order to categorize those uses. **Table 3.5.5** provides a listing or recreational and environmental sites within the subbasin.

**Table 3.5.5: Recreational and Environmental Water Uses within the Above Pathfinder Dam Subbasin**

| **Recreation Sites** | |
|---|---|
| Fishing Access | 20 |
| Whitewater Rafting | 8 |
| Trout Streams | |
| *Blue* | 4 |
| *Red* | 6 |
| *Yellow* | Numerous |
| Campgrounds | 22 |
| Natural Landmarks | 1 |
| Scenic Highways and Byways | 2 |
| National Historic and Scenic Trails | 0 |
| **Environmental Uses** | |
| Wilderness/Roadless Areas | Yes |
| US Forest Service Lands | Yes |
| Instream Flow Segments | 6 |
| Crucial Stream Corridors | 1 |
| Aquatic Crucial Priority Areas | 4 |
| Wetland Area | Yes |
| Source: GIS sources are provided in the Introduction. | |

Maps of these data are provided following the analysis.

### Categorization of Recreational and Environmental Water Uses in the Above Pathfinder Dam (East) Subbasin

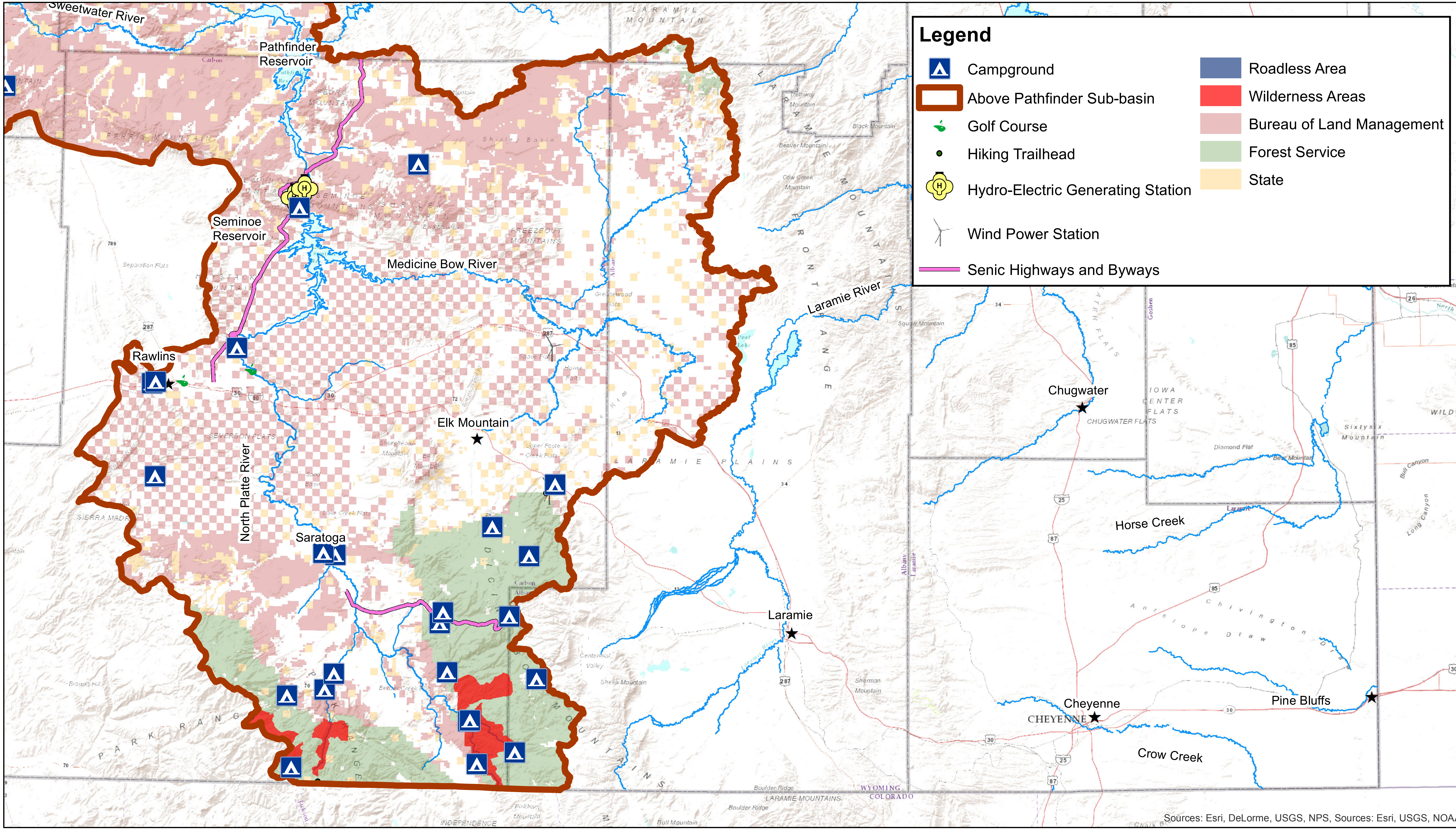
As shown on **Figure 3.5.2**, the fishing and whitewater activity south of Saratoga in the southwest corner of the subbasin are located within U.S. Forest Service (USFS) lands. As a result, these uses are considered protected. They are also within the Encampment River Watershed aquatic enhancement area, although this designation does not provide explicit protection. The southeastern portion of the subbasin is also within USFS lands and thus the fishing and whitewater rafting there are also protected. The Encampment River Watershed and Douglas Creek aquatic enhancement areas in the subbasin are within USFS lands which affords these areas protected status and facilitate proposed improvement activities. The Trout Unlimited Project is located along an instream flow segment which affords this environmental project protection.

Between these two tracts of USFS lands, there is one red ribbon trout stream. The upper portion of this stream is complementary to existing diversions. Downstream of the diversion and continuing as the red ribbon designation becomes yellow, there are numerous small diversions which provide a complementary status to this stream segment.

The North Platte River crosses the border from Colorado into this subbasin within USFS wilderness land. After it leaves that protected area, the area around the River is within the North Platte Crucial Stream Corridor. There is a long section of the River that has been designated Blue Ribbon Trout Stream that is complementary to downstream diversions south of Saratoga. After those diversion, where the Encampment River flows into the North Platte, the river flows to Seminoe Reservoir and there are no sizable diversions that would complement the bluE&Red ribbon stream segments. However, due to minimum release flows at Kortes Dam, the Cooperative Agreement and reservoir operating plans, it is unlikely that any new diversions could disrupt the recreational activities on the this stretch of the North Platte. Therefore, these uses should be considered complementary. As described above, minimum flow requirements between Kortes Dam and Pathfinder Reservoir provide explicit protection to the blue ribbon stream segment known as the Miracle Mile.

In the Elk Mountain area, an instream flow segment provides protected status to a whitewater rafting area and yellow ribbon stream. Elsewhere in the area surrounding Elk Mountain, fishing and whitewater rafting can be classified as complementary due to various irrigation diversions. To the east of the North Platte, several yellow ribbon streams are complemented by numerous small diversions and several large diversions. The Pathfinder National Wildlife Refuge is protected by its wildlife refuge status.

The determination for the Above Pathfinder Dam (East) subbasin is that all E&R uses are either protected or complementary and that there are no competing uses that should be eliminated from the water demand calculations. **Table 3.5.6** provides a summary of the classified uses in Above Pathfinder Dam (East) subbasin.




0 2.5 5 10 15 20 25
Miles

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**Figure 3.5.2 Land Use - Above Pathfinder East**

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**Table 3.5.6: Categorization of E&R Uses in the Above Pathfinder Dam (East) Subbasin**

| Status | Location and Uses |
|---|---|
| Protected | All activities on U.S. Forest Service lands, ISF segments, Miracle Mile blue ribbon stream, whitewater rafting and yellow ribbon segment upstream of an ISF near Elk Mountain, Pathfinder National Wildlife Refuge, aquatic enhancement areas |
| Complementary | Red and yellow segments between U.S. Forest Service lands, blue ribbon segment to Kortes Dam, whitewater rafting east of Elk Mountain, yellow ribbon segments in the northeast area of the subbasin |
| Competing | NA |

Maps of these resources are provided in **Figure 3.5.2 and Figure 3.5.3**.

### Categorization of Recreational and Environmental Water Uses in the Above Pathfinder Dam (West) Subbasin

Most of the area in the west portion of this subbasin is BLM land, with some state and USFS lands. Privately owned land is very limited. Much of the Sweetwater River and its tributaries are designated as yellow ribbon streams as they flow out of the Wind River Range. Fishing and whitewater rafting are protected by an ISF along one segment of the River. Segments at the higher elevations are protected by geography and complementary to downstream diversions. A designated fishing access point to the northeast at Carmody Lake is unprotected and subject to drought conditions. A second, small rafting location in the Granite Mountains is protected by its mountainous location and complemented by downstream diversions. Yellow ribbon streams that feed into the Sweetwater from the Granite Mountains are complemented by several large downstream diversions and the operating requirements of Pathfinder Reservoir, where the Sweetwater joins the North Platte. A third fishing access point in the Ferris Mountains is protected by that mountainous location.

The determination for the Above Pathfinder Dam (West) subbasin is that all E&R uses are either protected or complementary, with the exception of fishing access at Carmody Lake. **Table 3.5.7** provides a summary of the classified uses in the Above Pathfinder Dam (West) subbasin.

**Table 3.5.7: Categorization of E&R Uses in the Above Pathfinder Dam (West) Subbasin**

| Status | Location and Uses |
|---|---|
| Protected | Fishing and whitewater rafting upstream and contiguous with an ISF, yellow ribbon segments at high elevations, fishing access point in the Ferris Mountains, fishing at Pathfinder Reservoir |
| Complementary | Whitewater rafting in the Granite Mountains, yellow ribbon segments that feed into the Sweetwater River |
| Competing | Fishing access point at Carmody Lake |

Maps of these resources are provided in **Figures 3.5.4 and 3.5.5**.

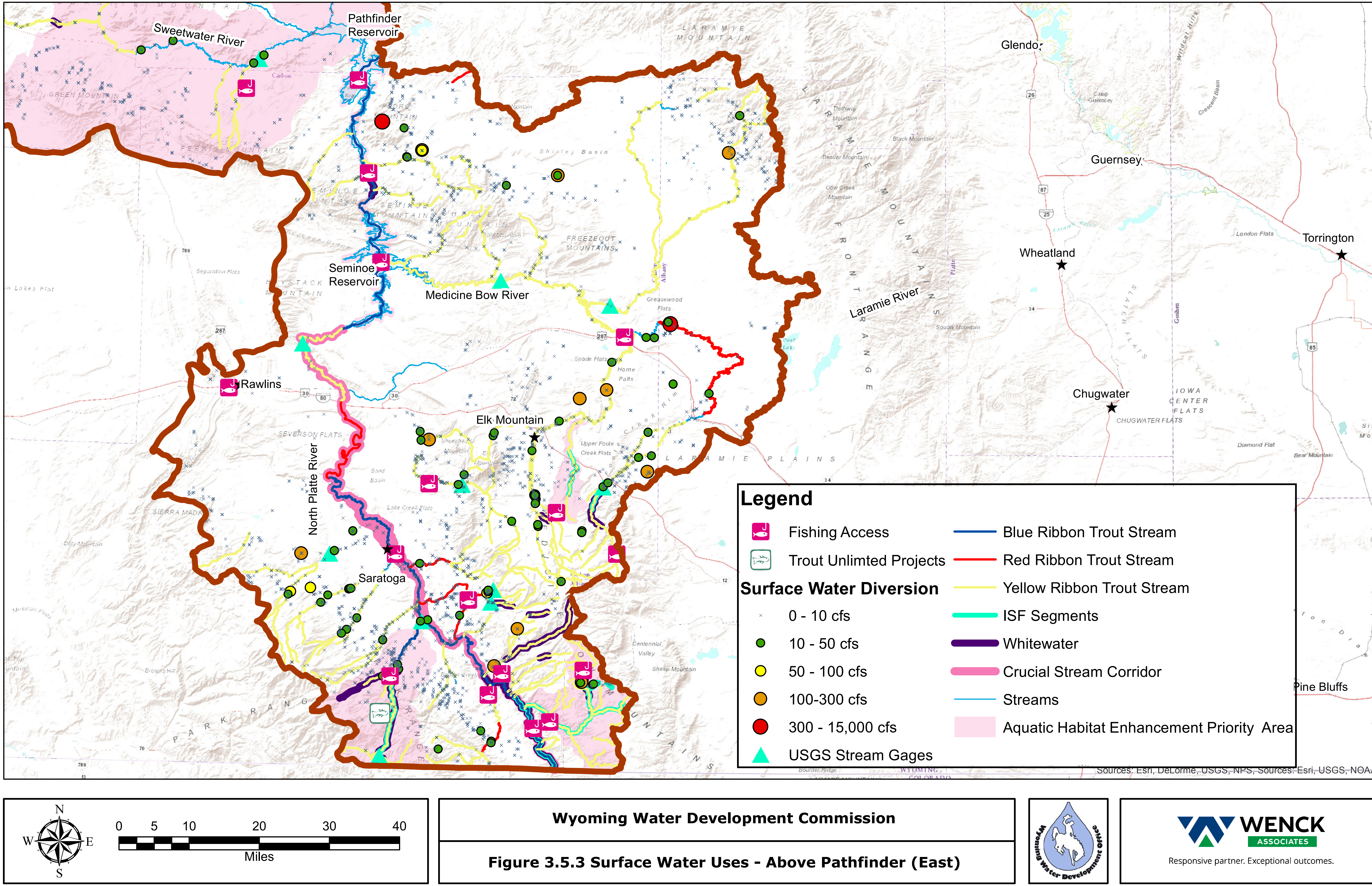


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**Figure 3.5.3 Surface Water Uses - Above Pathfinder (East)**

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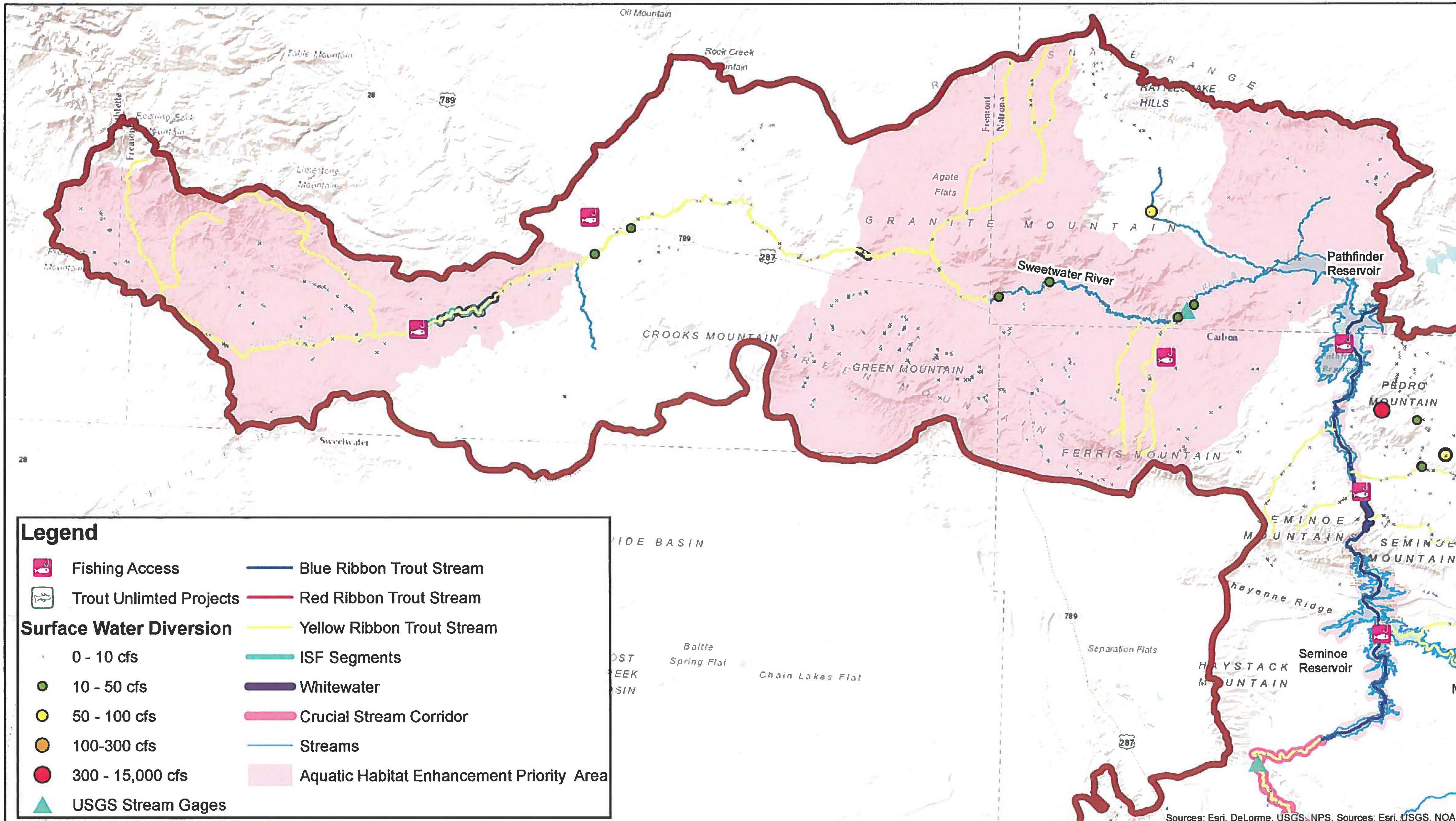


N W E S
0 2.5 5 10 15 20 25
Miles

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**Figure 3.5.4 Surface Water Uses - Above Pathfinder (West)**

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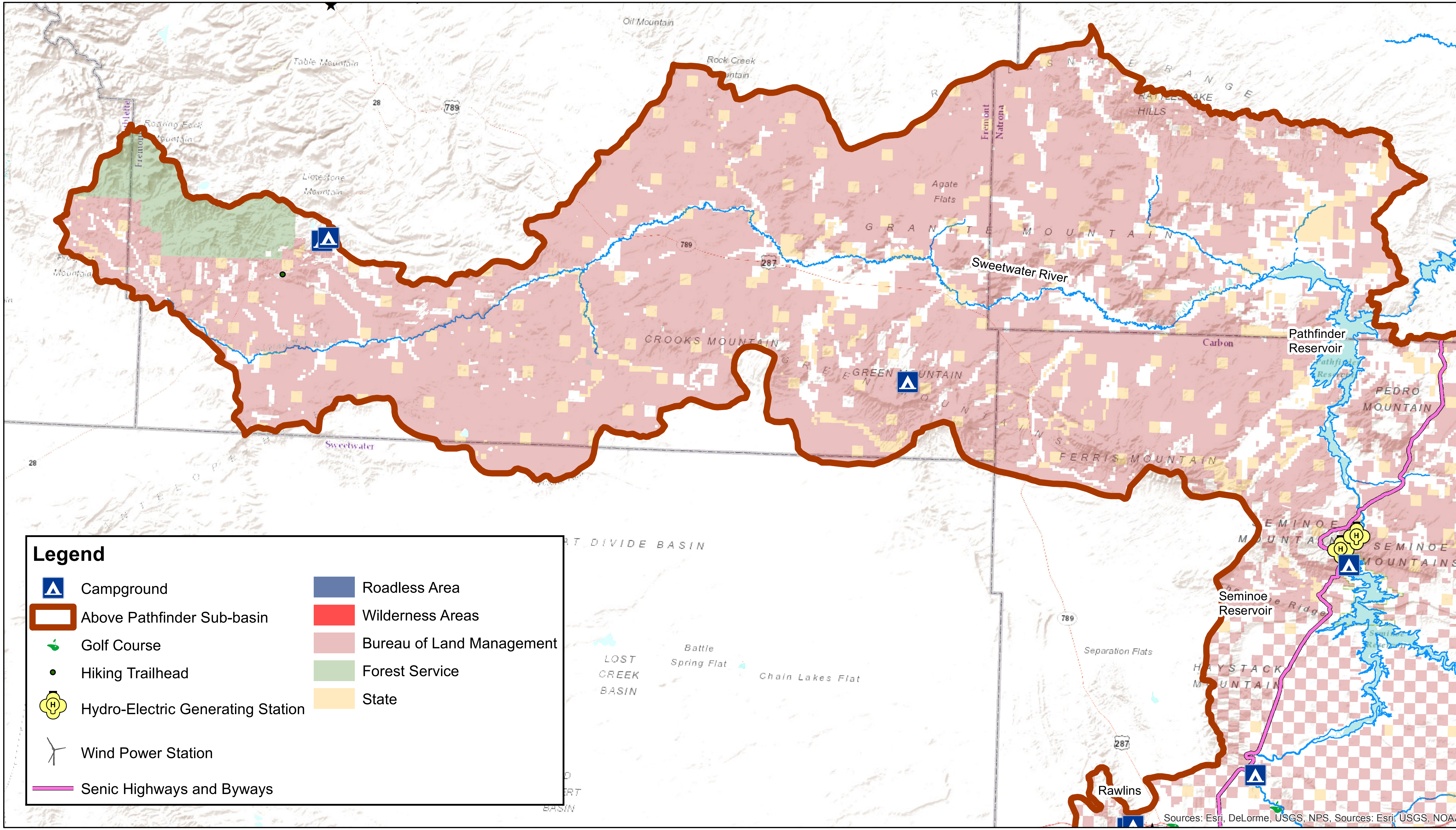


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**Figure 3.5.5 Land Use - Above Pathfinder (West)**

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### Pathfinder to Guernsey Subbasin

This subbasin is rich in recreational opportunities with its long reach of the North Platte River and three reservoirs, two of which are associated with state parks, and offers a wide variety of recreational opportunities. The Laramie and Granite Mountains provide numerous E&R benefits. Casper, the second largest city in the state, is also located here. As of 2012, there were about 65,000 irrigated acres in the subbasin, down almost 30% since 2006. About 12% of the total Basin irrigated acreage is located in this subbasin.

The elevation of this subbasin ranges from about 4,000 to 8,400 feet providing a variety of landscapes well suited to agriculture, recreational pursuits and environmental habitat.

#### Major Recreational Opportunities in the Pathfinder to Guernsey Subbasin

**Alcova Reservoir.** Alcova Reservoir is located on the North Platte River approximately 30 miles southwest of Casper, in Natrona County. The dam was completed in 1938 and has an adjudicated capacity of 184,295 acre-feet of water. The Natrona County Roads, Bridges and Parks Department manages recreational facilities at Alcova Reservoir for the USBR. Alcova Reservoir is unique in that it serves many facets of water use. The dam serves as a diversion dam for the Casper Irrigation Canal and as a forebay for the Alcova Power Plant. These uses, in addition to recreational use, make this reservoir an important basin feature. Campgrounds, boat ramps, an interpretive trail, and a marina concession are available at the site. A dinosaur interpretive trail is located near Cottonwood Creek Beach. In 2010, there were more than 100,000 visitor days at the lake; visitor days are projected to grow to more than 130,000 by 2030 (USBR, 2013).

**Edness K. Wilkins State Park.** This state park is located 6 miles east of Casper near Interstate 25 in Natrona County. The site covers 315 acres of what was once a rock quarry. As a result of a master reclamation plan to construct an attractive and functional park for all visitors, the site was transformed into a handicapped accessible facility with picnic tables, playgrounds, and a launching ramp for canoes and rafts. Lake water at the park is groundwater that has percolated from the subsurface. The property was purchased by the State of Wyoming in 1981 and is managed by the Wyoming Department of State Parks and Cultural Resources.

**Glendo Reservoir and State Park.** Glendo Reservoir is located on the North Platte River 6 miles southeast of the town of Glendo in Platte County. Construction on the dam was started in 1954 and completed in 1957. The power plant was completed in 1958. The adjudicated water right of Glendo Reservoir is 800,000 acre-feet. The Wyoming Department of State Parks and Cultural Resources manages recreational facilities at Glendo Reservoir for the USBR. Glendo State Park provides

campgrounds, boat ramps, and a marina concession. Three interpretive trails, including the Glendo Dam Wetlands Trail, Muddy Bay Wetlands Interpretive Trail, and the Glendo Dam Overlook Trail, provide recreational opportunities for those who desire to learn about the area. An entrance fee and a campground fee are assessed to users of Glendo State Park.

**Guernsey Reservoir and State Park.** Guernsey Reservoir is located on the North Platte River 2 miles west of the town of Guernsey in Platte County. A dam was built between 1925 and 1927 by the USBR to create Lake Guernsey. Guernsey Reservoir has an adjudicated water right for 71,040 acre-feet. The Civilian Conservation Corps completed approximately 85% of the construction of Guernsey State Park between 1933 and 1936. The Wyoming Department of State Parks and Cultural Resources manages the recreational facilities at Guernsey Reservoir for the USBR. Guernsey State Park provides campgrounds and boat ramps for public use. Fees are collected from the public to utilize campgrounds and to enter Guernsey State Park.

The Guernsey Reservoir water level is typically lowered twice each year for a relatively brief period in order to provide annual "silt runs." The "silt runs" are USBR operations which provides silt-laden irrigation water to the Goshen, Gering-Fort Laramie, and Pathfinder Irrigation Districts by decreasing Glendo Reservoir outflow, thereby reducing the Guernsey Reservoir water level; then increasing Glendo Reservoir discharge into and through Guernsey Reservoir, thereby flushing silt from Guernsey Reservoir and re-filling Guernsey Reservoir. This practice is thought to affect the Guernsey Reservoir fishery and the ways in which the public utilizes the park and reservoir for recreational purposes during periods of low water.

**Trappers Route Special Recreation Management Area.** This is a newer recreational area, managed by BLM, developed since the original Basin Plan. The area is operated under an adaptive management approach, which is more flexible than traditional resource management but requires monitoring of management actions to measure site-specific actions for potential extrapolation to a larger area. The recreation area consists of several recreation sites along the North Platte River between Alcova Lake and Casper. The various sites provide four-day use areas, camping, fishing, picnicking and floating opportunities. Future improvements and additional amenities are planned (BLM, 2014).

State Park visitor data for the parks discussed above are shown in **Table 3.5.8**.

**Table 3.5.8: State Park Visitor Days, Five Year Average and 2014**

| State Park | Five Year Average (2009-2013) | 2014 |
|---|---|---|
| Edness K. Wilkins | 60,983 | 85,593 |
| Glendo | 219,845 | 300,801 |
| Guernsey | 64,323 | 77,613 |
| **Total** | | **462,007** |
| Source: Wyoming Division of State Parks, Historic Sites and Trails, Department of State Parks & Cultural Resources, *Visitor Use Program, 2014*. | | |

**Fishing.** Fishing opportunities are abundant in the subbasin and are evident at all the state parks and recreational locations discussed above. Many trout species, including rainbow, brown and cutthroat, along with walleye and channel catfish can be found in the North Platte. **Table 3.5.9** provides angler days for various locations throughout the subbasin.

**Table 3.5.9: Angler Days for the Pathfinder to Guernsey Subbasin**

| Pathfinder to Guernsey Subbasin | Angler Days/Year |
|---|---|
| Dave Johnson Power Plant to Glendo Dam | 60,815 |
| Pathfinder Dam to Alcova | 94,670 |
| Alcova Dam to Dave Johnson Power Plant | 29,293 |
| North Slope Laramie Range | 7,500 |
| Sage Creek Drainage | 3,091 |
| Bates Hole | 2,365 |
| Glendo Dam to Guernsey Dam | 1,713 |
| **Total** | **199,447** |
| **Note:** Some of these data have not been updated in several years, but these are the latest available figures.<br>Source: Al Conder, Casper Regional Fisheries Supervisor, WGFD, December 2014. | |

### Notable Environmental Factors in the Pathfinder to Guernsey Subbasin

**Critical Habitat Areas.** The North Platte River from Seminoe Reservoir to Alcova Dam has been classified as a Crucial Habitat Area. The area above Alcova Dam is in the Above Pathfinder Dam Subbasin. This area received this designation due to its superior sport fisheries and wetlands. Brown trout, rainbow trout and walleye are species of concern. Proposed actions include enhancement of spawning habitat, working with USBR on minimum pool requirements and control of invasive species (WGF – Upper North Platte Reservoirs, 2014).

The area along the North Platte River from Seminoe Reservoir to Glendo Reservoir is also designated as an Aquatic Crucial Habitat Area. It is divided into two sections, North Platte Corridor and Middle with somewhat differing values and species of interest. The habitat values for the North Platte Corridor include sport fishery, cottonwood gallery forest, and riparian wetlands. The habitat narrative calls for efforts to maintain or enhance this economically significant fishery. Primary species in the area include brown and rainbow trout, walleye, bald eagles, white-faced ibis and many more. Water temperature and USBR water management are critical elements in this area (WGF North Platte, 2014).

***The Middle North Platte*** – Glendo Reservoir habitat values include sport fishery, existing and potential native sport fish habitat, riparian cottonwood habitat and wetlands that should be maintained or enhanced. Primary species include black crappie, brown trout, channel catfish, rainbow trout and more. Issues in the area include USBR water management, barriers to fish migration and degraded riparian habitat (WGF Glendo, 2014).

These areas do not receive specific protection due to this designation, but management efforts in these areas are designed to improve conditions.

**Minimum Release Reservoirs.** There are three minimum release flow reservoirs in this subbasin, each owned and operated by the USBR. Only releases at Gray Reef, a regulating reservoir downstream of Alcova Dam, are mandated by law. USBR voluntarily maintains releases at Pathfinder and Glendo Dams to improve fisheries, wetlands and wildlife habitat. Details on the minimum release flows are provided in **Table 3.5.10.**

**Table 3.5.10: Minimum Release Reservoirs in the Pathfinder to Guernsey Subbasin**

| Structure | Owner | Minimum Release | Regulation |
|---|---|---|---|
| Pathfinder Dam | USBR | 75 cfs | Voluntary low flow release for trout fisheries |
| Gray Reef Dam | USBR | 300 cfs | U.S. Public Law 85,695, Missouri Basin Project |
| Glendo Dam | USBR | 25 cfs | Voluntary release for wetlands and associated fish and wildlife benefits |
| Source: USBR Annual Operating Plan, North Platte River Area, 2013-2014. | | | |

### Classification of Recreational and Environmental Water Uses in the Pathfinder to Guernsey Subbasin

An analysis of recreational and environmental water uses was performed utilizing GIS data and maps in order to categorize those uses. **Table 3.5.11** provides a listing or recreational and environmental sites within the subbasin.

**Table 3.5.11: Recreational and Environmental Water Uses within the Pathfinder to Guernsey Subbasin**

| **Recreation Sites** | |
|---|---|
| Fishing Access | 5 |
| Whitewater Rafting | 3 |
| Trout Streams | |
| *Blue* | 2 |
| *Red* | 6 |
| *Yellow* | Numerous |
| Campgrounds | 14 |
| Natural Landmarks | 1 |
| Scenic Highways and Byways | 2 |
| National Historic and Scenic Trails | 1 |
| **Environmental Uses** | |
| Wilderness/Roadless Areas | Yes |
| US Forest Service Lands | Yes |
| Instream Flow Segments | 1 |
| Crucial Stream Corridors | 1 |
| Aquatic Crucial Priority Areas | 2 |
| Wetland Area | Yes |
| Source: GIS sources are provided in the Introduction. | |

**Categorization of E&R Water Uses in the Pathfinder to Guernsey Subbasin**

Many of the E&R water uses in this subbasin appear to be protected or complementary to the traditional diversions. The North Platte is somewhat different than other rivers because of the 1945 North Platte Decree and 2001 Modified Decree, which limits diversion for agriculture in this subbasin. In addition, the economic importance and quality of life value of the recreation associated with the North Platte make it highly unlikely that flows would be reduced to a level that would impair these uses. An additional level of protection exists because the reservoirs along the Platte, discussed above, ensure that water is released to the river. All uses directly associated with existing reservoirs are categorized as protected for this analysis.

The North Platte River is a prime recreational resource in the subbasin. In addition to the designated fishing access points, there are many fishing spots all along the Platte that offer opportunities to catch rainbow, brown and cutthroat trout, channel catfish and walleye (BLM, 2015). Much of the North Platte in this subbasin has been designated as a blue ribbon trout stream by WGFD. Most of the land area along the banks of the Platte in this subbasin has been designated as an Aquatic Enhancement Priority Area by WGFD, because of its high value as a fishery. However, there are no specific protections associated with this designation (WGF, 2009).

As the Platte leaves the Pathfinder Reservoir, there are several recreational water uses, including a whitewater rafting segment, a yellow ribbon trout stream and a fishing access point. Just downstream of these activity areas are two surface water diversion points, including a large diversion for power generation at Alcova Reservoir, a USBR project. The locations of these diversions complement the recreational uses and as long as those diversions are in place, the recreational uses upstream of them will be protected. It is likely that the power generation at Alcova will remain in place for the long term and thus these upstream uses should be considered protected.

North of Casper is a short rafting segment that is complemented by several large downstream diversions. West of Natrona County in Converse County, there is an important stream segment with a whitewater segment, red ribbon trout stream, and an instream flow segment. As the instream flow segment is protected by a water right, the trout stream and whitewater segment above it are thus protected. However, the whitewater segment below it and the yellow ribbon trout stream should be considered competing. Although there are numerous small diversions downstream, any changes to those diversions could allow for additional upstream diversions. Just to the east is another whitewater stream segment and yellow ribbon trout stream. These uses are complementary to several, large downstream diversions.

There are numerous yellow ribbon and a few red ribbon stream segments originating in the Laramie Mountains. Some of these are within the bounds of the Medicine Bow National Forest and are at high elevations. As a result, these uses can be considered protected, even though the segments outside of the national forest would not have explicit protection. Their location within the landscape provides the required protection. The red ribbon stream west of Douglas lacks sufficient complementary uses and should be considered competing.

There is a fishing access point in the northwest portion of the subbasin that should be considered competing as there is no evidence of protection from other uses. This is also true of the fishing access point that is south of Douglas. No apparent protection exists and it should be considered competing.

**Table 3.5.12** provides a summary of the classified uses in the subbasin.

**Table 3.5.12: Categorization of E&R Uses in the Pathfinder to Guernsey Subbasin**

| Status | Location and Uses |
|---|---|
| Protected | Uses at reservoirs, North Platte activities between Pathfinder and Alcova Reservoir, remaining stretch of the North Platte to Glendo, instream flow segments and associated upstream uses, uses originating in the upper reaches of the Laramie Mountains |
| Complementary | Whitewater rafting north of Casper, and rafting and yellow ribbon segment west of Douglas |
| Competing | Fishing access points in the northwest area of the subbasin and south of Douglas, whitewater and yellow stream segment below the ISF in Converse County, red ribbon stream west of Douglas |

Maps of these resources are provided in **Figures 5.3.6 and 5.3.7**.

### Guernsey to State Line Subbasin

This subbasin is home to the Goshen County seat of Torrington, which has a population of about 6,800. The remainder of the subbasin is sparsely populated. The area of the subbasin is predominately in Goshen County with a small area in Niobrara County and a very small area of Platte County. There is little recreational or environmental activity in the subbasin. As of 2012, there were about 81,700 irrigated acres in the subbasin, down from 90,980 in 2006, for a reduction in irrigated acres of about 10%. More than 15% of the Basin's total irrigated acreage is located here, much of it in the vicinity of Torrington.

The land here is relatively flat and well suited for agriculture. The elevation of this subbasin ranges from about 4,000 to 5,500 feet.

### Major Recreational Opportunities

Recreational opportunities in this subbasin are limited. There are no designated fishing access points or other recreational locations in the subbasin. The water used for the Torrington golf course will be included in the municipal demands.

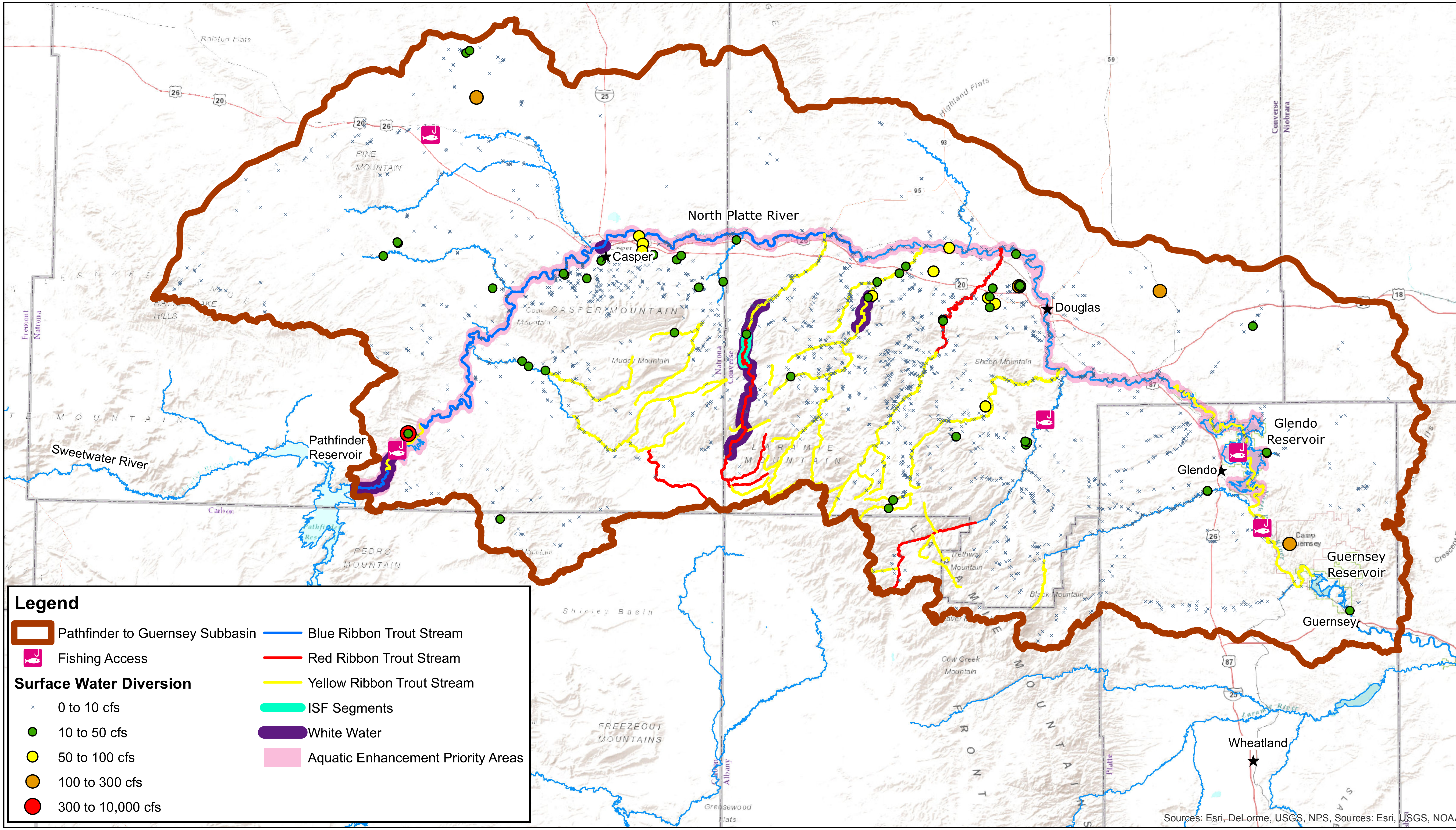


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**Figure 3.5.6 Surface Water Uses - Pathfinder to Guernsey**

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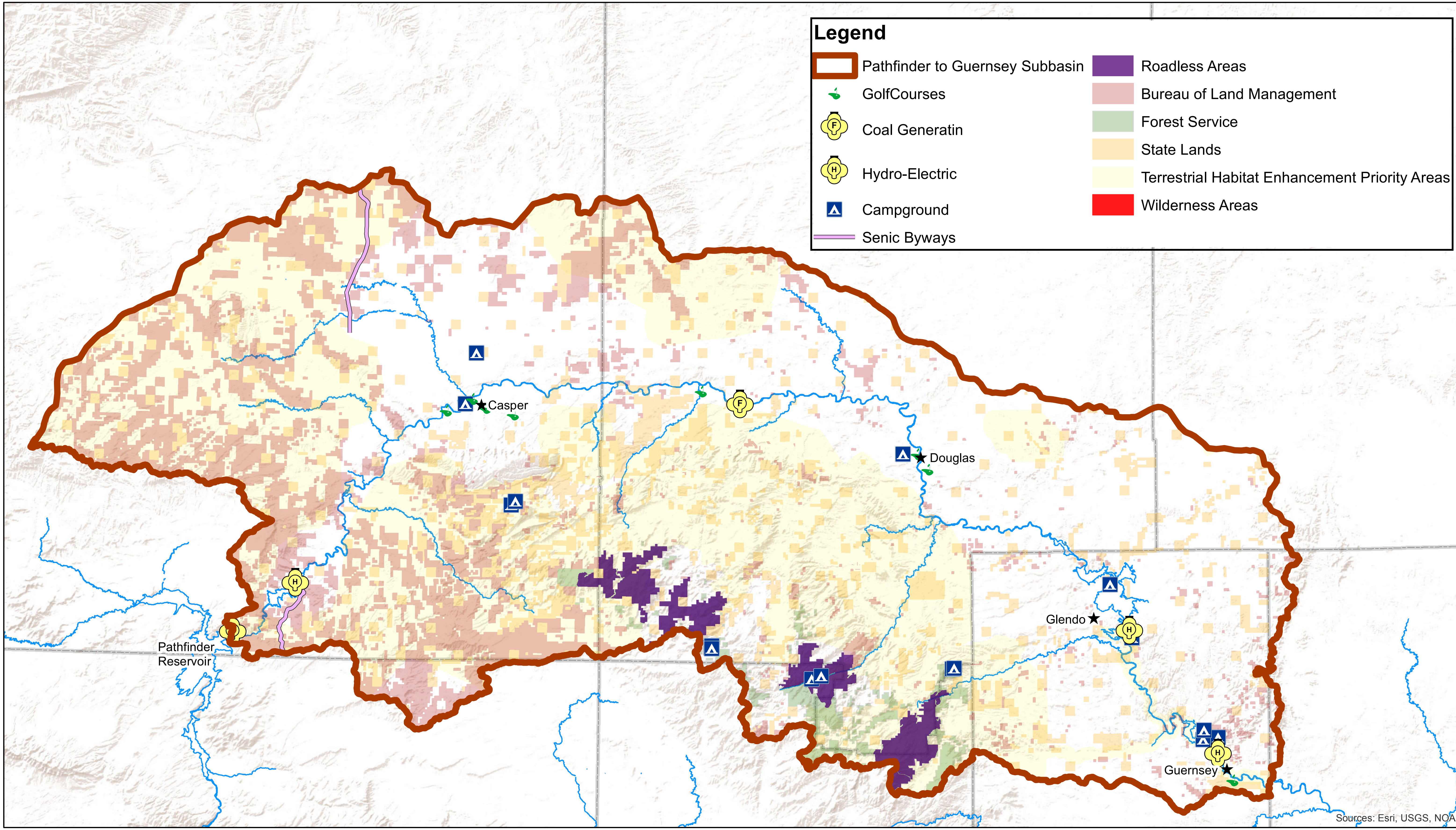


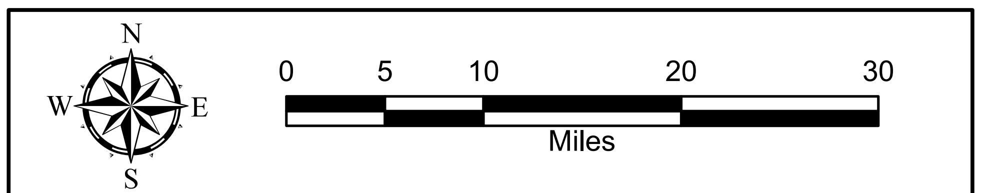


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**Figure 3.5.7 Land Use - Pathfinder to Guernsey**

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### Notable Environmental Factors in the Guernsey to State Line Subbasin

**Wetlands.** The Goshen Hole Complex, located in Southern Goshen County, is one of nine high priority wetland areas, as designated by the Wyoming Joint Ventures Steering Committee. Much of this wetland area has been created by and is sustained by irrigation activities. These wetlands are an important migration corridor for and provides habitat for waterfowl and attracts diverse species. This wetlands complex is the most important waterfowl hunting area in the state. A large number of acres of both wetlands and upland buffers are in private ownership and are enrolled in management agreements. This wetlands complex occupies about 491 square miles and includes about 7,000 acres of wetlands (Wyoming Joint Ventures Steering Committee, 2010).

**Critical Habitat Areas.** The Niobrara Critical Aquatic Area is mostly located north, and outside of Platte Basin. However, small sections of it cross over into the Guernsey to State Line Subbasin. WGF has identified the important habitat value here to be for native fish assemblage. The primary species of importance are the finescale dace, northern pearl dace and plains topminnow. Impacts from cultivated land, including nutrient and sediment inputs, and barriers to migration are issues here. Landowner awareness, conservation easements and stream surveys are some of the proposed actions for this area (WGF – Niobrara, 2014).

**Minimum Release Reservoirs.** There are no minimum release reservoirs in the subbasin.

### Classification of Recreational and Environmental Water Uses in the Guernsey to Stateline Subbasin

An analysis of recreational and environmental water uses was performed utilizing GIS data and maps in order to categorize those uses. **Table 3.5.13** provides a listing or recreational and environmental sites within the subbasin.

**Table 3.5.13: Recreational and Environmental Water Uses within the Guernsey to State Line Subbasin**

| **Recreation Sites** | |
|---|---|
| Fishing Access | 0 |
| Whitewater Rafting | 0 |
| Trout Streams | |
| *Blue* | 0 |
| *Red* | 0 |
| *Yellow* | 0 |
| Campgrounds | 0 |
| Natural Landmarks | 0 |
| Scenic Highways and Byways | 0 |
| National Historic and Scenic Trails | 0 |
| **Environmental Uses** | |
| Wilderness/Roadless Areas | 0 |
| US Forest Service Lands | 0 |
| Instream Flow Segments | 0 |
| Crucial Stream Corridors | 0 |
| Aquatic Crucial Priority Areas | 1 |
| Wetland Area | Yes |
| Source: GIS sources are provided in the Introduction. | |

### Categorization of Recreational and Environmental Water Uses

The only water use that meets the mapping standards for this analysis are those for irrigated agriculture and the small area of the Niobrara Critical Aquatic Area. However, as the large majority of the area is outside the subbasin, it is assumed that any impactful activities will take place there. In addition, there are no explicit protections associated with this classification.

Land and water use maps for the subbasin are presented in **Figures 3.5.8 and 3.5.9**.

### Upper Laramie Subbasin

This subbasin is home to Laramie. It is mostly within Albany County, but does extend into a small area of Carbon County. The Laramie River, several small lakes and reservoirs and the Medicine Bow National Forest provide ample opportunity for recreation. This subbasin is the only one in the Platte Basin that has seen an increase in irrigated acres since 2006. As of 2012, there were about 104,400 irrigated acres, up 13% from 92,250. This represents more than 18% of irrigated acres within the Basin. The elevation of this subbasin ranges from about 7,000 to 11,000 feet.

#### Major Recreational Opportunities in the Upper Laramie Subbasin

**Lake Hattie Reservoir.** Lake Hattie is located 15 miles west of Laramie near the foothills of the Medicine Bow Mountains in Albany County. The dam was originally constructed in 1912 and modified in 1990. The reservoir has an adjudicated water right to store 65,260 acre-feet of water. Lake Hattie contains 2,239 acres of land. The Lake Hattie Irrigation District owns the lake, and the WGFD manages the recreational facilities. Camping and picnic facilities are undeveloped, potable water is not available, and there are no fees to use the park. A boat launch is available.

**Rob Roy Reservoir.** Rob Roy Reservoir and campground is located in the Medicine Bow National Forest approximately 40 miles southwest of Laramie in Albany County. The reservoir has an adjudicated water right and a storage capacity of 35,434 acre-feet.

Construction of the dam and reservoir was completed in 1963 and modified in 1985. Rob Roy Reservoir is the largest and deepest of a series of five reservoirs in the Cheyenne public water supply system, including Hog Park Reservoir in the Sierra Madre Mountains; Rob Roy Reservoir and Lake Owen (Berg Reservoir) in the Medicine Bow Range; and Crystal Lake and Granite Springs Reservoir in the Laramie Range. Rob Roy contains 79% of Cheyenne's surface water storage capacity. Rob Roy is the only lake in the series that stores only runoff from its watershed and receives no inflow from other reservoirs. The reservoir campground is developed and includes picnic tables and potable water. The reservoir is managed by Cheyenne, and the nearby recreational facilities are administered by the USFS.

**Fishing.** Fishing opportunities are good in the subbasin, which has several red ribbon trout streams and numerous yellow ribbon streams. Rainbow, brown, brook, and cutthroat trout can be found in the streams and lakes. Angler days for the subbasin are provided in **Table 3.5.14**.

**Table 3.5.14: Angler Days for the Upper Laramie Subbasin**

| Upper Laramie Subbasin | Angler Days / Year |
|---|---|
| Upper Big Laramie | 24,975 |
| Little Laramie River and Drainages | 12,513 |
| **Total** | **37,488** |

**Note:** Some of these data have not been updated in several years, but these are the latest available figures.
Source: Mike Snigg, Laramie Regional Fisheries Supervisor, WGFD, January 2015.

There are no state parks in the subbasin.

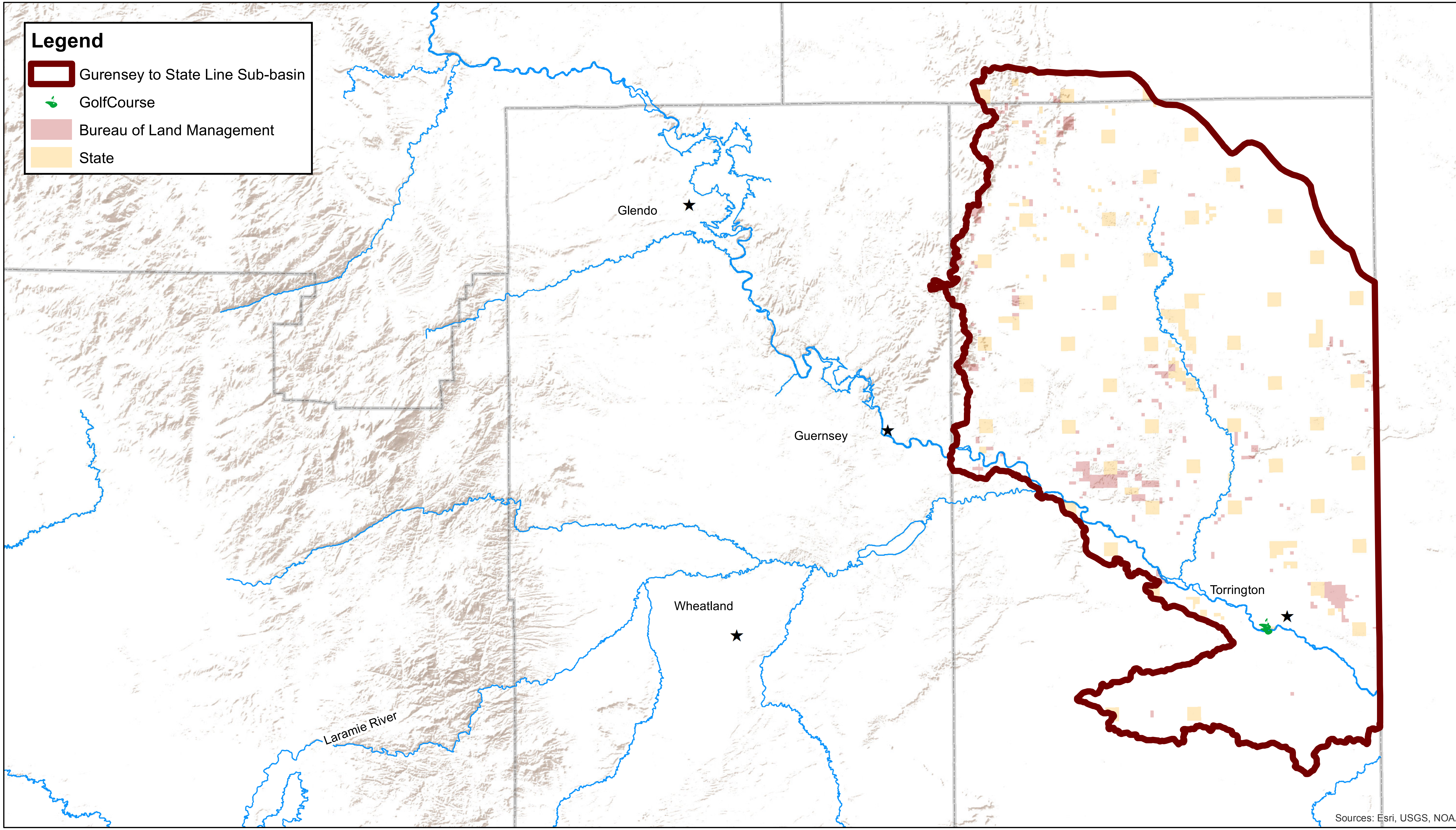


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**Figure 3.5.8 Land Use - Guernsey to State Line**

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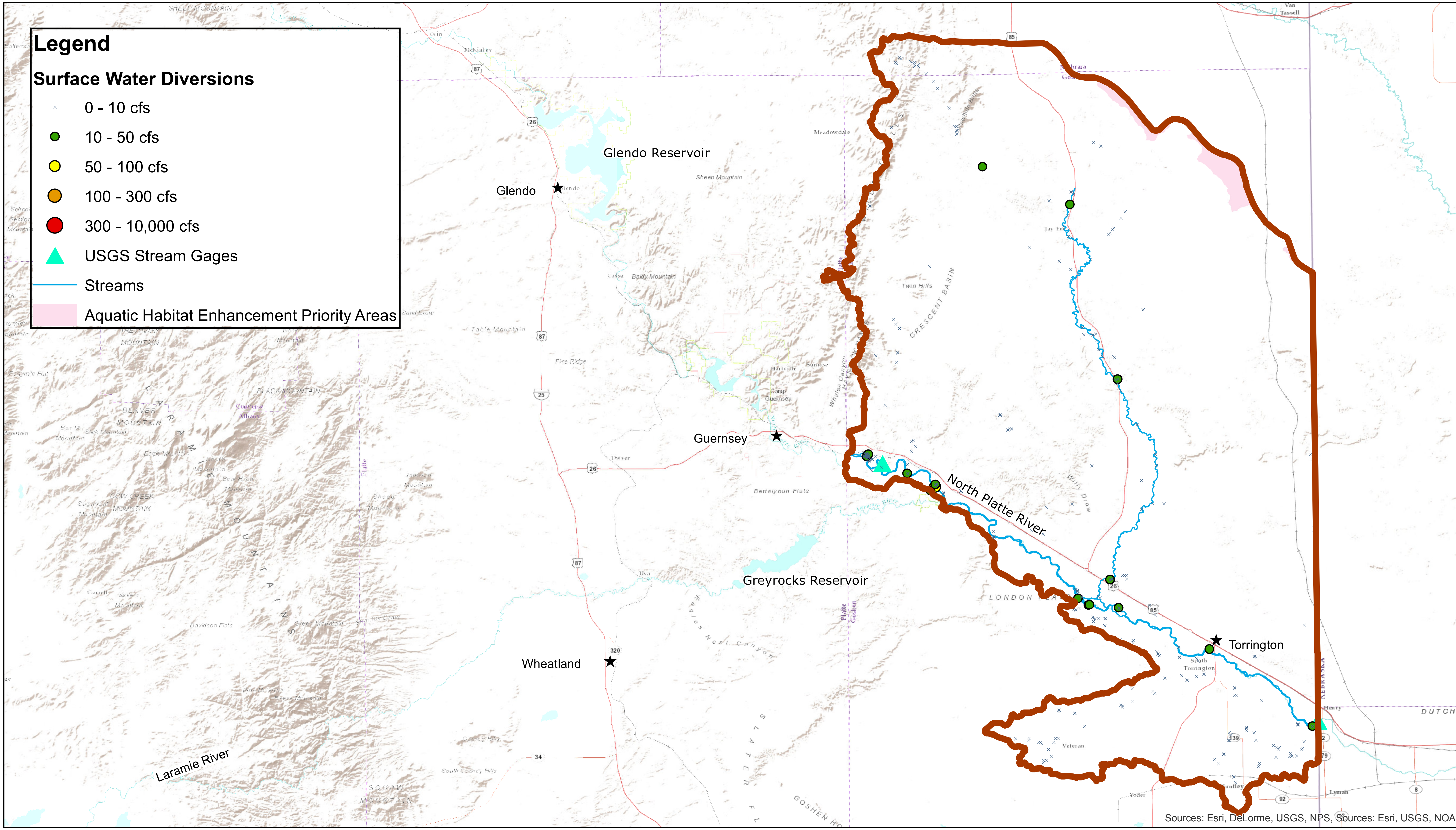


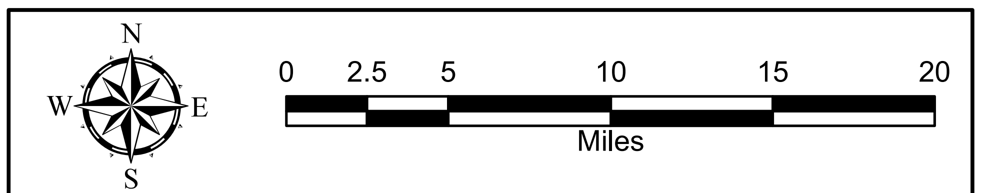


**Wyoming Water Development Commission**

**Figure 3.5.9 Surface Water Uses - Guernsey to State Line**

### Notable Environmental Factors in the Upper Laramie Subbasin

**Aquatic Habitat Enhancement Priority Area.** The Laramie River/Spring Creek aquatic enhancement area was adopted to improve brown and rainbow trout habitat that has been degraded due to stream channelization, streambank erosion, urbanization and willow removal. The creation of this cooperative project should improve habitat and improve upstream fishing opportunities.

**Trout Unlimited Project.** Trout Unlimited contributed funding to this National Resources Conservation Service project for channel restoration on Holland Ranch/ Laramie River. This project was completed in 2015.

**Permitted Instream Flow.** This 3.94 mile segment on the Laramie River was issued in 2012, with a priority date of December 15, 1989. The permitted cfs is a minimum of 50 and maximum of 100.

**Laramie Plains Wetlands Complex.** This large wetlands encompasses about 1,480 square miles in Albany and Carbon Counties. The dominant land use within the area is agriculture, including both irrigated and non-irrigated crops and native rangeland. Flood irrigation has contributed to the wetlands and snowmelt from the surrounding mountains reaches the wetlands through irrigation ditches and irrigation. Recreational activities in the Complex are not currently an issue, but that could change as population increases in the southeastern part of the state (WGF - Regional Wetland Conservation Plan, 2014).

### Classification of Recreational and Environmental Water Uses in the Upper Laramie Subbasin

As described in Section 3.5.3, an analysis of recreational and environmental water uses was performed utilizing GIS data and maps in order to categorize those uses. **Table 3.5.15** provides a listing or recreational and environmental sites within the subbasin.

**Table 3.5.15: Recreational and Environmental Water Uses within the Upper Laramie Subbasin**

| **Recreation Sites** | |
|---|---|
| Fishing Access | 7 |
| Whitewater Rafting | 4 |
| Trout Streams | |
| *Blue* | 0 |
| *Red* | 3 |
| *Yellow* | Numerous |
| Campgrounds | 6 |
| Natural Landmarks | 0 |
| Scenic Highways and Byways | 1 |
| National Historic and Scenic Trails | 0 |
| **Environmental Uses** | |
| Wilderness/Roadless Areas | Yes |
| US Forest Service Lands | Yes |
| Instream Flow Segments | 1 |
| Crucial Stream Corridors | 0 |
| Aquatic Crucial Priority Areas | 2 |
| Wetland Area | Yes |
| Source: GIS sources are provided in the Introduction. | |

### Categorization of Recreational and Environmental Water Uses in the Upper Laramie Subbasin

There are seven public access fishing locations on the map, the first being on the Laramie River just north of Colorado and upstream of the Trout Unlimited Project and the only permitted instream flow in this subbasin. It is recognized as protected due to its proximity to an instream flow segment as well as numerous senior downstream diverters. Just to the east of the Medicine Bow Range are four fishing locations at small lakes and reservoirs which are protected due to their location. This is also true of the fishing access point located at Wheatland Reservoir 3 on the northwest side of the subbasin. The final public fishing access point on the Laramie River has a single, close downstream diverter but is protected by the downstream irrigation rights of the Wheatland Irrigation District.

There are three red ribbon trout streams in this subbasin. The first is on the Laramie River beginning at the Colorado border. Much of this stretch is upstream of a permitted in-stream flow, and all of it is upstream to numerous senior diverters, providing it a protected status. Coming out of the Medicine Bow National Forest is a second lengthy red ribbon segment. Its location upstream of numerous senior downstream diverters affords this stretch of fishing a complementary use status. The final red ribbon stream is a short stretch high in the Medicine Bow Mountains which is protected by its location but is also complementary to numerous senior downstream diverters.

There are five whitewater rafting locations in the subbasin. The first is just north of Laramie on the Laramie River. This stretch of the river is also a yellow-ribbon trout stream, and is within the aquatic enhancement area discussed above. There are several senior traditional diversions downstream of this location associated with the Wheatland Irrigation District. Although its location in a priority area does not afford official protection, this river reach is considered complementary because the Laramie River has many downstream diverters which necessitate bypassing water through this segment. The WGF's goal is to improve the segments habitat and it is unlikely that flow would be curtailed. In the northern area of the subbasin, is another whitewater stretch, also a yellow-ribbon trout stream, which is complementary to one large senior downstream and several smaller diversions in the Lower Laramie Subbasin.

There are two whitewater stream segments coming out of the higher reaches of the Medicine Bow Mountains. Their location on USFS lands provides a protected status to these recreation areas. Just north of the Colorado border is a fifth whitewater rafting area on the Laramie River. This relatively short stretch is just upstream of an instream flow segment, which provides a protected status to this stream segment. **Table 3.5.16** provides a summary of the classified uses in the subbasin.

**Table 3.5.16: Categorization of E&R Uses in the Upper Laramie Subbasin**

| Status | Location and Uses |
|---|---|
| Protected | Fishing access locations, whitewater segments and a red ribbon stream in the Medicine Bow National forest, the ISF segment and whitewater rafting and red ribbon stream segment upstream of it |
| Complementary | Whitewater rafting and yellow ribbon stream segment north of Laramie, long red ribbon segment after it leaves the Medicine Bow Forest |
| Competing | NA |

Maps of these data are provided in **Figures 3.5.10 and 3.5.11**.

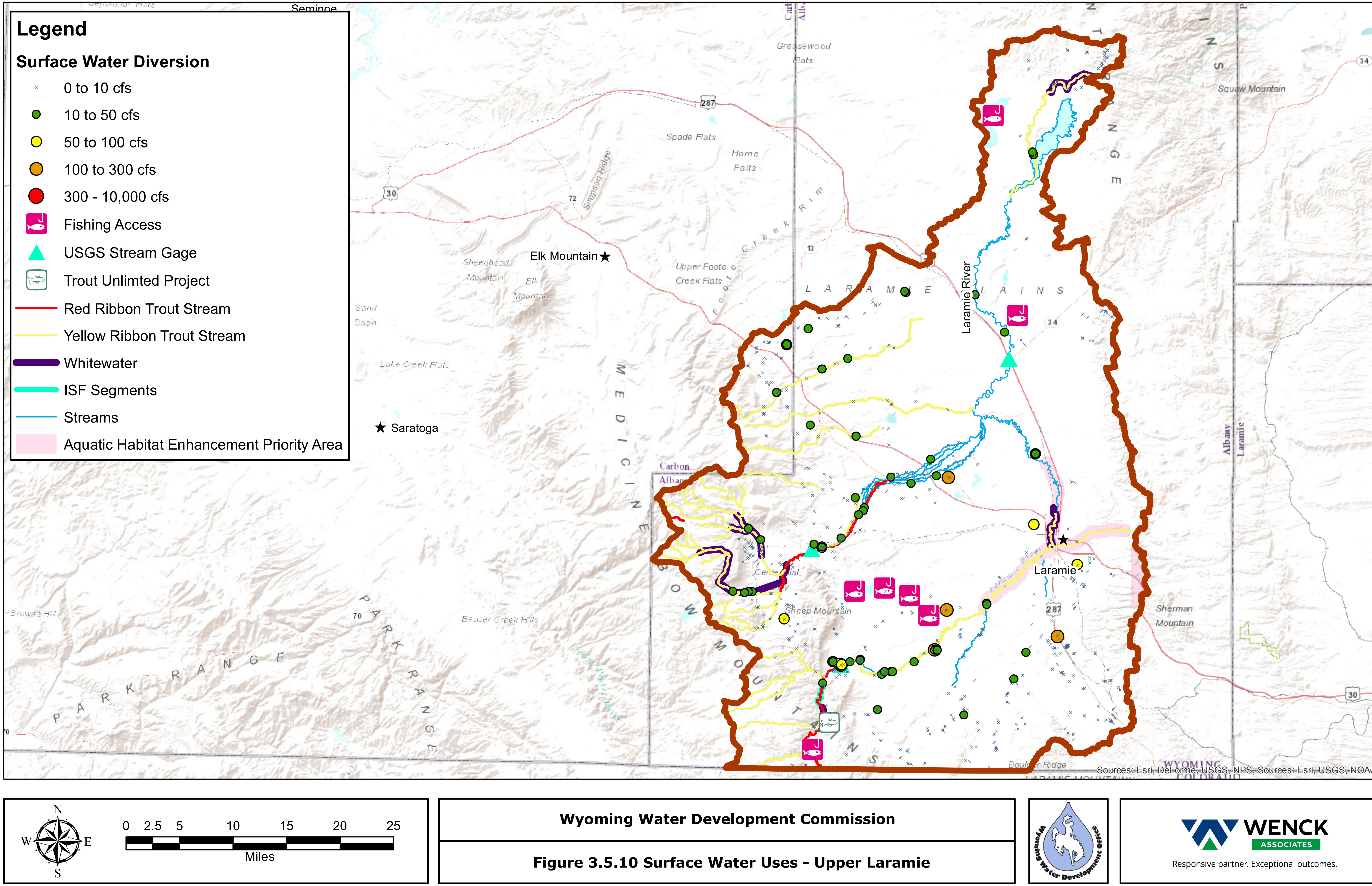


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**Figure 3.5.10 Surface Water Uses - Upper Laramie**

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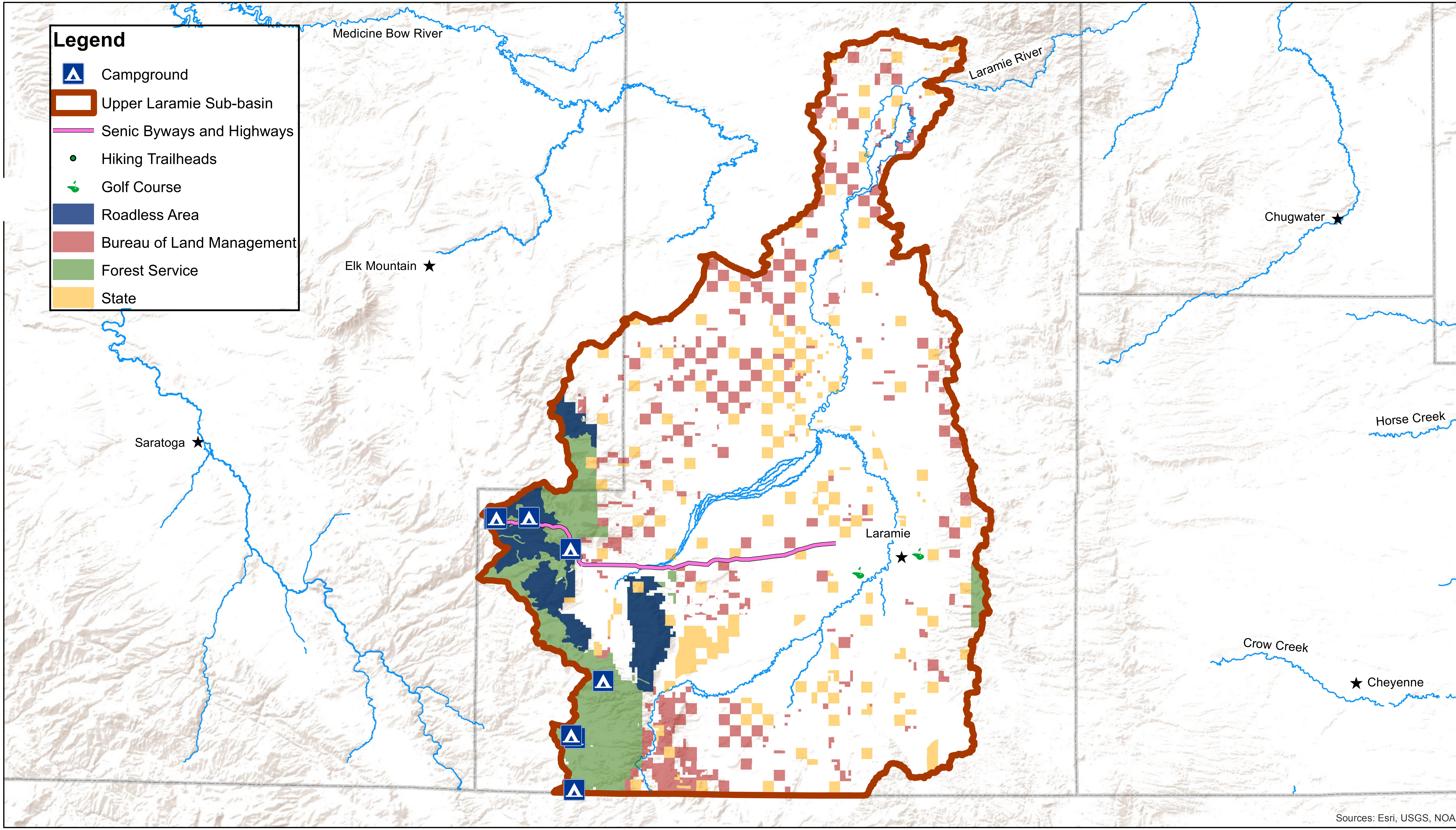


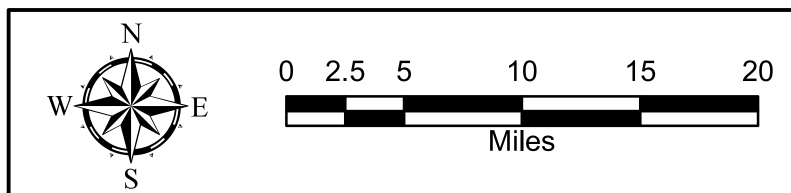


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**Figure 3.5.11 Land Use - Upper Laramie**

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### Lower Laramie Subbasin

This subbasin is home to Wheatland and encompasses parts of four counties, Albany, Platte, Laramie and Goshen. The Laramie River continues its course through the subbasin flowing out of the Upper Laramie Subbasin and providing many recreational opportunities. In addition, the Laramie Mountains provide excellent fishing and rafting locations. The area around Wheatland includes a heavy presence of irrigated agriculture, which has diminished about 27% since 2007. As of 2012, there were about 66,600 irrigated acres, including the Wheatland Irrigation District. The elevation of this subbasin ranges from about 4,000 to 8,000 feet, much of it at the lower elevations that are suitable for agriculture.

#### Major Recreational Opportunities

**Grayrocks Reservoir.** Grayrocks Reservoir is located on the Laramie River about 11 miles east of the Laramie River electrical power generating station. The reservoir lies at an elevation of approximately 4,000 feet in Platte County. The reservoir is about 8 miles long, has an adjudicated storage capacity of 104,109.60 acre-feet, and includes recreational facilities. The reservoir, which is owned by the Basin Electric Power Cooperative, is the primary source of steam production and cooling water for the power station. In addition, the reservoir and surrounding areas are managed by the WGF as a wildlife habitat management area. WGF stocks the reservoir with several species of game fish, and the reservoir contains largemouth bass, smallmouth bass, walleye, tiger muskie, channel catfish, crappie, pumpkinseed, and bluegill.

**Fishing.** There is one blue, several red, and numerous yellow ribbon streams in the subbasin. In addition to Grayrocks Reservoir, stream fishing opportunities exist for walleye, channel catfish, yellow perch, largemouth bass, black bullhead, and rainbow trout. Angler days are provided in **Table 3.5.17**.

**Table 3.5.17: Angler Days for the Lower Laramie Subbasin**

| Lower Laramie Subbasin | Angler Days/Year |
|---|---|
| North Laramie River and Drainages and Grayrocks Reservoir | 5,813 |
| Chugwater and Wheatland Creeks | 3,432 |
| Grayrocks Reservoir | 17,000 |
| **Total** | **26,245** |
| **Note:** Some of these data have not been updated in several years, but these are the latest available figures.<br>Source: Mike Snigg, Laramie Regional Fisheries Supervisor, WGFD, January 2015. | |

There are no state parks in the subbasin.

#### Notable Environmental Factors in the Lower Laramie subbasin

**Aquatic Enhancement Priority Areas.** A segment of the Laramie River as it exits the canyon in the Laramie Range to Grayrocks Reservoir has been designated an Aquatic Habitat Enhancement area. Irrigation diversions, livestock grazing and invasive plant species have caused degradation of the stream segment. Many fish species may benefit from an improved habitat and include bigmouth shiner, common shiner, hornyhead chub, Iowa darter, plains topminnow and many more. Potential actions include fish passage/screening projects, cottonwood regeneration, removal of invasive plants and conservation easements (WGF – Laramie River, Wheatland, 2008).

**Minimum Reservoir Releases.** There is one minimum release flow reservoir at the Grayrocks Dam, which is owned by the Basin Electric Power Cooperative. The minimums released are governed by the Modified North Platte Decree and are dependent on flows measured at the Grayrocks Reservoir and at the Fort Laramie Gauge. Details are provided in **Table 3.5.18** and in the italicized text below the table.

**Table 3.5.18: Minimum Release Reservoir in the Lower Laramie Subbasin**

| Structure | Owner | Minimum Release | Regulation |
|---|---|---|---|
| Grayrocks Dam | Basin Electric Power Cooperative | See notes below | 1978 Agreement of Settlement and Compromise and the Modified North Platte Decree |
| Source: 1978 Agreement of Settlement and Compromise and the Modified North Platte Decree. | | | |

*The operation of the Grayrocks is complicated. Natural flow is measured at the gage above the Reservoir. Senior rights downstream of the Reservoir total 24.69 cfs. Minimum release flows are dependent on storage at the Reservoir and time of year and are measured at the gage below Grayrocks (Below GR) and at the Ft. Laramie Gauge (FLG)*

*When storage is at least 50,000 AF:*

*October 1 to March 31 – 40 cfs at both GR and FLG*
*April 1 to April 30 – 50 cfs at both GR and FLG*
*May 1 – September 30 – minimum flow of whichever is greater: 40 cfs or 75% of natural flow at the gage above Grayrocks Reservoir, after all rights have been filled except the Grayrocks Reservoir storage right and the direct flow right for the Laramie River Station power plant; release rates are not to exceed 200 cubic feet per second – at both GR and FLG*

*When storage is at below 50,000 AF:*

*No minimum releases at GR*
*October 1 to March 31 – 20 cfs at FLG*
*April 1 to April 30 – 40 cfs at FLG*

### Classification of Recreational and Environmental Water Uses in the Lower Laramie Subbasin

As described in Section 3.5.3, an analysis of recreational and environmental water uses was performed utilizing GIS data and maps in order to categorize those uses. **Table 3.5.19** provides a listing or recreational and environmental sites within the subbasin.

### Categorization of Recreational and Environmental Water Uses in the Lower Laramie Subbasin

Fishing in the subbasin is excellent as evidenced by the number of red and yellow ribbon streams and one blue ribbon stream. The lone blue-ribbon stream is at the end of a long stretch of red ribbon through the Laramie Mountains. Although there are no traditional diversions downstream that would seem to protect these uses, their high mountain location makes it unlikely that they will be disturbed and are therefore recognized as protected. Just to the east is another red ribbon segment that is complementary to large, senior diversions at its end point. The red ribbon segments in the northern area of the subbasin appear to exist by virtue of their location and should be considered protected. This is also true of the yellow ribbon streams in the Laramie Mountains. The yellow ribbon streams in the eastern part of the subbasin however, lack the same level of protection. There are several yellow ribbon streams in the Chugwater area that are likely subject to frequent low flows under existing conditions. These streams should be considered competing.

**Table 3.5.19: Recreational and Environmental Water Uses within the Lower Laramie Subbasin**

| **Recreation Sites** | |
|---|---|
| Fishing Access | 3 |
| Whitewater Rafting | 2 |
| Trout Streams | |
| *Blue* | 1 |
| *Red* | 6 |
| *Yellow* | Numerous |
| Campgrounds | 6 |
| Natural Landmarks | 0 |
| Scenic Highways and Byways | 0 |
| National Historic and Scenic Trails | 0 |
| **Environmental Uses** | |
| Wilderness/Roadless Areas | Yes |
| US Forest Service Lands | Yes |
| Instream Flow Segments | 0 |
| Crucial Stream Corridors | 0 |
| Aquatic Crucial Priority Areas | 1 |
| Wetland Area | Yes |
| Source: GIS sources are provided in 3.5.3. | |

The fishing location at Grayrocks Reservoir is protected due to its location. A second fishing access point west of Grayrocks on the Laramie River is complementary to two large downstream diversions and minimum flow requirements at Grayrocks. A third fishing access location is at the Wheatland Reservoir #1, which has storage rights and should be considered protected.

There are two whitewater rafting segments within the subbasin. The first begins at the western border on the Laramie River, high in the Laramie Mountain Range. A very large, senior diversion complements the early reach of this rafting segment. As the river crosses into Platte County, it is part of the aquatic enhancement area discussed above. In addition to large, senior downstream diversions, the mountainous location of this stretch provides protection for this stretch of the river. Directly south of this segment is the second whitewater area. This stretch comes out of the mountains, which is the source of this segment's protection as there are no large diverters downstream. These rafting segments are all classified as protected due to location, but in some cases, are further enhanced by complementary, large downstream diversions.

The aquatic enhancement area along the Laramie River does not receive explicit protection due to this status. However, it is likely that projects will be undertaken to maintain or improve this stretch of the River. Its proximity to Grayrocks Reservoir also provides some level of protection due to the required minimum release flows.

**Table 3.5.20** provides a summary of the classified uses in the subbasin.

**Table 3.5.20: Categorization of E&R Uses in the Lower Laramie Subbasin**

| Status | Location and Uses |
|---|---|
| Protected | All red, yellow and the single ribbon segments high in the Laramie Mountains, whitewater rafting segments, fishing access points at Grayrocks Reservoir and Wheatland Reservoir #1 |
| Complementary | Fishing access point west of Grayrocks on the Laramie River |
| Competing | Yellow ribbon streams in the Chugwater area |

Maps of these resources are provided in **Figure 3.5.12 and 3.5.13**.

### Horse Creek Subbasin

This subbasin is sparsely populated with two small incorporated towns, Yoder and LaGrange. The area of the subbasin is predominately in Goshen and Laramie Counties, with small areas in Platte and Albany Counties. Fishing is the primary recreational activity here. There are several creeks that offer fishing opportunities and a variety of recreational activities are available at Hawk Springs Reservoir and State Park. There are no significant environmental water uses in this subbasin. As of 2012, there were about 41,700 irrigated acres in the subbasin, down from 61,500 in 2006, for a reduction in irrigated acres of 32%. The elevation of this subbasin ranges from about 4,000 to 8,000, much of it the lower range.

### Major Recreational Opportunities in the Horse Creek Subbasin

**Hawk Springs Reservoir and State Park.** Hawk Springs Reservoir is located approximately 20 miles south of Torrington in Goshen County. The site was named a state recreation area in 1987. The dam was originally constructed in 1925 and modified in 1985. The adjudicated storage capacity of the reservoir is 16,735 acre-feet of water (WWDC - Hawk Springs, 2013). The Horse Creek Conservation District owns the reservoir and surrounding area. The Wyoming Department of State Parks and Cultural Resources manages and maintains the recreational area around the reservoir while the WGF regulates recreational use of the water and stocks the reservoir with fish. Walleye, largemouth bass, brown trout, yellow perch, largemouth and smallmouth bass, and channel catfish are found in the reservoir. Hawk Springs State Park includes a blue heron rookery, home to blue-winged and green-winged teal, gadwall, pintail wood duck and great horned owls. Amenities at the park include a beach, boat ramp, playground, picnic area and campsites.

State Park visitor data are shown in **Table 3.5.21**.

**Table 3.5.21: State Park Visitor Days, Five Year Average and 2014**

| State Park | Five Year Average (2009-2013) | 2014 |
|---|---|---|
| **Hawk Springs** | 17,704 | 20,692 |
| **Total** | | **20,692** |
| Source: Wyoming Division of State Parks, Historic Sites and Trails, Department of State Parks & Cultural Resources, *Visitor Use Program, 2014*. | | |

**Fishing.** Opportunities for fishing are limited in this subbasin, but there are some creek locations that provide prospects for fishermen. Angler days for the subbasin are shown in **Table 3.5.22**.

**Table 3.5.22: Angler Days for the Horse Creek Subbasin**

| Horse Creek Subbasin | Angler Days/Year |
|---|---|
| Horse, Bear, Cherry and Deer Creeks | 3,663 |
| Hawk Springs Reservoir | 1,536 |
| **Total** | **5,199** |
| **Note:** Some of these data have not been updated in several years, but these are the latest available figures. Source: Mike Snigg, Laramie Regional Fisheries Supervisor, WGFD, January 2015. | |

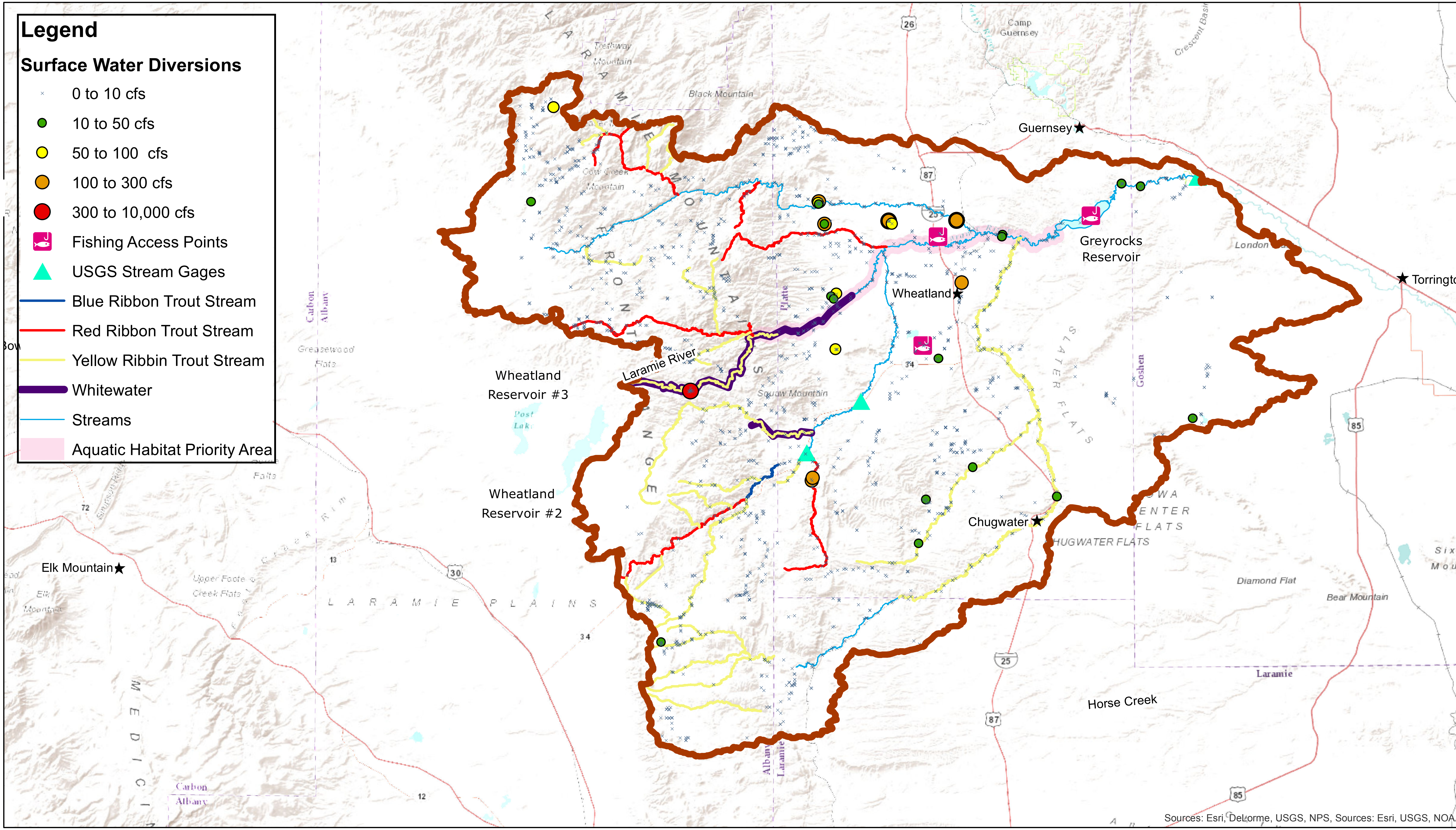


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Figure 3.5.12 Surface Water Uses - Lower Laramie

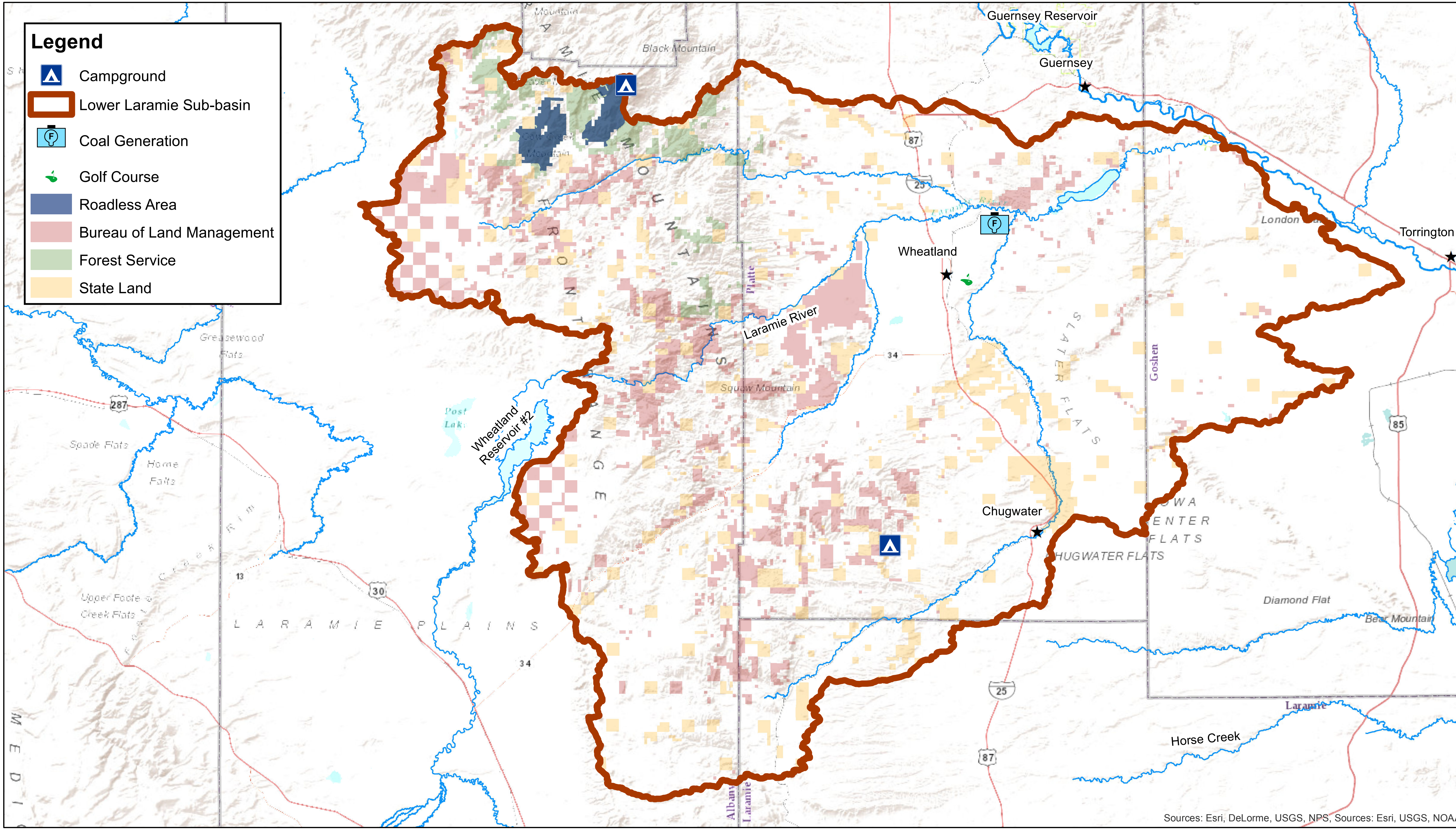


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**Figure 3.5.13 Land Use - Lower Laramie**

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### Notable Environmental Factors

There are no notable environmental areas within this subbasin.

### Classification of Recreational and Environmental Water Uses in the Horse Creek Subbasin

As described in Section 3.5.3, an analysis of recreational and environmental water uses was performed utilizing GIS data and maps in order to categorize those uses. **Table 3.5.23** provides a listing or recreational and environmental sites within the subbasin.

### Categorization of Recreational and Environmental Water Uses in Horse Creek Subbasin

Recreational and environmental water uses within this subbasin are minimal. The fishing location at Hawk Springs Reservoir is considered protected. The yellow ribbon stream segment in the western part of the subbasin is at a high elevation and likely protected by its location. The other two yellow ribbon segments north and south of Horse Creek eventually come together and flow into Hawk Springs Reservoir, which has storage rights. However, those rights are junior to other upstream diverters and these stream segments are over-appropriated. Thus, these segments are classified as competing. The fishing location at Packer Lake near the state line is classified as competing. This lake is rarely accruing water due to low flows and upstream diversions. **Table 3.5.24** provides a summary of the classified uses in the subbasin.

**Table 3.5.23: Recreational and Environmental Water Uses within the Horse Creek Subbasin**

| **Recreation Sites** | |
|---|---|
| Fishing Access | 2 |
| Whitewater Rafting | 1 |
| Trout Streams | |
| *Blue* | 0 |
| *Red* | 0 |
| *Yellow* | 3 |
| Campgrounds | 1 |
| Scenic Highways and Byways | 0 |
| National Historic and Scenic Trails | 0 |
| **Environmental Uses** | |
| Wilderness/Roadless Areas | 0 |
| US Forest Service Lands | 0 |
| Instream Flow Segments | 0 |
| Crucial Stream Corridors | 0 |
| Aquatic Crucial Priority Areas | 0 |
| Wetland Area | Yes |
| Source: GIS sources are provided in 3.5.3. | |

**Table 3.5.24: Categorization of E&R Uses in the Horse Creek Subbasin**

| Status | Location and Uses |
|---|---|
| Protected | Fishing access point at Hawk Springs Reservoir, yellow ribbon segment at high elevations |
| Complementary | NA |
| Competing | Yellow ribbon segments flowing to Hawk Springs Reservoir, fishing access point at Packer Lake |

Maps of these resources are provided in **Figures 3.5.14 and 3.5.15.**

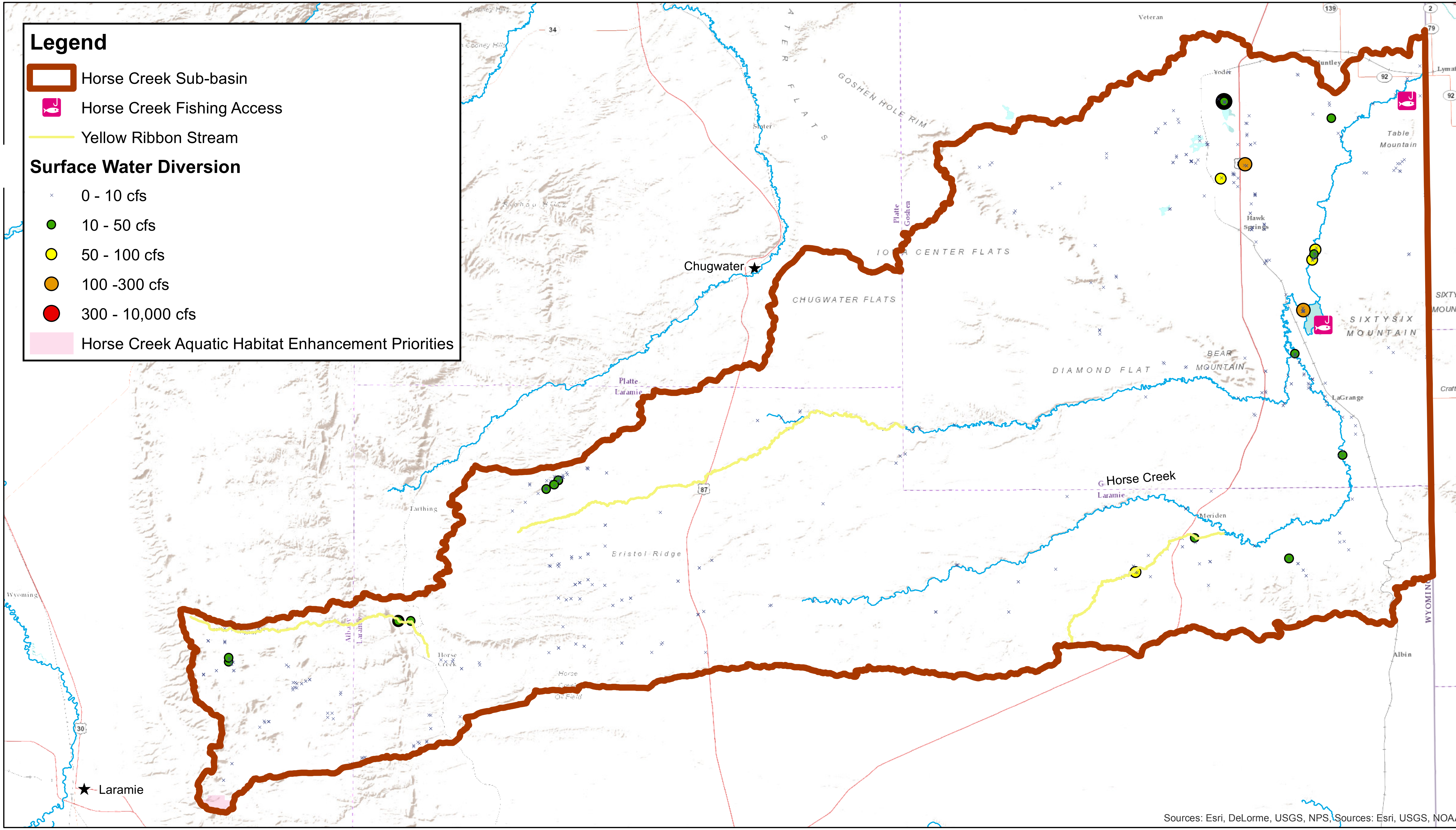


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**Figure 3.5.14 Surface Water Uses - Horse Creek**

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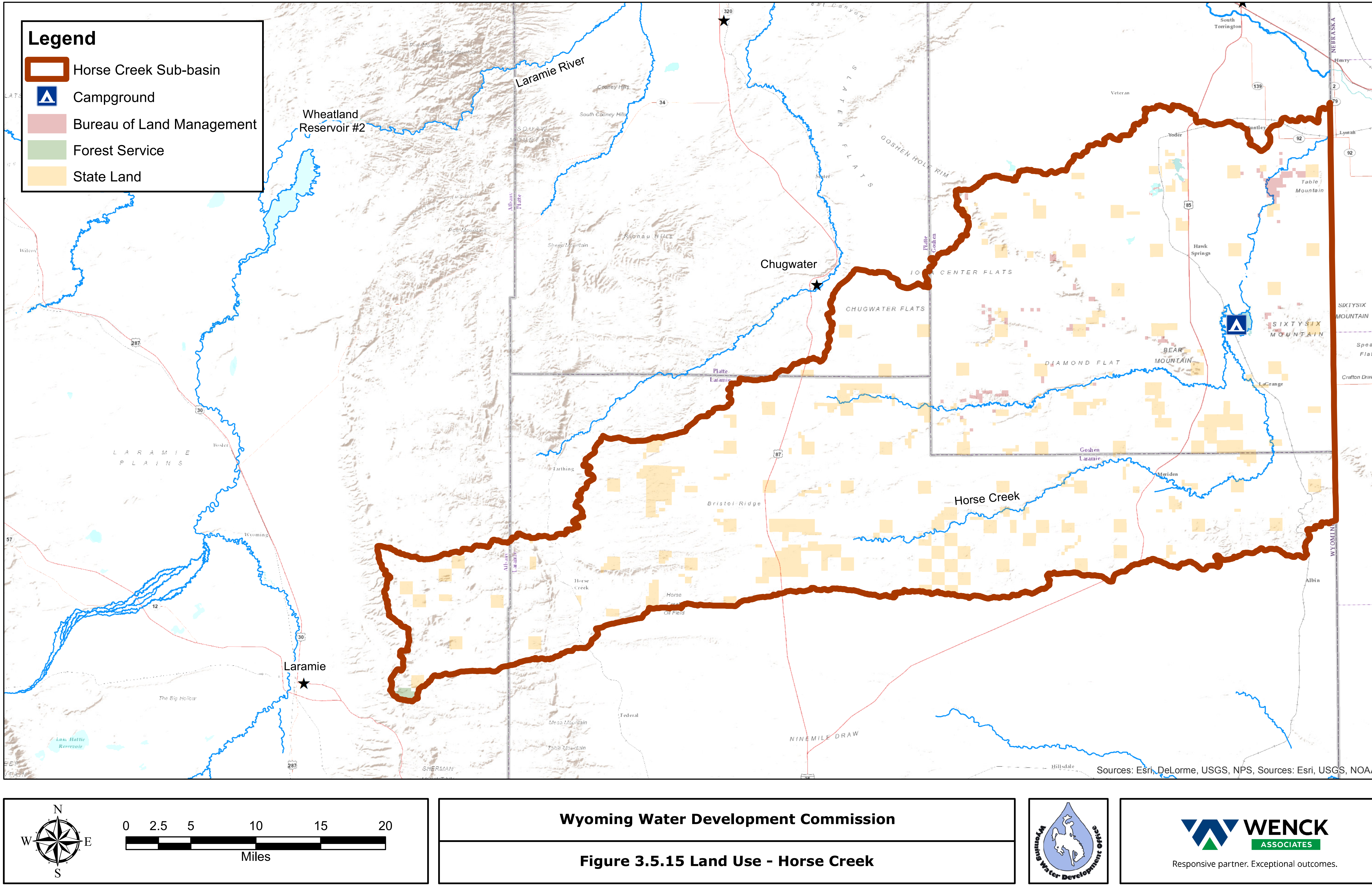


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**Figure 3.5.15 Land Use - Horse Creek**

### South Platte Subbasin

This subbasin is home to Cheyenne, the state capital and most populous city in Wyoming. The western area of the subbasin provides the most recreational opportunities, with its many streams flowing out of the Medicine Bow National Forest. In general, irrigated agriculture is located in the plains of the eastern part of the subbasin. As of 2012, there were about 43,300 irrigated acres in the subbasin, down over 5% since 2006. The elevation of this subbasin ranges from about 4,500 to 8,000 feet.

### Major Recreational Opportunities in the South Platte Subbasin

**Curt Gowdy State Park**. Curt Gowdy State Park is located 24 miles west of Cheyenne, 23 miles east of Laramie, and 12 miles north of the Colorado border. The park was established in 1971 through a lease with the City of Cheyenne and the Cheyenne Boy Scouts. The Wyoming State Parks and Cultural Resources Department administers the park. Crystal and Granite Reservoirs are located within the park. Crystal Lake Dam was constructed in 1922 and modified in 1987. The adjudicated water right for Crystal Reservoir is for 4,513 acre-feet. Granite Reservoir was constructed in 1904, and the dam was modified in 1987. The adjudicated water right of Granite Reservoir is 7,367 acre-feet. Motorized boating is allowed on Crystal Reservoir but not on Granite Reservoir. Other water activities are allowed at both reservoirs. The park has over 100 developed campsites available. Hynds Lodge was built in 1922-23 and has since received a listing on the National Register for historical sites. Hynds Lodge is managed by the Wyoming Department of State Parks. State Park visitor data are shown in **Table 3.5.25**.

**Table 3.5.25: State Park Visitor Days, Five Year Average and 2014**

| State Park | Five Year Average (2009-2013) | 2014 |
|---|---|---|
| Curt Gowdy | 116,931 | 149,756 |
| **Total** | | **149,756** |
| Source: Wyoming Division of State Parks, Historic Sites and Trails, Department of State Parks & Cultural Resources, *Visitor Use Program, 2014*. | | |

**Fishing.** Although there are only three fishing access points in the subbasin, there are a relatively large number of angler days. This is likely due to the proximity of locations to Cheyenne and larger population centers in Colorado. Angler days for the subbasin are shown in **Table 3.5.26**.

**Table 3.5.26: Angler Days for the South Platte Subbasin**

| South Platte Subbasin | Angler Days/Year |
|---|---|
| Crow Creek, North Crow Creek, Granite and Crystal Reservoirs | 34,954 |
| **Total** | **34,954** |
| Source: Mike Snigg, Laramie Regional Fisheries Supervisor, WGFD, January 2015. | |

### Notable Environmental Factors

**Aquatic Crucial Areas.** There are two crucial aquatic areas in the subbasin. Although there are no explicit legal protections associated with this designation, these areas have been identified as important to habitat. The Pole Mountain Watersheds in the western part of the subbasin are located on Medicine Bow National Forest lands. They received this designation due to the importance of the headwater streams that feed the streams in the Eastern Plains of Wyoming. The primary species within the area are the northern leopard frog, boreal chorus frog, beaver and brook trout. Potential remedial actions include grazing management, aspen restoration, management of beaver population and control of invasive plants (WGF – Pole Mountain, 2014).

In the central and eastern area of the subbasin, the Lower Lodgepole and Muddy Creeks received this designation due to high density of native fishes including, bigmouth shiner, common shiner, Iowa darter, orangethroat darter, plains topminnow and central stoneroller and others. The goal is to seek opportunities for conservation easements and to reduce impediments to habitat (WGF – Lower Lodgepole and Muddy Creeks, 2014).

#### Classification of Recreational and Environmental Water Uses in the South Platte Subbasin

As described in Section 3.5.3, an analysis of recreational and environmental water uses was performed utilizing GIS data and maps in order to categorize those uses. **Table 3.5.27** provides a listing or recreational and environmental sites within the subbasin.

#### Categorization of Recreational and Environmental Water Uses in the South Platte Subbasin

The major recreational activity in this subbasin is fishing. Two of the three fishing access areas are at the Crystal and Granite Reservoirs and as such have adjudicated water rights associated with them and are protected uses. The third location is within the Medicine Bow National Forest which provides a protected status to this location.

**Table 3.5.27: Recreational and Environmental Water Uses within the South Platte Subbasin**

| **Recreation Sites** | |
|---|---|
| Fishing Access | 3 |
| Whitewater Rafting | 1 |
| Trout Streams | |
| *Blue* | 0 |
| *Red* | 2 |
| *Yellow* | Numerous |
| Campgrounds | 10 |
| Natural Landmarks | 1 |
| Scenic Highways and Byways | 0 |
| National Historic and Scenic Trails | 0 |
| **Environmental Uses** | |
| Wilderness/Roadless Areas | 0 |
| US Forest Service Lands | Yes |
| Instream Flow Segments | 0 |
| Crucial Stream Corridors | 0 |
| Aquatic Crucial Priority Areas | 3 |
| Wetland Area | Yes |
| Source: GIS sources are provided in 3.5.3. | |

There are two red ribbon streams in the subbasin, the first is Middle Crow Creek flowing through Curt Gowdy State Park, through the two reservoirs. The 1-mile segment of this stream that is between the two reservoirs should be considered protected due to the water rights associated with Crystal, the downstream reservoir. Downstream of Crystal, this segment becomes a complementary use to the numerous small traditional diversions. Before reaching Cheyenne, the stream becomes a yellow-ribbon stream. This segment is complementary to several large and numerous small downstream diversions. A second red ribbon stream, in the southern part of the subbasin, is complementary to many small diversions and one very large downstream diversion and is categorized as complementary.

There are numerous yellow ribbon streams in the Medicine Bow National Forest whose location, both in the national forest and at high elevations, makes future disturbance of these uses unlikely and they should be considered protected. All other yellow ribbon segments in the subbasin lack sufficient protection from traditional uses and should be considered competing.

There is one whitewater rafting segment on Middle Crow Creek, the red ribbon stream between Granite and Crystal Reservoirs. This 1 mile stretch is complementary to the two reservoirs which store water for Cheyenne, and thus provide protection to the stream.

**Table 3.5.28** provides a summary of the classified uses in the subbasin.

**Table 3.5.28: Categorization of E&R Uses in the South Platte Subbasin**

| Status | Location and Uses |
|---|---|
| Protected | Fishing access points, red ribbon and whitewater segment upstream of Crystal Reservoir, yellow ribbon streams in Medicine Bow National Forest |
| Complementary | Red and yellow ribbon segment downstream of Crystal Reservoir, red ribbon segment southwest of Cheyenne |
| Competing | Yellow ribbon segments southeast of Cheyenne |

Maps of these resources are provided **Figure 3.5.16 and Figure 3.5.17**.

### Other Topics Related to E&R Water Use

**Endangered Species.** The presence of endangered species in the Basin is related to environmental water usE&Recreational activity, but it cannot be analyzed in the same fashion as utilized in subbasin analyses above. In addition, the data are only available at the county level. Therefore, **Table 3.5.29** provides threatened and endangered species by county, but the data are not included in the maps.

**Table 3.5.29: Endangered, Threatened, CandidatE&Recovering Species in the Platte Basin, by County**

| | County | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Species** | **Albany** | **Carbon** | **Converse** | **Fremont** | **Goshen** | **Laramie** | **Natrona** | **Niobrara** | **Platte** |
| **Endangered** | | | | | | | | | |
| Wyoming toad | √ | | | | | | | | |
| Blowout penstemon | | √ | | | √ | | | | |
| Black-footed ferret | √ | √ | | √ | | | √ | | |
| **Threatened** | | | | | | | | | |
| Yellow-billed cuckoo | | √ | | √ | | | | | |
| Colorado butterfly plant | | | | | √ | √ | | | √ |
| Desert yellowhead | | | | √ | | | | | |
| Ute ladies'-treses | √ | √ | √ | √ | √ | √ | √ | √ | √ |
| Grizzly bear | | | | √ | | | | | |
| Canada lynx | √ | √ | | √ | | | | | |
| Preble's meadow jumping mouse | √ | | √ | | √ | √ | | | √ |
| **Candidate** | | | | | | | | | |
| Greater sage-grouse | √ | √ | √ | √ | | √ | √ | √ | √ |
| Whitebark pine | | | | √ | | | | | |
| Fremont County rockcress | | | | √ | | | | | |
| **Recovery** | | | | | | | | | |
| Bald eagle | √ | √ | √ | √ | √ | √ | √ | √ | √ |
| Gray wolf | √ | √ | √ | √ | √ | √ | √ | √ | √ |
| Source: USFS, http://www.ws.gov/endangered/ | | | | | | | | | |

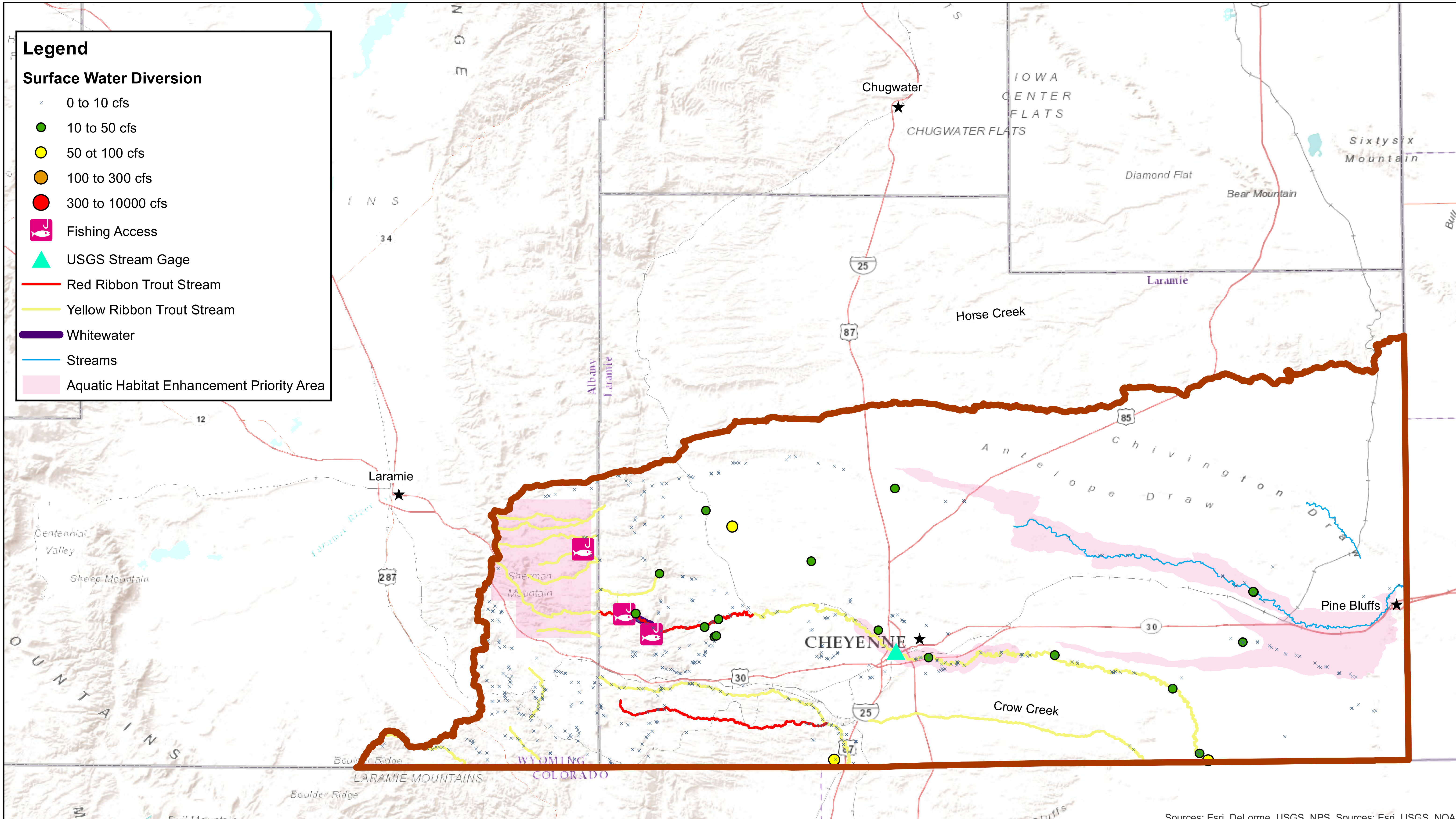


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**Figure 3.5.16 Surface Water Uses - South Platte**

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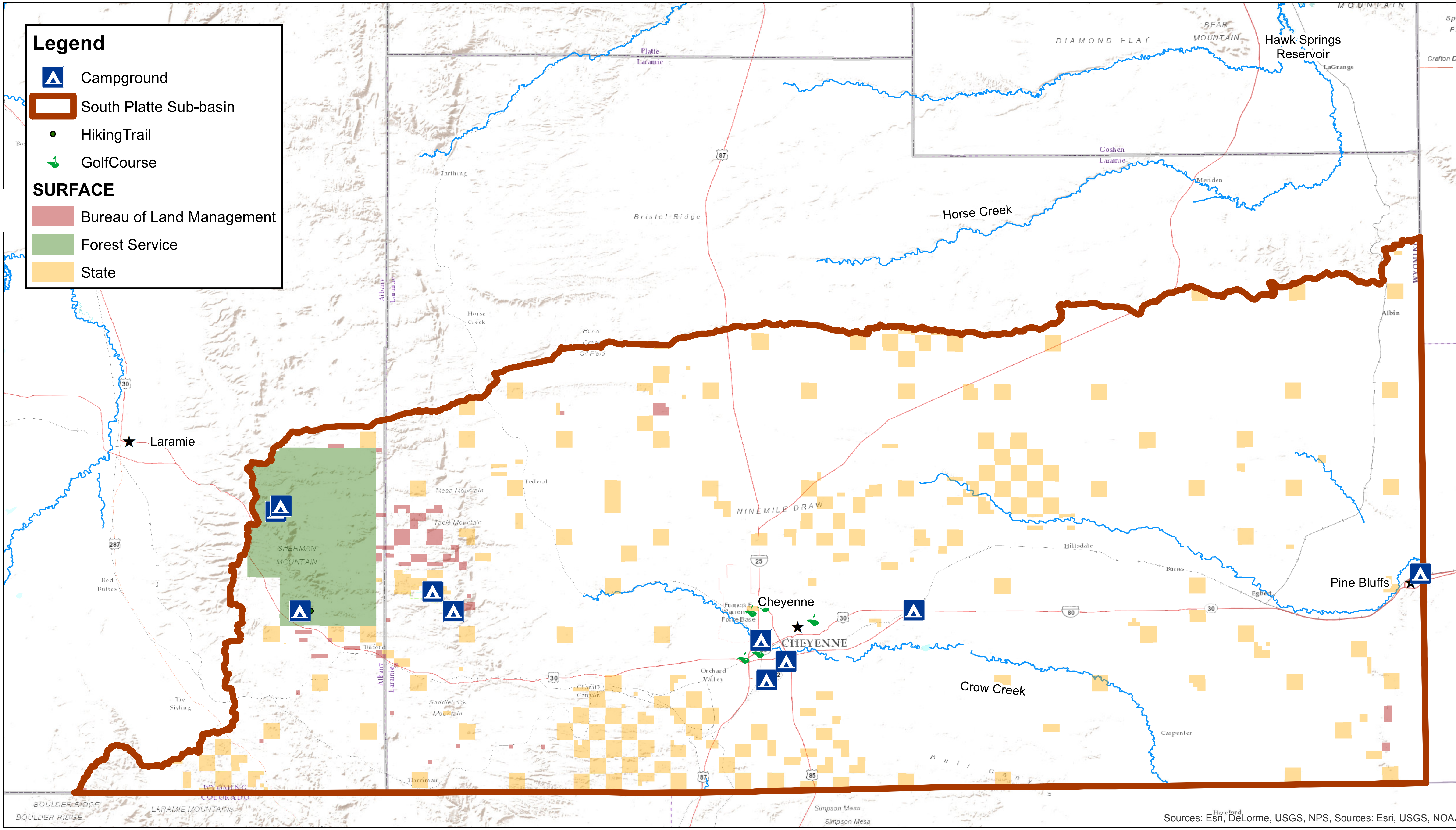




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**Figure 3.5.17 Land Use - South Platte**

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**Instream Flows.** Instream flows represent a permitted and thus protected water environmental water use. There are 13 instream flow segments in the Basin that have been permitted by the Wyoming State Engineer's Office totaling almost 90 miles. All have been permitted since 2007 and there are no current applications for new permits. Each of the permitted stream segments has been displayed on the appropriate subbasin water use map. SEO instream flow permits are shown in **Table 3.5.30**.

**Table 3.5.30: SEO Permitted Instream Flows within the Platte Basin**

| Permit No. | Stream Segment | Priority Date | Stream Length (mi) | CFS (min-max) | Water Division / District |
|---|---|---|---|---|---|
| 88 IF | S Fork Grand Encampment River | 10/08/93 | 13.60 | 54 | 1/7 |
| P29608D | Carlin Springs | 03/11/91 | 0.25 | 1.31 | 1/9 |
| 84 IF | Wagonhound Creek | 03/11/91 | 8.50 | 1.2-545 | 1/9 |
| 103 IF | Rock Creek IF | 03/11/91 | 3.9 | 13-60 | 1/9 |
| 87 IF | Sweetwater River | 06/21/91 | 10.20 | 16-80 | 1/12 |
| 86 IF | Deer Creek | 06/21/91 | 5.00 | 10-30 | 1/15-5 |
| 66 IF | North Platte River | 06/21/91 | 16.00 | 163* | 1/17 |
| 67 IF | Lake Creek | 06/21/91 | 5.80 | 0.5 | 1/17 |
| 61 IF | Horse Creek | 06/21/91 | 0.10 | 0.2 | 1/17 |
| 62 IF | Nugget Gulch Branch | 06/21/91 | 0.10 | 0.2* | 1/17 |
| 63 IF | Beaver Creek | 12/31/91 | 1.90 | 0.35* | 1/17 |
| 64 IF | Camp Creek | 01/05/93 | 1.20 | 0.2* | 1/17 |
| 65 IF | Douglas Creek | 01/21/93 | 22.30 | 5.5 | 1/17 |
| Source: Wyoming State Engineer's Office, 2015 | | | | | |

USFS Lands also have stream segments for which minimum and peak flows have been established. Many of these are important to both recreational and environmental activities. Additional information regarding Priority Watersheds and Streams in the Medicine Bow National Forest can be found in Appendix One of the Revised Land and Resource Management Plan. **Table 3.5.31** provides flow data for the USFS bypass flow points in the Basin.

**Table 3.5.31: USFS Permitted Bypass Flow Points in the Platte Basin**

| Stream | Minimum Flow (cfs) | Peak Flows (cfs) | Bypass Point |
|---|---|---|---|
| **Above Pathfinder Subbasin** | | | |
| Nugget Gulch Creek | 020 | 3-5 days natural peak discharge | T14N R79W Sec 14 |
| Little Beaver Creek | 0.35 | 7 | T14N R79W Sec 14 |
| Camp Creek | 0.20 | 2 | T14N R79W Sec 13 |
| Horse Creek | 0.20 | NA | T14N R79W Sec 16 |
| Douglas Creek | 5.50 | 130 | T14N R79W Sec 9 |
| Hog Park Creek | 15.00 | 5 days natural peak discharge | T12N R84W Sec 5 |
| Deep Creek, below Sand Lake | 0.80 | NA | T17N R79W Sec 9 |
| **South Platte Subbasin** | | | |
| Bamford Creek/South Fork of Middle Crow Creek | NA | 1.5 (maximum release permitted) | T14N R71W Sec 27 |
| Source: Mr. David Gloss, Hydrologist, Medicine Bow/Routt National Forests, Saratoga, WY, October 2015. | | | |

**Waterfowl Hunting.** Waterfowl hunting is an important recreational activity in the Platte Basin that is dependent on available water supplies. Wetland areas, lakes, streams and other water bodies provide the necessary habitat to support waterfowl, but the benefits of water to hunting are ancillary and cannot be accounted in this analysis. Despite this, it is important to recognize that changes to water availability would have an impact on hunting, which is an important economic contributor, especially on the eastern plains. Waterfowl management areas 1C, 2A, 2B, 3A and 4D are within the Platte Basin. **Table 3.5.32** provides data on hunters, harvest and hunter days for waterfowl hunting.

**Table 3.5.32: 2013 Duck and Geese Harvest Estimates for the Platte Basin**

| Management Area | Hunters | | Harvest | | Days | |
|---|---|---|---|---|---|---|
| | Ducks | Geese | Ducks | Geese | Ducks | Geese |
| 1C Central North Platte River | 939 | 566 | 8,765 | 2,071 | 4,742 | 2,747 |
| 2A Lower Platte River | 1,222 | 1,947 | 6,438 | 15,862 | 4,768 | 9,860 |
| 2B South Platte River | 78 | 47 | 348 | 168 | 180 | 101 |
| 3A Upper North Platte River | 401 | 154 | 2,536 | 377 | 1,901 | 945 |
| 4D Sweetwater River | 7 | 2 | 17 | 11 | 9 | 4 |
| **Total Platte Basin** | **2,647** | **2,716** | **18,104** | **18,489** | **11,600** | **13,657** |
| **Total Wyoming** | **6,483** | **5,744** | **53,296** | **30,861** | **30,386** | **26,125** |
| Percent in Basin | 41 | 47 | 34 | 60 | 38 | 52 |
| Source: WGFD. Annual Report of Small Game, Upland Game, Waterfowl, Furbearer, Wild Turkey & Falconry Harvey, 2013, July 2014. | | | | | | |

As **Table 3.5.32** demonstrates, a large percentage of all Wyoming waterfowl hunting occurs in the Platte Basin, especially in the Lower Platte River Management Area, which encompasses Platte and Goshen Counties and small parts of the surrounding counties.

**Wetlands.** The State of Wyoming has identified 49 major wetland complexes in the Wyoming Wetlands Conservation Strategy (WGF, 2010). For this work, the definition adopted by the USFWS was utilized:

> *"Wetlands are lands transitional between terrestrial and aquatic systems where the water table is usually at or near the surface or the land is covered by shallow water. For purposes of this classification wetlands must have one or more of the following three attributes: (1) at least periodically, the land supports predominantly hydrophytes; (2) the substrate is predominantly undrained hydric soil; and (3) the substrate is non-soil and is saturated with water or covered by shallow water at some time during the growing season each year"* (Cowardin, 1979).

Wetlands provide wildlife habitat and the associated riparian areas provide other benefits such as flood attenuation, aquifer recharge and discharge, sediment filtering, contaminant removal, erosion control, and biomass export. Grazing, stream regulation and other human actions can cause harm to wetlands and riparian areas. As shown in **Figure 3.5.17**, there are many wetland areas in the Basin. Some of these may be temporary in nature, as a result of flood irrigation or other seasonal influences. Major wetland complexes within the Platte Basin are discussed in the appropriate subbasin sections. A map of wetlands within the Basin is presented in **Figure 3.5.17**. A map of irrigated acres within the Basin is provided in **Figure 3.5.18**.

### 3.5.6 Summary and Conclusions

This examination of E&R uses in the Platte Basin has resulted in the identification of each E&R use by respective subbasin, along with the categorization of those uses into protected, complementary, and competing categories. There are numerous and excellent water-based recreational opportunities in most subbasins, primarily flat water or stream fishing. There

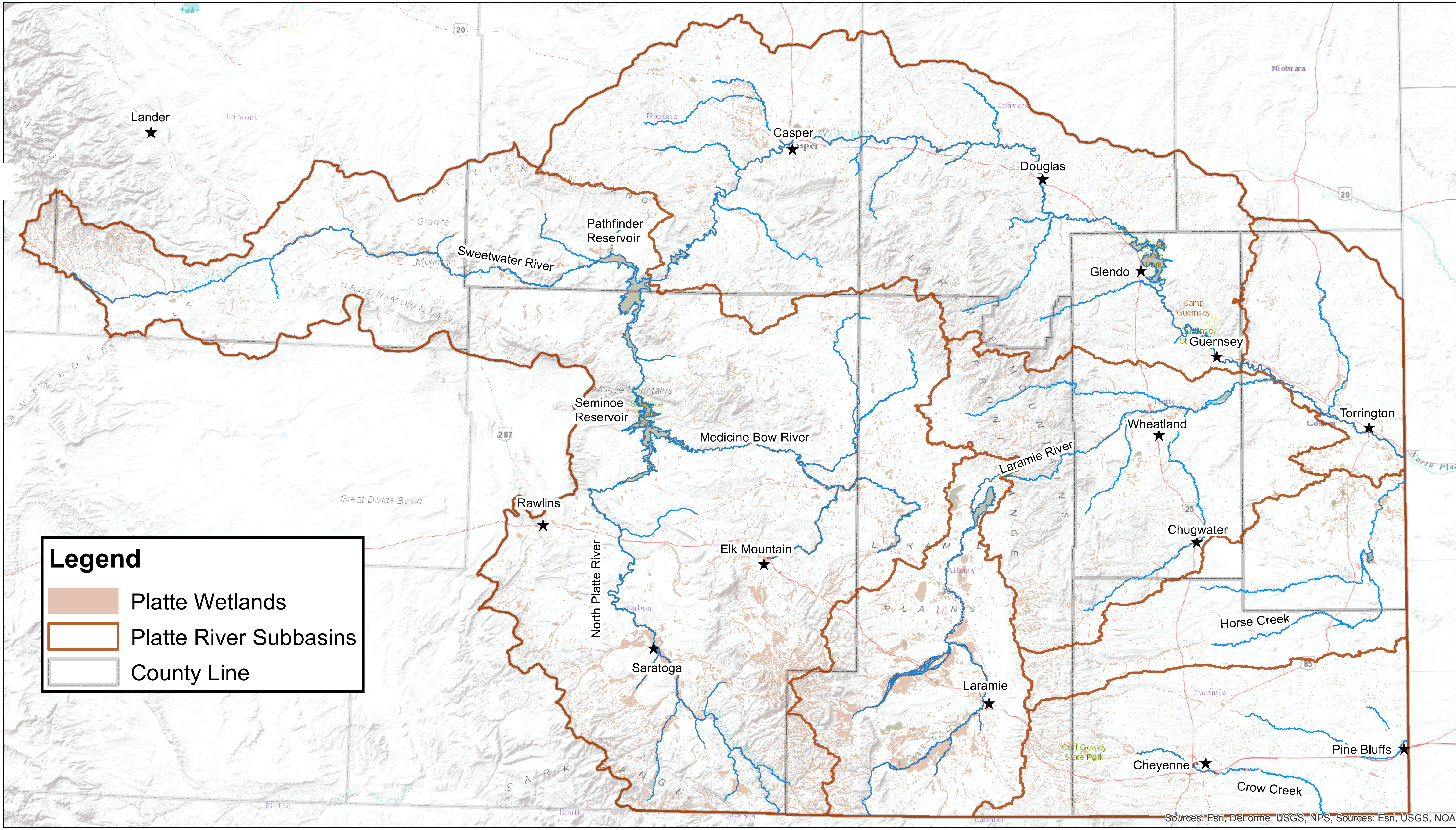


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**Figure 3.5.18 Wetland Areas**

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are also extensive environmental water uses, including wetland areas, crucial habitat areas and in-stream flows. Overall, almost all of the E&R uses in the Basin have been determined to be protected or complementary. Of those that are competing, most are likely already unavailable in many years due to over-appropriation of Basin water resources.

The maps and analysis provided in this section demonstrate the relative importance of E&R water use in each of the subbasins. There is a large variation in activity levels, which is generally determined by the natural landscape. Land use, especially Federal ownership, is a dominant factor in a number of subbasins. Topography related to high elevation also provides protection to some E & R uses. The interdependence between traditional consumptive water uses, such as irrigated agriculture, and E&R uses has also been demonstrated.

Unfortunately, we were unable to quantify the water amount which would fall into the three categories because of a lack of stream gauge or similar data on the tributaries in the subbasins. We do not know the water volumes associated with traditional uses or how they have changed since the original Platte Basin Plan. Ideally, in this part of the analysis, the mapping of E&R water use would be translated into a number, expressed in acre-feet, which would demonstrate how much of the Basin's water resources contribute to these important sectors. After that determination, the acre-feet that were attributed to competing uses would be subtracted from the total to establish current E&R water demand as prescribed in the Handbook methodology. Unfortunately, flow data for the Basin is very incomplete and thus such a calculation has not been possible.

The WWDC might consider future funding to gather these data. More geographically comprehensive flow data and changes in that data over time could represent a material improvement to water planning in Wyoming.

### 3.5.7 References


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## 3.6 WATER USE FROM STORAGE

### 3.6.1 Introduction

The objective of this section is to evaluate potential storage possibilities in irrigation reservoirs located in the Basin above Pathfinder Reservoir exclusive of Kendrick Project and Seminoe Reservoir. The previous Platte River Basin Plan (2006) identified and presented water right permit, physical and operational data on non-stock reservoirs greater than 50 acre-feet located within the entire basin. This plan presents any updated information on these reservoirs and includes information on any new reservoirs permitted or constructed since the original plan.

This planning effort reviews both non-structural and structural alternatives for optimizing the use of water supplies within the State of Wyoming. A non-structural alternative approach may be a more achievable undertaking because it involves optimizing the operation of the existing reservoirs and no new construction. Because private parties or irrigation districts own the irrigation reservoirs, any of the non-structural alternatives would require future coordination and monitoring efforts with the respective reservoir owners. A state agency or other state designated entity would need to be responsible for implementing one or more of the non-structural alternatives. A structural alternative to modify an existing reservoir or to build a new reservoir would be faced with environmental permitting and sponsorship funding requirements.

### 3.6.2 Overview

In accordance with an interstate decree settled in 1945, Wyoming is only able to accrue up to 18,000 acre-feet of water from the North Platte River and its tributaries above the Pathfinder Reservoir for irrigation purposes during any one year. Since the settlement of the decree, Wyoming has been required to track and report the storage accrual amounts on an annual basis. For this study, Wyoming's reported carryover, maximum storage, and accrual data from 1951 to the present was analyzed. An analysis of the maximum storage and accrual data collected since 2003 for the 11 largest irrigation reservoirs was conducted.

Based on recent Wyoming reports there are approximately 55 smaller active irrigation reservoirs with 8 in the Sweetwater drainage, 16 in the Medicine Bow drainage, and 31 within tributaries of the North Platte River in the Saratoga area. The largest reservoirs had water measurement devices installed in the last 10 years. Therefore, accurate continuous records are being collected. The combined total storage capacity of the largest reservoirs is equal to 15,930 acre-feet which represents over 55% of the estimated storage capacity of all the private irrigation reservoirs located above Pathfinder Reservoir. Since 1951 the average annual accrual amount for all these reservoirs is 12,038 acre-feet and the average carryover is 5,380 acre-feet. The average accrual amount for the 11 largest reservoirs since 2003 is 8,015 acre-feet and the average carryover is 4,167. A number of irrigation reservoirs located above Pathfinder Reservoir are inactive.

Any trends in storage accruals and carryover were evaluated. The analysis revealed reservoir owners' operational decisions to conserve water during a drought period or to maintain a minimum pool serving recreational or fishery needs are factors affecting carryover quantities.

The structural and non-structural recommendations presented in this document are based on the water storage analysis performed on the reservoirs. One non-structural recommendation is to facilitate the coordination of storage accruals amongst the reservoir owners. Coordination with reservoir owners on an annual basis would allow Wyoming to maximize storage accruals occurring in Wyoming in any one year. Another non-structural recommendation is to re-describe the reservoir water rights for the actual water right purpose that is occurring on-the-ground. The beneficial use of meeting fishery or recreational needs could be formally designated for that purpose within the reservoir storage water right. A structural alternative is to construct a new reservoir or the enlargement of an existing irrigation reservoir in the Basin Above Pathfinder Reservoir.

The implementation of one or more of the non-structural alternatives and the structural alternative provides feasible opportunities for Wyoming to maximize its annual accrual quantities for irrigation purposes on an annual basis.

### 3.6.3 Background

The focus of this section is irrigation reservoirs that fall under compliance activities of the Modified North Platte Decree. The U.S. Supreme Court handed down a 1945 Decree to Wyoming and Nebraska that contained the provision that the State of Wyoming was enjoined from storing[2] more than 18,000 acre-feet of water from the North Platte River and its tributaries above the Pathfinder Reservoir for irrigation purposes during any one year. In 1986 Nebraska filed a lawsuit in U.S. Supreme Court alleging that Wyoming had violated certain aspects of the 1945 decree. One of Nebraska's claims questioned the accuracy of the procedures Wyoming followed to collect and report water stored above Pathfinder for irrigation purposes. The U.S. Supreme Court approved the Final Settlement Stipulation and entered the Modified Decree on November 13, 2001. The storage accrual cap of 18,000 acre-feet in any one year remained unchanged in the Modified Decree.

The headwaters of the North Platte River above Pathfinder Reservoir are in north-central Colorado and south-central Wyoming and the headwaters of the Sweetwater River are in the southern tip of the Wind River Mountains. Various tributaries flow into the North Platte River fed by snowmelt and springs flowing from the two primary mountain ranges. The Snowy Range and Sierra Madre Mountains are the two ranges which receive the most snow in the watershed. The Encampment River, Medicine Bow River, and Sweetwater River are the largest tributary water sources.

The overall climate varies significantly within this region of Wyoming varying from arid to semi-arid primarily affected by changes in elevation. All of the reservoirs affected by the Decree requirement are depicted in **Figure 3.6.1.** The reported annual precipitation at Saratoga which lies within the Decree compliance area is 9.8 inches. Precipitation mainly occurs in the form of snow and rain. On average the wettest months are April and May. The majority of the precipitation occurs between April and October.

The annual precipitation in the form of rain and snow in each subbasin affects carryover and accrual within the reservoirs. The irrigated lands and reservoirs in the above Pathfinder Reservoir basin vary in elevation from about 5,800 to 8,500 feet msl. The primary crop is native hay and most ranchers only perform one harvest cutting per year. Portions of the irrigated lands are not cultivated and only serve as pasture for livestock. Most ranchers rely on flood irrigation practices although some center pivots and siderolls are present within the Saratoga area. The overall runoff and active irrigation can be relatively short for the tributary areas due to the short period of high runoff which primarily occurs in the spring and early summer months. The storage water held in the reservoirs provides for mid to late season irrigation supplies; thereby, extending the irrigation seasons for irrigated lands.

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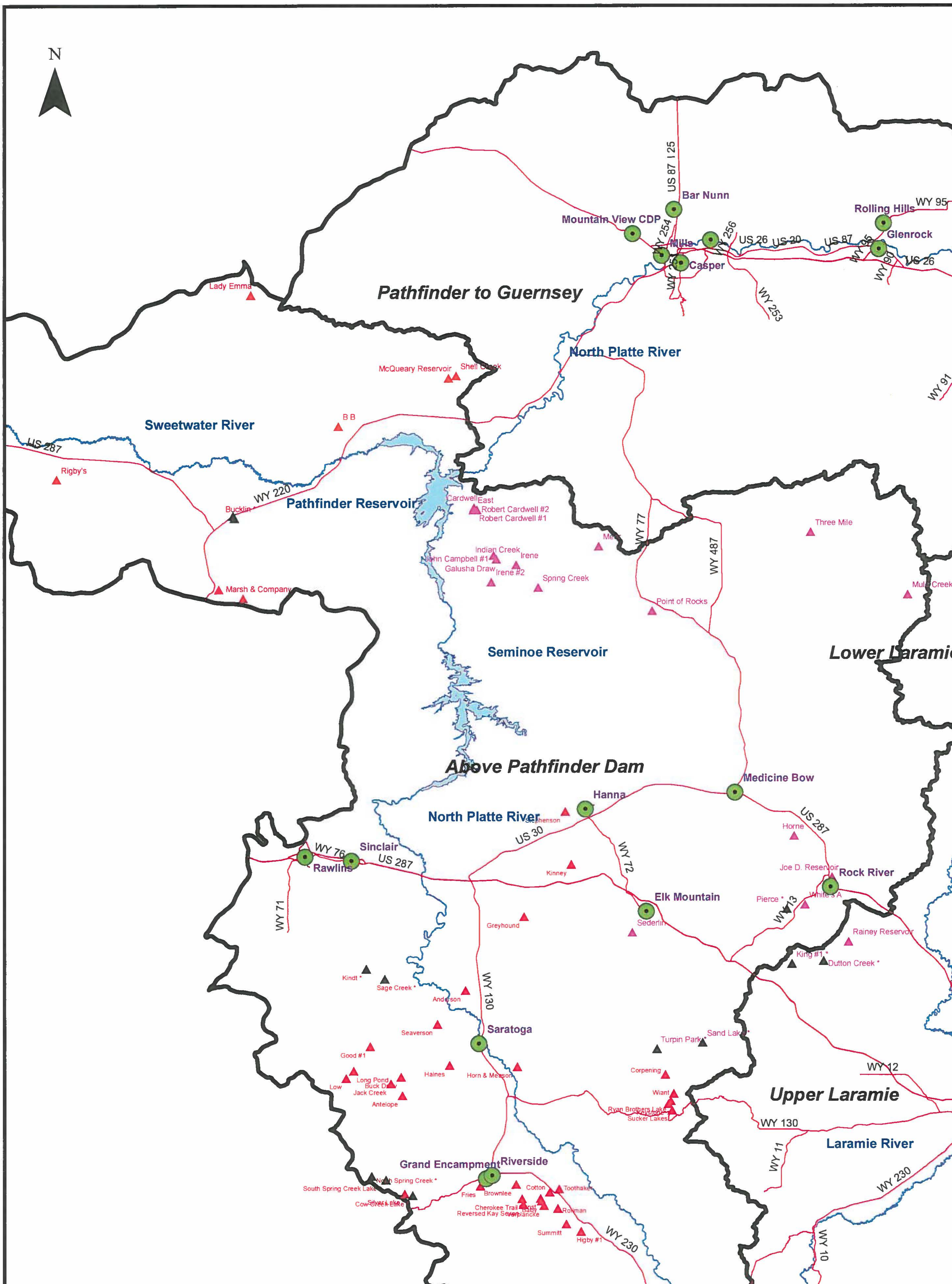
[2] The 1945 Decree reference to "storing" is actually referring to the amount of accrual in storage that is allowed in the above Pathfinder Reservoir basin each Water Year.




**Legend**

- Municipality
- Reservoirs
- Largest 11 Reservoirs
- Basin Boundaries
- WyDOT_Highways

**Figure 3.6.1 Irrigation Reservoirs above Pathfinder Reservoir**

Platte River Basin Plan Update Level 1 Study
Irrigation Reservoirs above Pathfinder Reservoir
Feb. 2016

0 5 10 20 30 40 Miles

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1720 Carey Avenue Suite 612
Cheyenne, Wyoming
307.778.9500

Surface water supplies in the North Platte River basin are considered to be fully appropriated. Any new water supplies for a new large water need are typically only available through the transfer of existing water rights, transbasin diversion, or the development of non-hydrologically connected groundwater.

The primary purpose of four federal reservoirs in the Basin is to provide agricultural water supplies to various Federal projects. Pathfinder and Guernsey Reservoirs serve the North Platte Project which was authorized by Congress in 1903. Seminoe and Alcoa Reservoirs which were completed in 1939 serve the Kendrick Project. The Glendo Unit, which includes Glendo Reservoir, is considered a multiple-purpose natural resource development that provides for up to 40,000 acre-feet of irrigation water annually to irrigation lands in Wyoming and Nebraska. The federal reservoir system is allowed flexible operations in accordance with the Modified Decree and Wyoming Water Laws. The filling and re-regulation operations allow for exchanges of ownership between the various federal reservoirs to provide for maximum capacity and to enhance operations.

The overall population is small and most of the human activities are related to hay production, ranching and livestock grazing as well as recreation. A significant amount of public lands is present in the drainage with the majority of federal lands owned by either the BLM or the USFS. The remaining lands are private and State owned lands. The private ranchers hold allotments on BLM lands and leases on State Lands for livestock grazing purposes. The BLM and others have sought to improve the management of livestock and address various environmental issues such as riparian conditions, erosion problems, wildlife/fisheries habitat, and noxious weeds. The management practices include changes to the season, duration or type of livestock use as well as herding, fencing, water development, and vegetation treatments (BLM 2005).

### 3.6.4 Irrigation Water Storage above Pathfinder Reservoir

For the overall compliance activities, Wyoming, through the SEO, is tracking and reporting storage accruals on an annual basis for 69 active reservoirs listed in **Appendix 3-C,** Table 1 and illustrated in **Figure 3.6.2**. The tracking and reporting of storage is contained within three different subbasins. Within the SEO reporting, the subbasins are referred to as Saratoga, Medicine Bow River, and Sweetwater River and illustrated within each respective subbasin in **Figures 3.6.2, 3.6.3, and 3.6.4**. The total storage accrual data is available from 1951 to the present and is contained within **Appendix 3-C,** Table 3.

In accordance with the Modified Decree requirements, Wyoming has installed measuring devices at 11 of the largest irrigation reservoirs to improve the accuracy of measuring the annual accruals in each reservoir. The Wenck Team reviewed Wyoming's water storage reporting for Decree compliance with particular emphasis on reporting since 2003 for the largest reservoirs that had new measuring equipment installed. The largest storage facilities represent the primary opportunities for maximizing the annual storage quantities.

#### Wyoming's Field Checking and Reporting

SEO field staff typically visit each reservoir two times each year. The reservoirs are field checked in late spring or early summer when storage levels are the highest and during the fall following the irrigation season when water levels are at the lowest. The fall visit occurs as close to the first of October as possible. The fall water level measurement is considered the carry-over quantity in the reservoir at the beginning of the water year. Many of the irrigation reservoirs were permitted and built within the Decree compliance area prior to the mid 1950's. The field staff refers to various maps and capacity tables to convert the water level measurements to a reservoir capacity. For the many small reservoirs, SEO field staff refers to maps and capacity tables prepared in the 1950's by J.A. Cole, Special Assistant

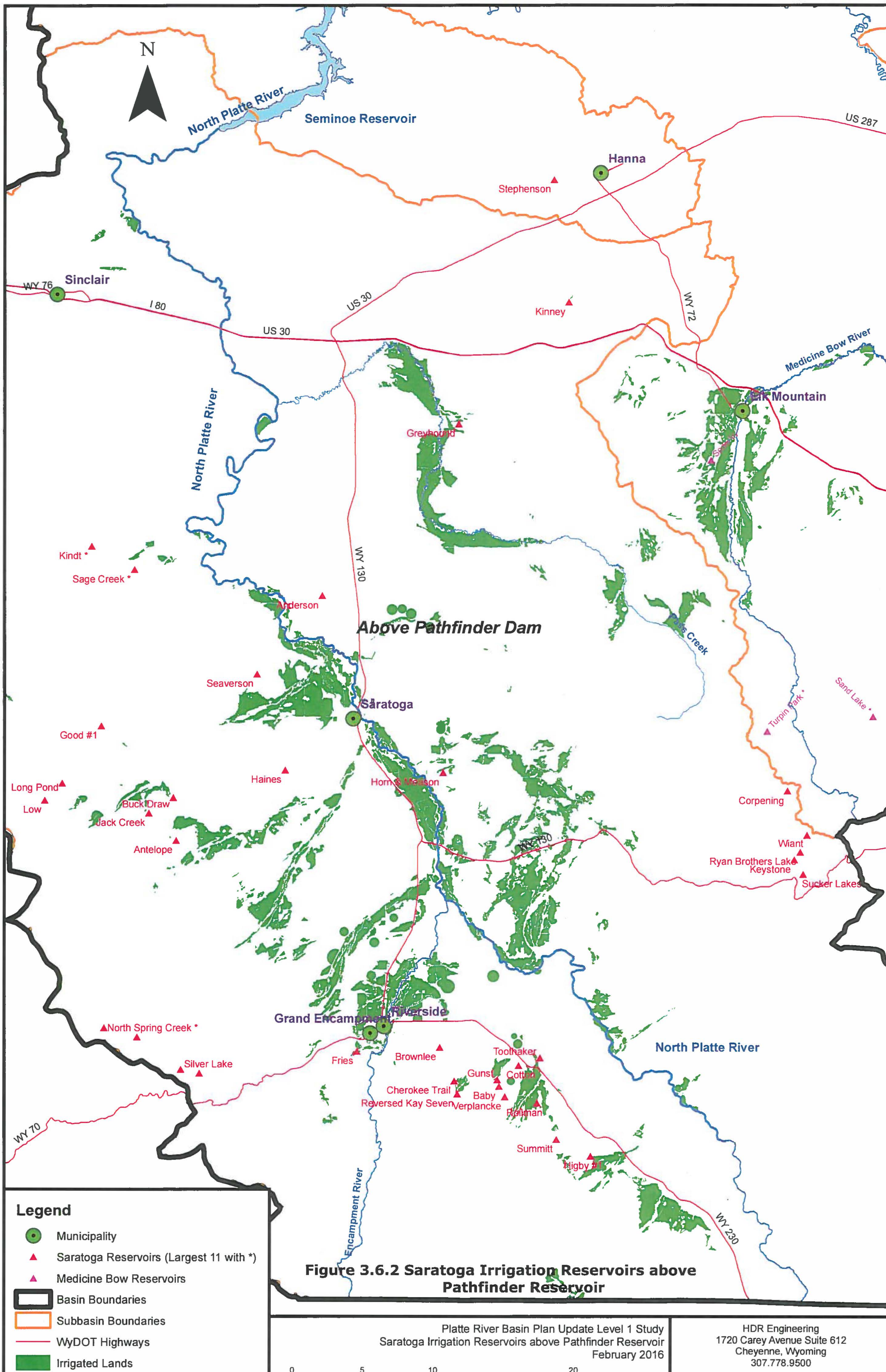


**Figure 3.6.2 Saratoga Irrigation Reservoirs above Pathfinder Reservoir**

Platte River Basin Plan Update Level 1 Study
Saratoga Irrigation Reservoirs above Pathfinder Reservoir
February 2016

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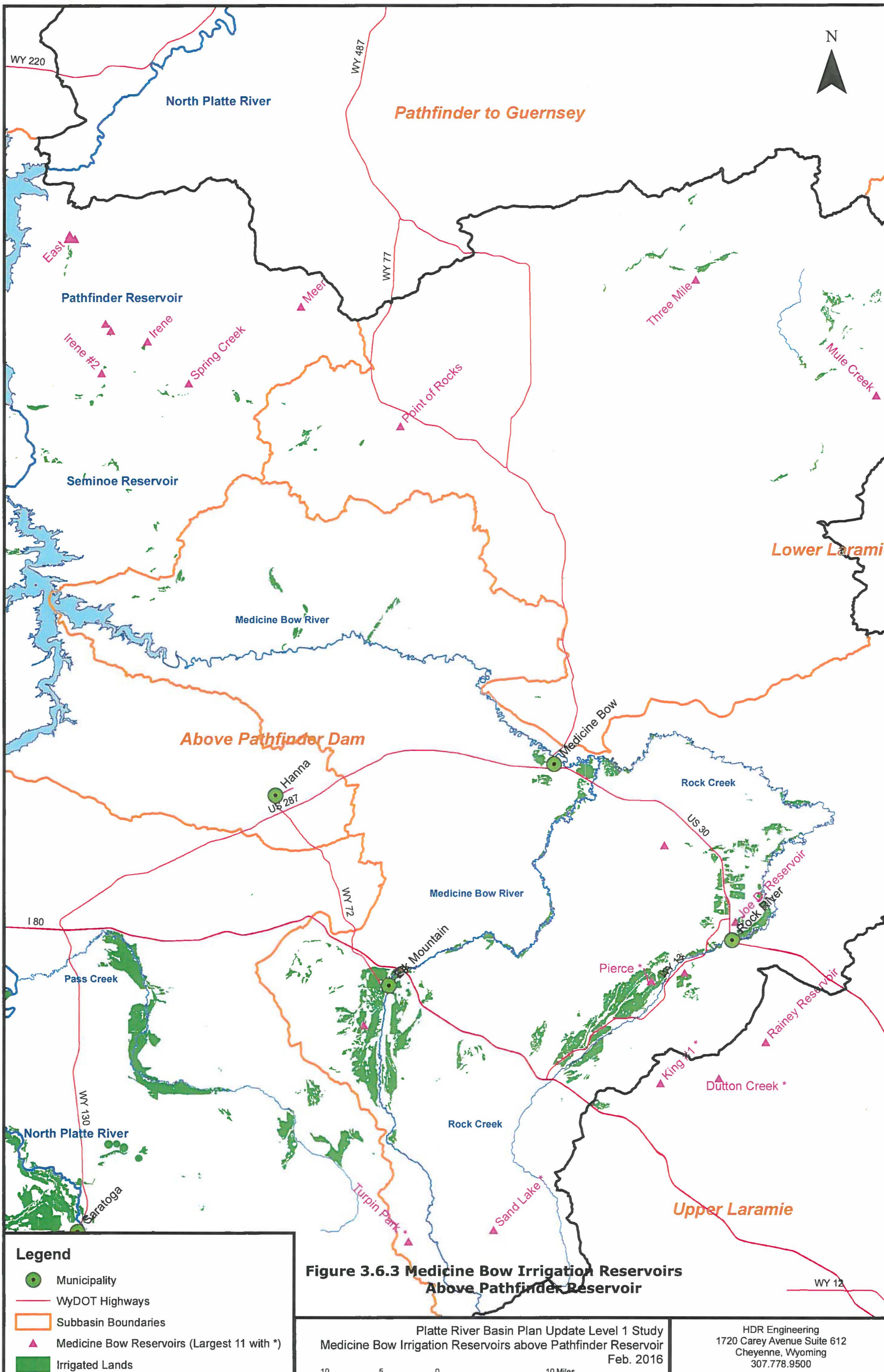


**Figure 3.6.3 Medicine Bow Irrigation Reservoirs Above Pathfinder Reservoir**

Platte River Basin Plan Update Level 1 Study
Medicine Bow Irrigation Reservoirs above Pathfinder Reservoir
Feb. 2016

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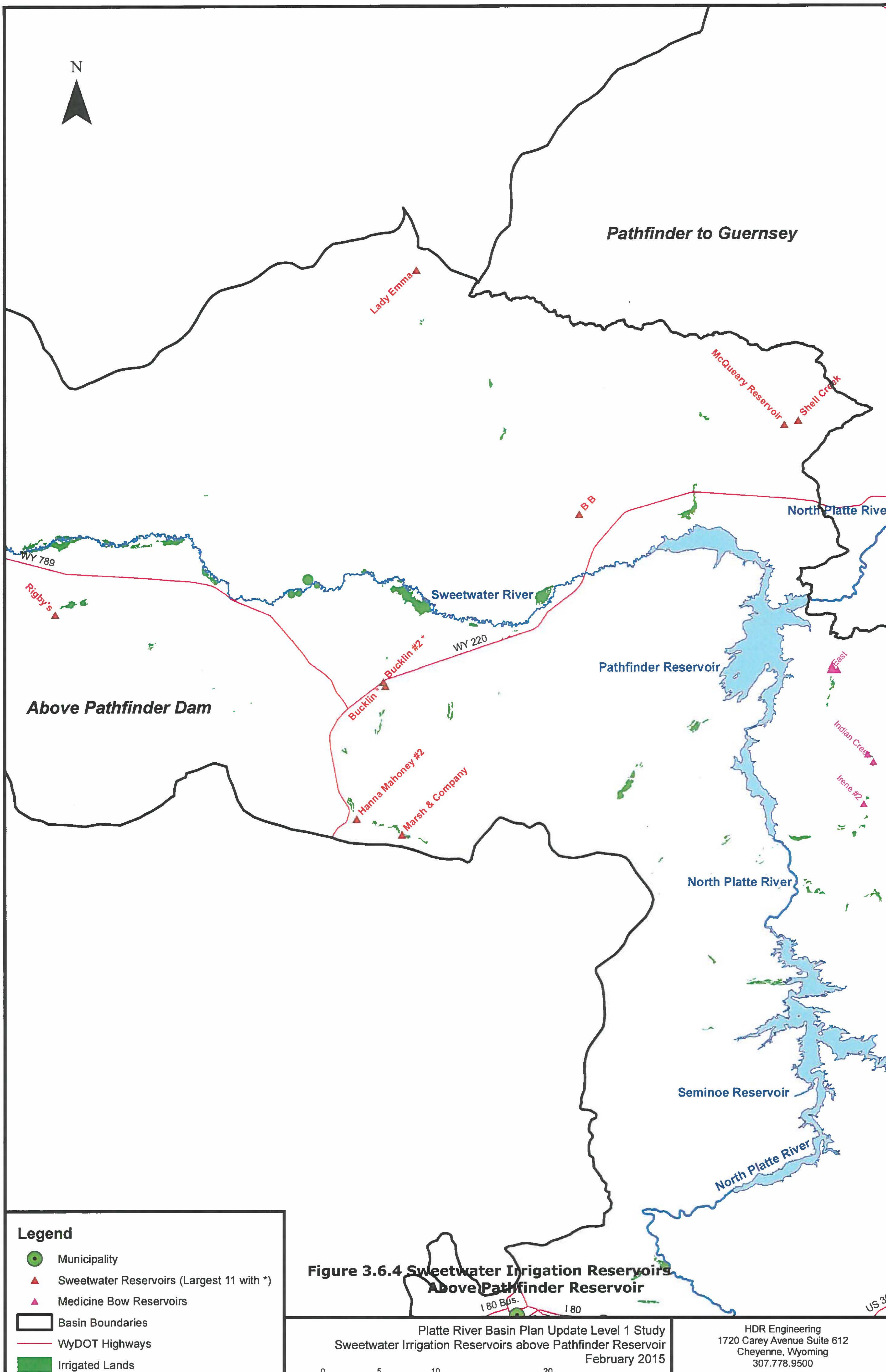



**Figure 3.6.4 Sweetwater Irrigation Reservoirs Above Pathfinder Reservoir**

State Engineer. Over 90% of the existing reservoirs were physically surveyed at that time. Following the issuance of the Modified Decree in 2001, the 11 largest reservoirs were re-surveyed and new capacities tables were developed.

State West Water Resources, subsequently acquired by Wenck Associates, Inc., oversaw and completed the survey and capacity table calculations as well as completing the design and contractor administration for the installation of measuring devices. The State of Wyoming through the SEO financed the project and completed the coordination between the reservoir owners, engineering firm, and contractor. SEO field personnel rely on the new capacity tables for the largest reservoirs and the measuring devices collect and record data on a frequent basis, typically every 15 minutes. The reservoir water level elevations are measured continuously on a year-round basis. The reservoir water level data for the largest reservoirs is telemetered via the GOES system and served to the public on nearly a real-time basis with the AQUARIUS WebPortal hosted on SEO's website.

**Overall Reporting Versus Compliance**

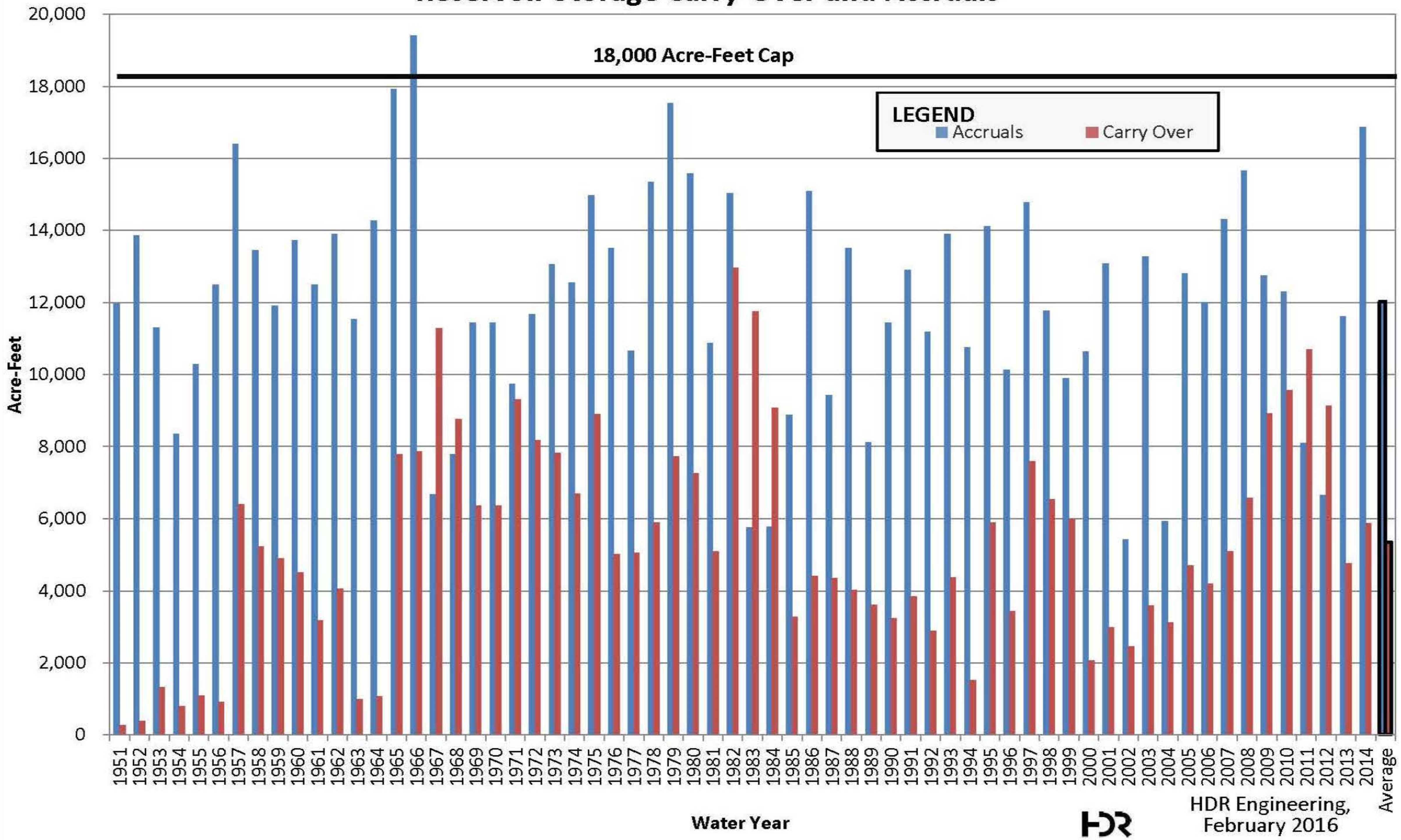
The SEO prepares a report at the end of each water year that contains the water storage accrual amounts. Presently the reports are submitted by the Wyoming State Engineer to the North Platte Decree Committee (NPDC) prior to the end of February each year. The NPDC was established by the States of Nebraska, Wyoming, and Colorado, and the United States of America through the USBR to assist in monitoring, administering, and implementing the Modified North Platte Decree and the Final Settlement Stipulation dated March 31, 2001.

The annual carryover quantities and accrual amounts for each water year are provided in **Appendix 3-C,** Table 3 and are illustrated in **Figure 3.6.5** beginning with 1951. These amounts are the sums from the individual irrigation reservoirs that are tracked and reported by SEO field personnel. Based on all available data, Wyoming has never accrued more than 18,000 acre-feet. The State Engineer's reports in 1965, 1966, and 1967 mistakenly included the storage of Seminoe Reservoir within the total reported accrual quantity. The actual quantity reported in water year 1966 should have been 10,136 acre-feet, not the 19,435 acre-feet that was reported, so the accrual total was less than the compliance cap. The actual maximum accrual quantity as reported by the SEO is 17,552 acre-feet which occurred in 1979. Recently in water year 2014, the total combined accrual quantity reported was 16,875 acre-feet.

The average annual accrual amount since 1951 is 12,038 acre-feet. To maximize water storage for irrigation purposes for above Pathfinder Reservoir in Wyoming, the estimated additional storage accrual amount available on an average annual basis is approximately 6,000 acre-feet. All the years of reporting since 1951 were reviewed and no accrual years were removed as outliers or as being non-representative. Further analysis could be completed to eliminate specific water years from the statistical analysis, but it is unlikely the overall analysis and recommendations would be significantly affected. From the 63 years of SEO reporting, the estimated maximum quantity stored in all the reservoirs combined in any one year is 23,433 acre-feet. This storage quantity occurred in 1979, the same year as the maximum accrual quantity. Water Year 2014 represented a larger than average water storage year with 22,744 acre-feet total storage.

The estimated overall storage capacity of all the reservoirs (active and inactive reservoirs combined) is 27,525 acre-feet. The overall storage capacity was calculated based on adding the actual active capacities from the surveys of the largest 11 reservoirs to the capacities of the smaller reservoirs. Most of the small reservoirs have low-level outlets so the reservoirs are nearly completely drained at the end of the irrigation season and have very small amounts of inactive storage. Based on this estimated total physical capacity, when the

FIGURE 3.6.5 Platte River Basin Plan Update - Level 1 Study
Historical WSEO Data of Above Pathfinder
Reservoir Storage Carry-Over and Accruals



combined carryover quantities are larger than an estimated 9,525 acre-feet for all the reservoirs at the beginning of the water year, there would not be enough available capacity in the reservoirs to exceed the 18,000 acre-feet compliance cap. This is a rare occurrence because the 9,525 carryover amount was exceeded only 5 years in the 64 years of Wyoming's compliance reporting. The reservoirs above Pathfinder subject to Decree compliance are listed in **Appendix 3-C,** Table 1.

### Review of the Largest Reservoirs and Carry-Over and Accruals

**Largest Eleven Reservoirs.** Reporting documents for the largest 11 reservoirs with storage accruals utilizing the new measuring device equipment since about 2003 were reviewed. **Appendix 3-C**, Table 2 contains the annual carryover quantities and accrual amounts for each water year beginning in 2003 for the largest 11 reservoirs. The combined total storage capacity of the largest reservoirs is equal to 15,930 acre-feet which represents over 55% of the estimated storage capacity of all the irrigation reservoirs.

The reservoir filling operations typically occur prior to the irrigation season so senior direct flow water rights are not actively calling for and diverting water. With the exception of Kindt Reservoir, the reservoirs filled to capacity or near capacity every year. The minor occurrences of filling exceptions were North Spring Creek Reservoir in water years 2009 and 2013 and Pierce Reservoir in water year 2013. Kindt Reservoir storage and accruals are highly variable with no storage accruing in most normal or dry years. During the 12-year period since 2003, Kindt stored water in only two years, water years 2010 and 2011. Kindt can store up to an estimated capacity of 2,422 acre-feet when adequate supplies are available.

Many of the largest reservoirs filled in water year 2012 which was a record dry year in the Basin, indicating that most of the larger reservoirs under the Decree compliance cap are not limited by available water supplies or water right priority administration activities. Although, water year 2012 followed a wetter year so carryover quantities were larger in many reservoirs going into water year 2012. In addition, the reservoirs owned and operated by Wheatland Irrigation District; Sand Lake, King #1, and Dutton Creek Reservoirs appeared to fill every year if the facilities and conveyance systems were in good working order.

**Carry-Over and Accrual Quantities of all Reservoirs**. In the overall reporting of all the reservoirs since 2000, **Figure 3.6.5** illustrates increasing carry-over quantities from a low of 2,059 acre-feet in 2001 to a maximum of 10,713 acre-feet in 2011. Both water years 2002 and 2004 stand out in **Figure 3.6.5** as record dry years; with very small accruals of 5,429 and 5,922 acre-feet, respectively.

Reservoir owners of the largest reservoirs following the drought of 2002-2004 purposely conserved storage water in meeting irrigation needs and intentionally increasing carry-over quantities because of uncertainties about future water availability.

Communications with SEO staff and reservoir owners has confirmed this analysis. Another consideration is that most of the reservoir owners have irrigated lands that are served by both direct flow and storage water. The owners will rely on direct flow when it is available and will conserve storage water for the future. The owners' objective to save water and provide carry-over for water needs in future years is evident. Following 2011, the carry-over quantities have steadily decreased to a quantity similar to the long-term carry-over average of 5,380 acre-feet.

For the largest reservoirs that fill almost every year, the carry-over quantities directly affect the storage space available for accruals. The storage space limitation also affects the smaller reservoirs that make up a large percentage of the overall storage and accrual reporting.

Direct communication with SEO staff has confirmed that some of the reservoir owners operate their reservoirs to meet water needs and objectives other than the permitted irrigation uses. In addition to drought concerns, some reservoir owners are increasing carry-over amounts to serve other beneficial uses and purposes; such as the needs of the existing reservoir fisheries as well as serving recreation uses within the reservoirs.

### 3.6.5 Water Use from Storage Updates

#### New Reservoir Permits

All new reservoirs or enlargements in the Wyoming's Platte River Basin that have been permitted by the SEO since the last plan update have been identified in **Appendix 3-C**, Tables 3 through 9. In accordance with the provisions of the Scope of Service, reservoirs less than 50 acre-feet capacity were excluded. The permits in **Appendix 3-C**, Table 3 are listed together within each respective subbasin with the permitted beneficial use identified. Tables 4 through 9 are updated reservoir listings from the previous Platte River Basin Plan (2006) that identified non-federal reservoirs greater than 1,000 acre-feet in storage capacity. At the bottom of each table is a listing of any new reservoirs greater than 50 acre-feet permitted or constructed since the original plan. The reservoirs were also contained in Table 3.

Many of the newly permitted reservoirs were existing facilities. The owners merely obtained a formal water right permit by the Wyoming State Engineer's Office to make the facility a "matter of record." Two reservoirs serving irrigation purposes were constructed in the Pathfinder to Guernsey Subbasin. One of the reservoirs was supplied with a non-hydrologically connected groundwater source (Eastgate Reservoir) and the other reservoir (McMurry no. 4 Reservoir) acquired water supplies through a water right transfer process. The other reservoirs permitted throughout the Basin appear to have been built for a variety of different reasons serving various beneficial uses which included industrial treatment, recreation, wildlife, fish propagation, and flood control.

### 3.6.6 Summary

Wyoming's reported carryover, maximum storage, and accrual data from 1951 to the present was reviewed. A more detailed analysis of the maximum storage and accrual data collected from the 11 largest reservoirs since 2003 was conducted. Per the Modified 2001 North Platte Decree requirements, the largest reservoirs had measurement devices installed to improve the accuracy of reporting annual accruals. Due to their size and locations, the largest reservoirs represent the best opportunities for maximizing annual storage quantities.

The statistical results of the 63 years of reporting are summarized in **Table 3.6.1**.

**Table 3.6.1: 64-Year Statistics of Water Stored for Irrigation Purposes Above Pathfinder Reservoir in Wyoming**

| Storage Quantities | Carry-Over (acre-feet) | Max Water Stored (acre-feet) | Reported Accrual (acre-feet) |
|---|---|---|---|
| Averages | 5,380 | 17,272 | 11,908 |
| Minimums | 255 | 8,412 | 5,429 |
| Maximums | 12,956 | 23,433 | 17,552 |

The average annual accrual quantity is 11,908 acre-feet so the estimated additional storage potential on an average annual basis is approximately 6,000 acre-feet to maximize Wyoming's available allocation of 18,000 acre-feet. Various carryover factors and the actual storage quantity physically available in any one year affect the feasibility of Wyoming accruing up to 18,000 acre-feet as often as possible. Reservoir owners' operational decisions to conserve water during a drought period or to maintain a minimum pool are factors affecting carryover quantities.

### 3.6.7 Conclusions and Recommendations

The reservoirs above Pathfinder have permitted and actual active storage capacities that exceed 18,000 acre-feet so the potential exists for Wyoming to exceed the cap in any one year. The records reviewed for the largest reservoirs instrumented with new measuring devices confirmed that most reservoirs filled nearly every year except when affected by severe drought conditions or when reservoir or conveyance deficiencies prevented their physical ability to store water.

During drought periods, the reservoir owners are intentionally saving water to conserve water supplies for the following year so the storage space available for accruals the following year is physically limited. Some reservoir owners are also increasing reservoir carry-over amounts to serve other beneficial uses such as fishery or recreational purposes. HDR's structural and non-structural recommendations are based on the water storage analysis performed on the reservoirs storing for irrigation purposes above Pathfinder Reservoir exclusive of Seminoe Reservoir. The implementation of one or more of the stated alternatives could assist Wyoming in maximizing the annual accrual quantities.

#### Reservoir Owner Operating Strategies

A potential non-structural recommendation is to facilitate the coordination of storage accruals among the reservoir owners. Coordination with reservoir owners on an annual basis could occur that would allow maximizing storage accruals occurring in Wyoming in any one year. This approach requires cooperation between the SEO and the entities responsible for coordinating the individual reservoir owners. The reservoir owners of the largest reservoirs with measuring device equipment may be the most amenable to this coordination approach based on their previous coordination with the State of Wyoming. The largest reservoirs represent the most efficient entities to accomplish this cooperation alternative due to their size and the practicality of coordinating with fewer reservoir owners.

In cooperation with reservoir owners, reservoir operational plans could be developed for the largest reservoirs. The operation plans would specify a procedure and method to coordinate communications with the reservoirs owners so they are aware of the carry-over amounts and the targeted accrual quantity. The procedure would require monitoring of individual reservoir carry-over quantities each water year and estimating target accrual amounts. The target accrual amounts would be added together in the respective larger reservoirs so that operational plans can be modified to maximize Wyoming's storage quantities up to the Decree allowance of near 18,000 acre-feet in every water year.

In addition, reservoir owners with excess storage may be in a position to contract with other downstream irrigators that are deficient in direct flow water rights when natural flows decrease in the mid-summer months. This contracting process would allow the reservoir owners to enhance the use of their storage water. In addition, the improved analysis and monitoring of snow pack and estimated runoff quantities would help reservoir owners optimize their reservoirs in meeting irrigation beneficial uses as well as conserving water for future drought conditions.

The new measuring device equipment will allow for near real-time monitoring of accruals and maximum storage amounts at the largest eleven reservoirs. The reservoir owners would be capable of adjusting reservoir outlets or the bypassing of inflows so Wyoming does not exceed the 18,000 acre-feet accrual cap.

#### Reservoir Water Right Re-descriptions

Another potential non-structural alternative is to consider the reservoir storage water right and its function for serving irrigation purposes. A portion of the active reservoir storage in the larger reservoirs could be better defined and modified within a Wyoming Board of Control change of use petition process to eliminate the requirement and the need to track the storage under the Modified Decree requirements. For example, the portion of storage that is for the purposes of meeting fishery or recreation beneficial uses could be formally designated for that purpose within the reservoir storage water right. The portion of the storage water right for in-place environmental or recreation uses should not be included in the SEO reporting of storage water dedicated to meeting irrigation purposes.

This re-description of a portion of the water storage rights would allow for more certainty for Wyoming to only account for the storage water actually used to meet irrigation demands. The process of optimizing the tracking and reporting would allow for Wyoming to maximize storage accruals that need to be specifically tracked and reported under the Modified Decree. Following the petition process, the SEO field personal would be required to monitor and track the storage and accruals in accordance with the modified water right for the reservoir. A potential negative impact of this alternative is that the reservoir owner must agree to a permanent change in their reservoir water rights, which eliminates the flexibility in their reservoir operations that has occurred in the past.

#### Constructing New Reservoirs or Enlargement of Existing Reservoirs

Constructing new reservoirs or enlarging existing irrigation reservoirs are challenging projects to implement. The siting of new reservoirs would require the need to evaluate suitable reservoir sites and consider the environmental effects of each site to address the environmental permitting requirements. Water supply alternative analysis evaluations would also be a NEPA requirement for a reservoir enlargement project. The permitting process will require NEPA compliance for the issuance of federal permits or required right-of-way agreements on federal lands. Wyoming's compliance with the PRRIP and Wyoming's Depletions Plan will need to be considered for either alternative. A new irrigation reservoir would require the need for a local sponsor that could provide for a share of the overall capital costs.

To be eligible for WWDC Account III funds, new reservoirs would have to be 2,000 acre-feet or greater and reservoir enlargements would have to be 1,000 acre-feet or greater. The proposed or existing irrigation reservoirs above Pathfinder must provide irrigation to service areas greater than 2,000 acres which is an additional WWDC funding requirement. New reservoirs and enlargements to reservoirs smaller than these storage quantities could be funded through WWDC Account I funds with WWDC grant funding up to 67% of the total project costs.

Following its construction or after the enlargement of an existing reservoir, the designated sponsor would need to collaborate with State officials to implement an operational strategy to maximize storage accruals to allow Wyoming to accrue near the 18,000 acre-foot quantity on an annual basis. This alternative could be implemented in concert with the nonstructural options. A potential disadvantage of this approach is that new storage under current-day priority water rights may not accrue enough storage to fill the reservoir every year.

Personal contacts were made with SEO staff regarding the water supplies, water rights, and irrigation needs served by Pierce Reservoir, which is the largest irrigation reservoir with an existing capacity of 3,895 acre-feet. SEO indicated that irrigation shortages exist downstream along Rock River because of declining natural flows during the mid to late irrigation season months that could be addressed through an enlarged storage supply. This would require contractual arrangements between the direct flow only appropriators and the current reservoir owners or an enlargement of the current service area of the Rock Creek Ditch Company. Irrigation supply shortages may exist on other irrigated lands located downstream of small irrigation reservoirs located above Pathfinder Reservoir. Further analysis would be needed to evaluate the irrigation shortages and to evaluate the potential firm water supply yields available for a new or enlarged reservoir.

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# APPENDIX 3-A

Irrigation System Issues within Subbasins of the Platte River Basin

## Table 1. Irrigation System Issues within Subbasins of the Platte River Basin

| Name | 2003 Problems[1] | 2012 Problems[2] |
|---|---|---|
| Above Pathfinder | | |
| None | | |
| Pathfinder To Guernsey | | |
| LaPrele Irrigation District | Ditch improvements, dam maintenance, vandalism | Repairs to Dams and Canals needed; Backhoe, shop, pipe |
| Bates Creek Reservoir Company | Lack of water | Dry Fork of Bates Creek accurately named; Ongoing maintenance of dam & supply ditch. |
| Casper Alcova Irrigation District | Leaky ditches | High conveyance losses – 20% |
| Douglas Water Users | No response to survey | No response to survey. |
| Wagonhound Land and Livestock | No response to survey | No response to survey. |
| Guernsey To State Line | | |
| Angel Draw Irrigation District | No response to survey | No response to survey. |
| Burbank Ditch | State and Federal requirements | Inadequate water sources; dependable supply. |
| Corn Creek Irrigation District | Not listed in survey | Not listed in survey |
| Goshen Hole Water Users Association | Lake needs to be dredged, headgates and water measuring devices need to be improved | No improvements made for 40+ years, entire system needs an upgrade; Interested in help, but debt is not an option |
| Goshen Mutual Reservoir and Ditch Company | No response to survey | drought, excessive water loss, state and federal requirements |
| Hill Irrigation District | None | None |
| Lingle Water Users Association | Drought, short water | No response to survey. |
| Lucerne Canal and Power Company | No response to survey | Not listed in survey. |
| New Grattan Ditch | No response to survey | No response to survey. |
| New North Platte Irrigation & Ditch Company | Diversion from river during flows less than 500 cfs | Needed improvements, Maintenance requirements; diversion dam on river |
| Pratte-Ferris Irrigation District | No response to survey | Improvements for conveyance loss |
| Rock Ranch Ditch Company | The diversion in the North Platte | The diversion in the North Platte |
| Torrington Irrigation District | Needed improvements, maintenance through subdivisions | No response to survey. |
| Wright & Murphy Ditch Company | No response to survey | No response to survey. |
| Upper Laramie | | |
| Laramie Valley Municipal Irrigation District | Flumes, need headgates, riprap, concrete, repairs | Unpredictability of water availability to lower priority water rights holders (specifically, those of lower priority than Wheatland Irrigation District, approximately 1890); Increasing costs of ditch maintenance (measuring |

| | | |
|---|---|---|
| | | flumes, culverts, headgates; equipment costs of equipment hired for ditch cleaning services). |
| Medicine Bow Conservation District | No response to survey | No response to survey. |
| Pioneer Canal-Lake Hattie Irrigation District | Limited storage imposed by U.S. Fish and Wildlife Service | Improvements at Lake Hattie outlet structure; Major erosion control on supply canal from Big Laramie River; Minimize ditch loss on the entire system. |
| Rock Creek Ditch Company | Lack of water during drought | Not listed in survey. |
| Rock Creek Water Users Association | No response to survey | High flows trying to reroute flows away from diversion structures. |
| Toltec Watershed Improvement District | No response to survey | None |
| Lower Laramie | | |
| Gunbarrel Lateral Ditch Company | 2002 – only 0.2 ft/acre; 2003 – 0.4 ft/acre | Dirt & rubbish blows into open ditch |
| Wheatland Irrigation District | Lack of storage | Old system started in 1883; unwritten easements; subdivided lands, delivery to subdivided lands. |
| Horse Creek | | |
| Goshen Irrigation District | State and federal requirements, subdivided land, seepage, lack of adequate water measurement, system age | Canal was established in 1920's and is in need of several improvements. Seepage problems, Federal EDSA, subdivisions, deliveries to and transfers to other lands in our district; Assessments are higher due to increasing costs of materials and rising fuel prices. |
| Horse Creek Conservation District | Drought, inadequate water supply, easements access issues at Hawk Springs Reervoir with state parks and G & F | Financial burdens; Ditch repairs |
| South Platte | | |
| None | | |

Notes: [1]Problems noted in Wyoming Water Development Commission 2003 Irrigation System Survey Report
[2] Problems noted in Wyoming Water Development Commission 2012 Irrigation System Survey Report

## APPENDIX 3-B

New Municipal Wells or Enlargements Filed on Existing Municipal Wells Since January 1, 2004

Summary of Water Usage for Community Water Systems for the Subbasins of the Platte River Basin

**Table 1. New Municipal Wells or Enlargements Filed on Existing Municipal Wells Since January 1, 2004**

| Entity / Municipality | Well / Facility Name | Uses | Appropriation (GPM) | Total Depth (Ft) | Depth to Water (Ft) |
|---|---|---|---|---|---|
| ALBIN | ALBIN 04-01 NOELLE | MUN_GW | 50 | 361 | 224.1 |
| ALBIN | ALBIN 04-02 MARY | MUN_GW | 110 | 430 | 217.1 |
| TOWN OF YODER | STATE NO. 04 WELL | MUN_GW | 45 | 160 | 74.5 |
| TOWN OF PINE BLUFFS | PINE BLUFFS LANCE/FOX HILLS #1 | MUN_GW | 250 | 1,008 | 240 |
| CITY OF CHEYENNE | ENL. CHEYENNE NO. 51 (FINNERTY NO. 2) | MUN_GW | 175 | 210 | 45.48 |
| CITY OF CHEYENNE | ENL. BELL NO. 10 | IRR_GW; MUN_GW | 0 | 250 | 40 |
| TOWN OF GLENDO | ROBBENS WELL | MUN_GW | 30 | 650 | 160 |
| WYOMING WATER DEVELOPMENT COMMISSION | BELVOIR NO. 5 | MUN_GW | 700 | 272 | 82 |
| TOWN OF MILLS | ENL. MILLS NO. 9 | MUN_GW | 115 | 35 | 8 |
| TOWN OF SARATOGA | SARATOGA WELL #1 | MUN_GW | 230 | 305 | 62 |
| TOWN OF SARATOGA | SARATOGA WELL #2 | MUN_GW | 230 | 352 | 78 |
| TOWN OF SARATOGA | SARATOGA WELL #3 | MUN_GW | 230 | 390 | 98 |
| TOWN OF SARATOGA | SARATOGA WELL #4 | MUN_GW | 230 | 412 | 100 |
| TOWN OF SARATOGA | SARATOGA WELL #5 | MUN_GW | 230 | 430 | 100 |
| WYOMING WATER DEVELOPMENT COMMISSION | LONE TREE #2 | MUN_GW | 500 | - | - |
| WYOMING WATER DEVELOPMENT COMMISSION | BELVOIR NO. 6 | MUN_GW | 300 | 406 | 122 |
| TOWN OF GLENROCK | GLENROCK WELL NO. 7 | MUN_GW | 1500 | 1,233 | 173 |
| CITY OF CHEYENNE, BOARD OF PUBLIC UTILITIES | 2ND ENL. BELL # 10 | IRR_GW; MUN_GW; MIS | 75 | 250 | 40 |
| TOWN OF GLENDO | ENL ROBBENS WELL | MUN_GW | 45 | 650 | 160 |
| TOWN OF ELK MOUNTAIN | ELK MOUNTAIN WELL #4 | MUN_GW | 200 | 2,926 | 0 |
| SIERRA MADRE WATER AND SEWER JOINT POWERS BOARD | RIVERSIDE NO. 7 WELL | MIS; MUN_GW | 150 | 631 | 38 |
| TOWN OF PINE BLUFFS | PINE BLUFFS #9 | MUN_GW | 300 | 702 | 271.4 |
| TOWN OF YODER | ENL. PRODUCTION WELL NO. 2 | MUN_GW | 12 | 195 | 70 |
| TOWN OF YODER | ENL PRODUCTION WELL NO. 3 | MUN_GW | 10 | 193 | 85 |
| TOWN OF YODER | ENL STATE NO. 04 | MUN_GW | 7 | 160 | 75 |
| CITY OF DOUGLAS | LITTLE BOX ELDER WELL NO. 1 | MUN_GW | 600 | 1,170 | 0 |
| WYOMING WATER DEVELOPMENT COMMISSION | THOMAS MEMORIAL NO. 1 | MUN_GW | 200 | 537 | 33.5 |
| TOWN OF YODER | YODER PRODUCTION WELL #5 | MUN_GW | 65 | 1,110 | 65.4 |
| TOWN OF GLENROCK | ENL. GLENROCK WELL NO. 7 | MUN_GW | 185 | 1,233 | 173 |
| CITY OF CHEYENNE/BOARD OF PUBLIC UTILITIES | ENLARGEMENT BAILEY NO. 5 | MUN_GW | 160 | 317 | 84 |

**Table 2. Summary of Water Usage for Community Public Water Systems in the Above Pathfinder Dam Subbasin, Wyoming**

| | | | | 2002 WWDC Report[2] | | | | 2013 WWDC Report[3] | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Use | County | Public water system identification number[1] | Name | Population served | Water Source | Average daily use (gallons per day) | Peak daily use (gallons per day) | Population served | Water Source | Total Annual Water Use (gallons) | Average daily use (gallons per day)[4] | Peak daily use (gallons per day)[5] | Source/Remarks |
| Groundwater Use | Albany | WY5600034 | Town of Medicine Bow | 282 | 3 Casper Aquifer wells | 91,600 | 129,500 | 300 | 4 Casper Aquifer wells | 44,324,926 | 121,438 | 172,500 | WWDC, 2013; Peak estimated. |
| | Fremont | WY5600106 | Jeffrey City Water & Sewer District | 50 | 2 Arikaree Aquifer wells | 11,300 | 28,750 | 50 | 1 Split Rock Aquifer well | 23,266,150 | 63,743 | 120,000 | 609 Consulting, 2013 |
| | Carbon | WY5600065 | Town of Elk Mountain | 207 | 2 Clovery Aquifer wells | 24,000 | 80,000 | 200 | 2 Cloverly Aquifer wells | 9,000,000 | 24,658 | 60,000 | PMPC and Hinckley, 2011; WWDC, 2013 |
| | Carbon | WY5600225 | Deer Haven Mobile Home Park | 50 | 2 Quaternary Aquifer wells | 11,300 | 28,750 | 35 | 1 Quaternary Aquifer wells | 2,887,150 | 7,910 | 20,125 | Usage estimated. |
| | Carbon | WY5601332 | Sierra Madre JPB | 195 | 2 North Park Aquifer wells | 29,254 | 99,000 | 180 | 3 North Park Aquifer wells | 8,899,640 | 24,383 | 47,000 | PMPC and Hinckley, 2011; WWDC, 2013 |
| | Carbon | WY5600061 | Town of Saratoga | NA | NA | NA | NA | 1,800 | 5 North Park Aquifer wells | 175,000,000 | 479,452 | 1,200,000 | Switched to groundwater system in 2007; Hinckley, 2007; WWDC, 2013 |
| | | | **Totals** | **784** | | **167,454** | **366,000** | **2,565** | | **263,377,866** | **721,583** | **1,619,625** | |
| Surface Water Use | Carbon | WY5600025 | Town of Hanna | 1,200 | Rattlesnake Creek | 60,000 | 900,000 | 841 | Rattlesnake Creek | 84,036,000 | 230,236 | 515,000 | WWDC, 2013 |
| | Carbon | WY5600048 | Town of Rock River | 200 | Rock River | 18,000 | 22,000 | 245 | Rock River | 35,800,000 | 98,082 | 120,000 | WWDC, 2013 |
| | Carbon | WY5600060 | Town of Encampment | 443 | North Fork Encampment River | 141,279 | 332,220 | 450 | North Fork Encampment River | 22,403,000 | 61,378 | 258,750 | WWDC, 2013; Peak estimated. |
| | Carbon | WY5600061 | Town of Saratoga | 1,850 | North Platte River | 500,000 | 1,200,000 | NA | NA | NA | NA | NA | Switched to groundwater system in 2007 |
| | | | **Totals** | **3,693** | | **719,279** | **2,454,220** | **1,536** | | **142,239,000** | **389,696** | **893,750** | |
| | | | | | | | | | | | | | |
| Conjunctive Water Use | Carbon | WY5600045 | City of Rawlins Water System | 9,730 | 27 Springs, Rawlins Reservoir, North Platte River, 3 Nugget Aquifer wells | 2,251,000 | 5,243,000 | 9,006 | 3 Nugget Aquifer wells, 14 Sage Creek Basin springs, North Platte River, Atlantic Rim Reservoir, Peaking Reservoir, Rawlins Reservoir | 684,979,000 | 1,876,655 | 4,421,000 | Sells water to Sinclair; Wester-Wetstein, 2010; WWDC, 2013 |
| | 3Carbon | WY5600054 | Town of Sinclair | 500 | City of Rawlins | 50,000 | 100,000 | 433 | City of Rawlins | 45,300,000 | 124,110 | 400,000 | WWDC, 2013 |
| | | | **Totals** | **10,230** | | **2,301,000** | **5,343,000** | **9,439** | | **730,279,000** | **2,000,764** | **4,821,000** | |

Notes: (1) Public Water System identification according to USEPA

(2) Data from 2002 WWDC water system survey report or sources included in original Basin Plan technical memorandum

(3) All data from 2013 Wyoming Water Development Commission Public Water System Survey Report unless noted otherwise under remarks.

**Table 3. Summary of Water Usage for Community Public Water Systems in the Pathfinder Dam to Guernsey Subbasin, Wyoming**

| | | | | 2002 WWDC Report[2] | | | | 2013 WWDC Report[3] | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Use | County | Public water system identification number[1] | Name | Population served | Water Source | Average daily use (gallons per day) | Peak daily use (gallons per day) | Population served | Water Source | Total Annual Water Use by system (gal) | Average daily use (gallons per day)[4] | Peak daily use (gallons per day)[5] | Source/Remarks |
| Groundwater Use | Platte | WY5600023 | Town of Guernsey | 1,200 | 3 wells | 484,800 | 866,870 | 1,147 | 3 Alluvial Aquifer wells | 144,722,000 | 396,499 | 771,065 | AVI, 2013; WWDC, 2013 |
| | Natrona | WY5600072 | Riverside Trailer Court | 155 | 2 wells | 35,030 | 89,125 | 137 | 2 Alluvial Aquifer wells | 11,301,130 | 30,962 | 78,775 | Usage estimated |
| | Natrona | WY5600074 | Broken Wrench LLC | 50 | 2 springs | 11,300 | 28,750 | 30 | 2 springs | 2,474,700 | 6,780 | 17,250 | Usage estimated |
| | Platte | WY5600186 | Town of Hartville | 94 | 4 wells | 23,500 | 51,000 | 62 | 2 Alluvial Aquifer wells | 6,000,000 | 16,438 | 35,650 | WWDC, 2013; peak estimated |
| | Converse | WY5600199 | Town of Glenrock | 2,500 | 3 wells | 600,000 | 1,400,000 | 2,550 | 4 Casper Aquifer wells | 218,000,000 | 597,260 | 1,700,000 | Weston, 2007; WWDC, 2013 |
| | Platte | WY5600231 | Town of Glendo | 250 | 1 well | 95,587 | 178,685 | 205 | 2 Hartville Aquifer wells | 20,000,000 | 54,795 | 150,000 | Wyoming Groundwater, 2009; WWDC, 2013 |
| | Natrona | WY5600756 | Countryside Court | 125 | 1 well | 28,250 | 71,875 | 125 | 1 Alluvial Aquifer well | 10,311,250 | 28,250 | 71,875 | Usage estimated |
| | Converse | WY5600782 | Town of Rolling Hills | 475 | 4 wells | 70,349 | 387,168 | 450 | 5 Lance/Fox Hills Aquifer wells | 24,329,142 | 66,655 | 174,000 | CEPI, 2012; WWDC, 2013 |
| | Converse | WY5600918 | Fairway Estates | 100 | 5 wells | 22,600 | 57,500 | 100 | 5 High Plains Aquifer wells | 8,249,000 | 22,600 | 57,500 | Usage estimated |
| | Natrona | WY5600959 | Ingram Water Company/Teton Homes | 300 | 1 well | 67,800 | 172,500 | NA | NA | NA | NA | NA | Inactive? |
| | | | **Totals** | **5,249** | | **1,439,216** | **3,303,473** | **4,806** | | **445,387,222** | **1,220,239** | **3,056,115** | |
| Surface Water Use | Natrona | WY5600018 | Town of Evansville | 2,800 | North Platte River | 350,000 | 1,000,000 | 2,500 | North Platte River | 160,235,000 | 445,000 | 820,220 | C.H. Guernsey, 2009; WWDC, 2013 |
| | | | **Totals** | **2,800** | | **350,000** | **1,000,000** | **2,500** | | **160,235,000** | **445,000** | **820,220** | |
| Conjunctive Water Use | Natrona | WY5600009 | Central Wyoming Regional Water System (Casper) | 53,412 | 20 Quaternary Aquifer wells, North Platte River | 10,300,000 | 28,000,000 | 62,000 | 29 Alluvial Aquifer wells, North Platte River | 4,100,000,000 | 11,232,877 | 29,200,000 | CEPI, 2006; WWDC, 2013 |
| | Natrona | WY5600036 | Town of Mills | 5,745 | 7 Quaternary Aquifer wells, North Platte River | 861,750 | 2,500,000 | 3,300 | 7 Alluvial Aquifer wells, North Platte River | 237,107,500 | 649,610 | 1,550,000 | WWDC, 2013 |
| | Converse | WY5600137 | Town of Douglas | 5,800 | 1 spring, 1 well, North Platte River | 1,489,085 | 3,866,500 | 6,120 | 1 Casper Aquifer spring, 1 Casper Aquifer well, North Platte River | 630,739,154 | 1,728,052 | 3,643,853 | Dowl HKM, 2010; WWDC, 2013 |
| | | | **Totals** | **64,957** | | **12,650,835** | **34,366,500** | **71,420** | | **4,967,846,654** | **13,610,539** | **34,393,853** | |

Notes: (1) Public Water System identification according to USEPA

(2) Data from 2002 WWDC water system survey report or sources included in original Basin Plan technical memorandum

(3) All data from 2013 Wyoming Water Development Commission Public Water System Survey Report unless noted otherwise under remarks.

(4) Where estimated, based on 226 gallons per person per day.

(5) Where estimated, based on 575 gallons per person per day.



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**Table 4. Summary of Water Usage for Community Public Water Systems in the Guernsey to State Line Subbasin, Wyoming**

| | | | | 2002 WWDC Report[2] | | | | 2013 WWDC Report[3] | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Use** | **County** | **Public water system identification number[1]** | **Name** | **Population served** | **Water Source** | **Average daily use (gallons per day)** | **Peak daily use (gallons per day)** | **Population served** | **Water Source** | **Total Annual Water Use (gal)** | **Average daily use (gallons per day)[4]** | **Peak daily use (gallons per day)[5]** | **Source/Remarks** |
| **Groundwater Use** | Goshen | WY5600030 | Town of Lingle | 510 | 3 Quaternary Aquifer wells | 295,800 | 928,200 | 510 | 3 Alluvial Aquifer wells | 45,000,000 | 123,288 | 600,000 | WWDC, 2013 |
| | Goshen | WY5600164 | Torrington Municipal Water System | 6,500 | 6 Quaternary Aquifer wells | 2,360,000 | 4,700,000 | 5,800 | 5 Alluvial Aquifer wells | 644,000,000 | 1,764,384 | 4,500,000 | Sells to South Torrington; WWDC, 2013 |
| | Goshen | WY5600168 | South Torrington Water & Sewer | 650 | Torrington | 250,250 | 300,000 | 450 | Torrington | 24,300,000 | 66,575 | 100,000 | WWDC, 2013 |
| | Goshen | WY5600171 | Potlach Trailer Court | 75 | 1 well | 16,950 | 43,125 | 70 | 1 Alluvial Aquifer well | 5,774,300 | 15,820 | 40,250 | Usage estimated |
| | Goshen | WY5600185 | Town of Fort Laramie | 248 | 2 Quaternary Aquifer wells | 141,360 | 233,120 | 200 | 2 Alluvial Aquifer wells | 20,160,900 | 55,235 | 176,500 | WWDC, 2013 |
| | Goshen | WY5601233 | Cottonwood Acres | 100 | 4 wells | 22,600 | 57,500 | 100 | 4 Alluvial Aquifer wells | 8,249,000 | 22,600 | 57,500 | Usage estimated |
| | Goshen | WY5601248 | Dillman Estates | 46 | 1 well | 10,396 | 26,450 | 65 | 1 Alluvial Aquifer well | 7,500,000 | 20,548 | 37,375 | WWDC, 2013; peak usage estimated |
| | | | **Totals** | **7,479** | | **3,097,356** | **6,288,395** | **6,745** | | **754,984,200** | **2,068,450** | **5,511,625** | |

Notes: (1) Public Water System identification according to EPA
(2) Data from 2002 WWDC water system survey report or sources included in original Basin Plan technical memorandum
(3) All data from 2013 Wyoming Water Development Commission Public Water System Survey Report unless noted otherwise under remarks.
(4) Where estimated, based on 226 gallons per person per day.
(5) Where estimated, based on 575 gallons per person per day.

**Table 5. Summary of Water Usage for Community Water Systems in the Upper Laramie Subbasin, Wyoming**

| | | | | 2002 WWDC Report[2] | | | | 2013 WWDC Report[3] | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Use** | **County** | **Public water system identification number[1]** | **Name** | **Population served** | **Water Source** | **Average daily use (gallons per day)** | **Peak daily use (gallons per day)** | **Population served** | **Water Source** | **Total Annual Water Use (gal)** | **Average daily use (gallons per day)[4]** | **Peak daily use (gallons per day)[5]** | **Source/Remarks** |
| **Groundwater Use** | Albany | WY5600162 | Country Meadow Estates | 375 | 2 wells | 84,750 | 215,625 | 375 | 3 Casper Aquifer wells | 12,154,500 | 33,300 | 215,625 | WWDC, 2013; peak usage estimated |
| | Albany | WY5600208 | Wyoming Technical Institute | 560 | 2 wells | 126,560 | 322,000 | 560 | 2 Casper Aquifer wells | 46,194,400 | 126,560 | 322,000 | Usage estimated |
| | Albany | WY5601232 | Centennial Water & Sewer | 100 | 2 wells | 17,000 | 57,500 | 100 | 2 Casper Aquifer wells | 9,000,000 | 24,658 | 45,000 | WWDC, 2013 |
| | Albany | WY5601457 | Antelope Ridge H.O.A. | 50 | 2 wells | 11,300 | 28,750 | 70 | 2 Casper Aquifer wells | 5,774,300 | 15,820 | 40,250 | Usage estimated |
| | | | **Totals** | **1,085** | | **239,610** | **623,875** | **1,105** | | **73,123,200** | **200,338** | **622,875** | |
| **Conjunctive Water Use** | Albany | WY5600029 | City of Laramie | 27,000 | Big Laramie River; 9 Casper Aquifer wells | 6,000,000 | 15,750,000 | 30,816 | 9 Casper Aquifer wells, 3 Casper Aquifer springs, Laramie River | 1,963,550,000 | 5,379,589 | 12,670,000 | WWC, 2006; WWDC, 2013 |
| | | | **Totals** | **27,000** | | **6,000,000** | **15,750,000** | **30,816** | | **1,963,550,000** | **5,379,589** | **12,670,000** | |

Notes: (1) Public Water System identification according to EPA

(2) Data from 2002 WWDC water system survey report or sources included in original Basin Plan technical memorandum

(3) All data from 2013 Wyoming Water Development Commission Public Water System Survey Report unless noted otherwise under remarks.

(4) Where estimated, based on 226 gallons per person per day.

(5) Where estimated, based on 575 gallons per person per day.

**Table 6. Summary of Water Usage for Community Public Water Systems in the Lower Laramie Subbasin, Wyoming**

| | | | | 2002 WWDC Report[2] | | | | 2013 WWDC Report[3] | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Use** | **County** | **Public water system identification number[1]** | **Name** | **Population served** | **Water Source** | **Average daily use (gallons per day)** | **Peak daily use (gallons per day)** | **Population served** | **Water Source** | **Total Annual Water Use (gal)** | **Average daily use (gallons per day)[4]** | **Peak daily use (gallons per day)[5]** | **Source/Remarks** |
| **Groundwater Use** | Albany | WY5600162 | Country Meadow Estates | 375 | 2 wells | 84,750 | 215,625 | 375 | 3 Casper Aquifer wells | 12,154,500 | 33,300 | 215,625 | WWDC, 2013; peak usage estimated |
| | Albany | WY5600208 | Wyoming Technical Institute | 560 | 2 wells | 126,560 | 322,000 | 560 | 2 Casper Aquifer wells | 46,194,400 | 126,560 | 322,000 | Usage estimated |
| | Albany | WY5601232 | Centennial Water & Sewer | 100 | 2 wells | 17,000 | 57,500 | 100 | 2 Casper Aquifer wells | 9,000,000 | 24,658 | 45,000 | WWDC, 2013 |
| | Albany | WY5601457 | Antelope Ridge H.O.A. | 50 | 2 wells | 11,300 | 28,750 | 70 | 2 Casper Aquifer wells | 5,774,300 | 15,820 | 40,250 | Usage estimated |
| | | | **Totals** | **1,085** | | **239,610** | **623,875** | **1,105** | | **73,123,200** | **200,338** | **622,875** | |
| **Conjunctive Water Use** | Albany | WY5600029 | City of Laramie | 27,000 | Big Laramie River; 9 Casper Aquifer wells | 6,000,000 | 15,750,000 | 30,816 | 9 Casper Aquifer wells, 3 Casper Aquifer springs, Laramie River | 1,963,550,000 | 5,379,589 | 12,670,000 | WWC, 2006; WWDC, 2013 |
| | | | **Totals** | **27,000** | | **6,000,000** | **15,750,000** | **30,816** | | **1,963,550,000** | **5,379,589** | **12,670,000** | |

Notes: (1) Public Water System identification according to EPA

(2) Data from 2002 WWDC water system survey report or sources included in original Basin Plan technical memorandum

(3) All data from 2013 Wyoming Water Development Commission Public Water System Survey Report unless noted otherwise under remarks.

(4) Where estimated, based on 226 gallons per person per day.

(5) Where estimated, based on 575 gallons per person per day.

**Table 7. Summary of Water Usage for Community Public Water Systems in the Horse Creek Subbasin, Wyoming**

| | | | | 2002 WWDC Report[2] | | | | 2013 WWDC Report[3] | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Use** | **County** | **Public water system identification number[1]** | **Name** | **Population served** | **Water Source** | **Average daily use (gallons per day)** | **Peak daily use (gallons per day)** | **Population served** | **Water Source** | **Total Annual Water Use (gal)** | **Average daily use (gallons per day)[4]** | **Peak daily use (gallons per day)[5]** | **Source/Remarks** |
| **Groundwater Use** | Goshen | WY5600169 | Town of Yoder Water System | 300 | 3 wells | 55,000 | 150,000 | 151 | 3 Chadron Aquifer wells, 1 Lance/Fox Hills Aquifer well | 11,627,100 | 31,855 | 125,000 | Wyoming Groundwater, 2011; WWDC, 2013 |
| | Goshen | WY5600788 | La Grange | 350 | 2 wells | 25,000 | 37,000 | 350 | 2 High Plains Aquifer wells | 28,871,500 | 79,100 | 201,250 | WWDC, 2013; Usage estimated |
| | | | **Totals** | **650** | | **80,000** | **187,000** | **501** | | **40,498,600** | **110,955** | **326,250** | |

Notes: (1) Public Water System identification according to USEPA

(2) Data from 2002 WWDC water system survey report or sources included in original Basin Plan technical memorandum

(3) All data from 2013 Wyoming Water Development Commission Public Water System Survey Report unless noted otherwise under remarks.

(4) Where estimated, based on 226 gallons per person per day.

(5) Where estimated, based on 575 gallons per person per day.

**Table 8. Summary of Water Usage for Community Public Water Systems in the South Platte Subbasin, Wyoming**

| | | | | 2002 WWDC Report[2] | | | | 2013 WWDC Report[3] | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Use** | **County** | **Public water system identification number[1]** | **Name** | **Population served** | **Water Source** | **Average daily use (gallons per day)** | **Peak daily use (gallons per day)** | **Population served** | **Water Source** | **Total Annual Use (gal)** | **Average daily use (gallons per day)[4]** | **Peak daily use (gallons per day)[5]** | **Source/Remarks** |
| **Groundwater Use** | Laramie | WY5600012 | Orchard Valley Water Company | 300 | 2 wells | 34,500 | 172,500* | 400 | 2 High Plains Aquifer wells | 9,000,000 | 24,658 | 35,000 | WWDC, 2013 |
| | Laramie | WY5600021 | Evergreen Park LLC | 50 | 1 well | 11,300 | 28,750 | 50 | 1 High Plains Aquifer well | 4,124,500 | 11,300 | 28,750 | Usage estimated |
| | Laramie | WY5600040 | Town of Pine Bluffs | 1,153 | 5 Brule Aquifer wells | 288,250 | 662,975 | 1,137 | 2 Lance/Fox Hills Aquifer wells, 2 Brule Aquifer wells, 1 Terrace Aquifer well | 95,444,024 | 261,490 | 735,000 | Lidstone, 2015; WWDC, 2013 |
| | Laramie | WY5600051 | Miller Lower Mobile Home Park | 70 | 1 well | 15,820 | 40,250 | 40 | 2 High Plains Aquifer wells | 3,299,600 | 9,040 | 23,000 | Usage estimated |
| | Laramie | WY5600188 | Town of Burns | 315 | 4 wells | 42,000 | 75,000 | 301 | 4 High Plains Aquifer wells | 38,880,000 | 106,521 | 405,000 | Lidstone, 2011; WWDC, 2013 |
| | Laramie | WY5600189 | Town of Albin | 120 | 3 wells | 15,000 | 40,000 | 120 | 5 High Plains Aquifer wells | 26,664,146 | 73,052 | 200,000 | Benchmark, 2005; WWDC, 2013 |
| | Laramie | WY5600260 | High Plains Ranch | 60 | 1 well | 13,560 | 34,500 | 50 | 1 High Plains Aquifer well | 4,124,500 | 11,300 | 28,750 | Usage estimated |
| | Laramie | WY5600263 | Hide-a-Way Mobile Home Park | 69 | 2 wells | 15,594 | 39,675 | 130 | 2 High Plains Aquifer wells | 10,723,700 | 29,380 | 74,750 | Usage estimated |
| | Laramie | WY5600266 | Avalon Mobile Manor | 120 | 1 well | 27,120 | 69,000 | 120 | 1 High Plains Aquifer well | 9,898,800 | 27,120 | 69,000 | Usage estimated; WWDC, 2013 |
| | Laramie | WY5600779 | Winchester Hills | 600 | 2 wells | 135,600 | 345,000 | 937 | 3 High Plains Aquifer wells | 77,293,130 | 211,762 | 538,775 | Usage estimated |
| | Laramie | WY5601265 | AAA Mobile Home Park | 200 | 2 wells | 45,200 | 115,000 | NA | NA | NA | NA | NA | System Inactive |
| | Laramie | WY5601464 | Carpenter Water & Sewer District | 90 | 2 Chadron Aquifer wells | 20,340 | 51,750 | 100 | 2 Chadron Aquifer wells | 8,249,000 | 22,600 | 57,500 | Usage estimated |
| | | | **Totals** | **3,147** | | **664,284** | **1,501,900** | **3,385** | | **287,701,400** | **788,223** | **2,195,525** | |
| **Conjunctive Water Use** | Laramie | WY5600011 | Cheyenne Board of Public Utilities | 65,000 | 39 wells, Several surface water sources | 13,100,000 | 36,800,000 | 73,836 | 33 High Plains Aquifer wells, numerous surface water sources including N Fork, Little Snake R, Middle Fork, Crow Creek and Douglas Creek | 4,942,100,000 | 13,540,000 | 31,000,000 | HDR, 2013; WWDC, 2013 |
| | | | **Totals** | **65,000** | | **13,100,000** | **36,800,000** | **73,836** | | **4,942,100,000** | **13,540,000** | **31,000,000** | |

Notes: (1) Public Water System identification according to EPA
(2) Data from 2002 WWDC water system survey report or sources included in original Basin Plan technical memorandum
(3) All data from 2013 Wyoming Water Development Commission Public Water System Survey Report unless noted otherwise under remarks.
(4) Where estimated, based on 226 gallons per person per day.
(5) Where estimated, based on 575 gallons per person per day.

# APPENDIX 3-C

Reservoirs Above Pathfinder Subject to Decree Compliance

Water Stored for Irrigation Purposes in Eleven Largest Reservoirs

**Table 1. Reservoirs above Pathfinder Subject to Decree Compliance**

| Reservoir | Permit Number[2] | Capacity (acre-feet) | Township | Range | Section | Subbasin | Source |
|---|---|---|---|---|---|---|---|
| **Anderson** | 4121R<br>4449R | 369 | 15 | 84 | 21 | Saratoga | Teddy Creek, Otto Creek |
| **Antelope** | 5242R | 147 | 16 | 85 | 18 | Saratoga | North Spring Creek |
| **B B** | 2688R | 117 | 30 | 86 | 28 | Sweetwater | Dry Creek |
| **Baby** | 1551R | 28 | 14 | 82 | 19 | Saratoga | Beaver Creek |
| **Brownlee** | 1R | 98 | 14 | 83 | 9 | Saratoga | Cotton Creek |
| **Buck Draw** | 5530R<br>6079R | 315 | 16 | 85 | 6 | Saratoga | Jack Creek |
| **Bucklin[1]** | 1026R<br>1976R | 736 | 28 | 88 | 18 | Sweetwater | Whiskey Creek |
| **Bucklin #2[1]** | 4108R | 519 | 28 | 88 | 18 | Sweetwater | Whiskey Creek |
| **Cardwell** | 692R | 56 | 28 | 84 | 13 | Medicine Bow | Hill Creek |
| **Cherokee Trail** | 1767R | 95 | 14 | 83 | 22 | Saratoga | Indian Creek |
| **Corpening** | 4726R | 116 | 17 | 80 | 34 | Saratoga | Little Canyon Creek |
| **Cotton** | 3804R | 12 | 14 | 83 | 15 | Saratoga | Indian Creek |
| **Cow Creek Lake[1]** | 1726R<br>3960R<br>5486R | 601 | 14 | 85 | 15 | Saratoga | Cow Creek |
| **Dutton Creek[1]** | 528R<br>1215R<br>2375R | 1489 | 19 | 77 | 24 | Medicine Bow | Dutton Creek |
| **East** | 3843R | 13 | 28 | 84 | 13 | Medicine Bow | Hill Creek |
| **Fries** | 459R | 6 | 14 | 84 | 11 | Saratoga | North Fork |
| **Galusha Draw** | 6003R | 28 | 27 | 83 | 16 | Medicine Bow | Indian Creek |
| **Good #1** | 5824R | 191 | 17 | 86 | 15 | Saratoga | Beaver Creek |
| **Greyhound** | 1120R | 108 | 20 | 83 | 26 | Saratoga | Rattlesnake Creek |

**Table 1. Reservoirs above Pathfinder Subject to Decree Compliance (cont.)**

| Reservoir | Permit Number[2] | Capacity (acre-feet) | Township | Range | Section | Subbasin | Source |
|---|---|---|---|---|---|---|---|
| **Gunst** | 240R<br>1552R<br>3260R | 269 | 14 | 83 | 24 | Saratoga | Dufunny Creek |
| **Gunst** | 240R<br>1552R<br>3260R | 269 | 14 | 83 | 24 | Saratoga | Dufunny Creek |
| **Hanna Mahoney #2** | 824R<br>3433R | 84 | 26 | 89 | 2 | Sweetwater | Muddy Creek |
| **Higby #1** | 5545R | 8 | 13 | 82 | 11 | Saratoga | Bear Creek |
| **Horn & Meason** | 1052R<br>2414R | 430 | 17 | 83 | 27 | Saratoga | Cedar Creek |
| **Horne** | 461R<br>6130R | 230 | 21 | 77 | 4 | Medicine Bow | Foote Creek |
| **Indian Creek** | 6002R | 65 | 27 | 83 | 16 | Medicine Bow | Indian Creek |
| **Irene** | 5816R | 251 | 27 | 83 | 13 | Medicine Bow | Dry Creek |
| **Irene #2** | 5904R | 87 | 27 | 83 | 33 | Medicine Bow | Indian Creek |
| **Jack Creek** | 783R<br>2595R | 182 | 16 | 86 | 12 | Saratoga | Jack Creek |
| **Joe D. Reservoir** | 703R | 21 | 21 | 76 | 32 | Medicine Bow | Fieland Creek |
| **John Campbell #1** | 2034R | 56 | 27 | 83 | 9 | Medicine Bow | Indian Creek |
| **Keystone** | 3519R | 172 | 16 | 80 | 23 | Saratoga | South Twin Lakes Creek |
| **Kindt[1]** | 729R | 2422 | 19 | 86 | 33 | Saratoga | Little Sage Creek |
| **Kinney** | 474R | 311 | 21 | 82 | 24 | Saratoga | Dana Springs |
| **King #1[1]** | 3617R | 2900 | 19 | 77 | 29 | Medicine Bow | Canon |
| **Lady Emma** | 1641R | 29 | 32 | 88 | 3 | Sweetwater | Dry Creek |
| **Long Pond** | 5481R | 55 | 17 | 86 | 32 | Saratoga | Beaver Creek |
| **Low** | 5475R | 184 | 16 | 87 | 1 | Saratoga | Willow Creek |
| **Marsh & Company** | 825R<br>823R | 152 | 26 | 88 | 8 | Sweetwater | Muddy Creek |

**Table 1. Reservoirs above Pathfinder Subject to Decree Compliance (cont.)**

| Reservoir | Permit Number[2] | Capacity (acre-feet) | Township | Range | Section | Subbasin | Source |
|---|---|---|---|---|---|---|---|
| **North Spring Creek**[1] | 539R<br>6065R | 1623 | 14 | 86 | 4 | Saratoga | North Spring Creek |
| **Pierce**[1] | 634R<br>2407R | 3895 | 20 | 77 | 20 | Medicine Bow | Rock Creek |
| **Point of Rocks** | 990R | 149 | 26 | 80 | 15 | Medicine Bow | Cottonwood Creek |
| **Rainey Reservoir** | 3547R | 1113 | 19 | 76 | 9 | Medicine Bow | Coalbank Creek |
| **Reversed Kay Seven** | 1766R | 10 | 14 | 83 | 22 | Saratoga | Indian Creek |
| **Robert Cardwell #1** | 959R | 6 | 28 | 83 | 18 | Medicine Bow | Dry Gulch |
| **Robert Cardwell #2** | 960R | 335 | 28 | 83 | 18 | Medicine Bow | Dry Gulch |
| **Rigby's** | P82R<br>P403R | 336 | 29 | 92 | 27 | Sweetwater | Crook's Creek |
| **Rollman** | 281R | 17 | 14 | 82 | 29 | Saratoga | Beaver Creek |
| **Ryan Brothers Lake** | 2134R | 207 | 16 | 80 | 23 | Saratoga | North Twin Lake |
| **Sage Creek**[1] | 2040R | 635 | 18 | 86 | 2 | Saratoga | Sage Creek |
| **Sand Lake**[1] | 6136R | 1300 | 17 | 79 | 9 | Medicine Bow | Rock Creek |
| **Seaverson** | 4612R<br>5531R | 50 | 18 | 85 | 36 | Saratoga | McPhail Creek |
| **Sederlin** | 1162R | 78 | 19 | 81 | 1 | Medicine Bow | Fish Creek |
| **Shell Creek** | P5508R | 130 | 31 | 84 | 26 | Sweetwater | Shell Creek |
| **Silver Lake** | 3763R | 322 | 14 | 85 | 18 | Saratoga | Silver Lake Brook |
| **South Spring Creek Lake**[1] | 2508R | 857 | 14 | 86 | 2 | Saratoga | South Spring Creek |
| **Spring Creek** | 3460R | 240 | 27 | 82 | 32 | Medicine Bow | Spring Creek |
| **Stephenson** | 730R | 75 | 22 | 82 | 23 | Saratoga | Big Ditch Creek |
| **Sucker Lakes** | 3990R | 49 | 16 | 80 | 26 | Saratoga | Snow |

**Table 1. Reservoirs above Pathfinder Subject to Decree Compliance (cont.)**

| Reservoir | Permit Number[2] | Capacity (acre-feet) | Township | Range | Section | Subbasin | Source |
|---|---|---|---|---|---|---|---|
| **Summitt** | 804R<br>6076R | 128 | 13 | 82 | 3 | Saratoga | Beaver Creek |
| **McQueary Reservoir** | 2160R | 81 | 31 | 84 | 27 | Sweetwater | Fish Creek |
| **Meer** | 5952R | 122 | 27 | 81 | 3 | Medicine Bow | Dry Creek |
| **Mule Creek** | 991R | 96 | 26 | 7 | 1 | Medicine Bow | Mule Creek |
| **Three Mile** | 239R | 132 | 28 | 77 | 36 | Medicine Bow | Three Mile Creek |
| **Toothaker** | 5816R | 215 | 14 | 82 | 16 | Saratoga | Beaver Creek |
| **Turpin Park**[1] | 6155R | 1503 | 17 | 80 | 16 | Medicine Bow | Turpin Creek |
| **Verplancke** | 518R<br>6085R | 224 | 14 | 82 | 30 | Saratoga | Billy Creek |
| **White's A** | 3217R | 32 | 20 | 77 | 22 | Medicine Bow | Coalbank Creek |
| **Wiant** | 2202R<br>3859R | 296 | 16 | 80 | 11 | Saratoga | South Bush Creek |

**Notes:** 1) Largest reservoirs with new measuring devices installed per requirement of Modified Decree. Wenck Associates completed surveying and new reservoir capacity tables in 2005. Total capacity volumes in the third column were updated based on new survey data.

2) WSEO original reservoir permits and enlargement permits.

**Table 2. Water Stored for Irrigation Purposes in Eleven Largest Reservoirs**

| Water Year | Carry-Over<br>acre-feet | Estim. Max Water Stored<br>acre-feet | Reported Accrual<br>acre-feet |
|---|---|---|---|
| **2003** | 1,485 | 11,999 | 10,514 |
| **2004** | 1,618 | 5,519 | 3,901 |
| **2005** | 1,483 | 10,877 | 9,394 |
| **2006** | 2,183 | 11,745 | 9,562 |
| **2007** | 3,116 | 13,721 | 10,605 |
| **2008** | 4,591 | 15,235 | 10,644 |
| **2009** | 5,997 | 14,608 | 8,611 |
| **2010** | 6,869 | 14,644 | 7,775 |
| **2011** | 7,595 | 11,699 | 4,104 |
| **2012** | 6,015 | 9,600 | 3,815 |
| **2013** | 3,861 | 11,532 | 7,685 |
| **2014** | 5,185 | 14,756 | 9,571 |
| | | | |
| **Averages** | 4,167 | 12,161 | 8,015 |
| **Minimums** | 1,483 | 5,519 | 3,815 |
| **Maximums** | 7,595 | 15,235 | 10,644 |

**Table 2. Water Stored for Irrigation Purposes in Reservoirs above Pathfinder in Wyoming**

| Water Year | Carry-Over<br>acre-feet | Estim. Max Water Stored[3]<br>acre-feet | Reported Accrual[2]<br>acre-feet |
|---|---|---|---|
| **1951** | | | 11,986 |
| **1952** | 255 | 14,108 | 13,853 |
| **1953** | 371 | 11,691 | 11,320 |
| **1954** | 1,323 | 9,669 | 8,346 |
| **1955** | 787 | 11,080 | 10,293 |
| **1956** | 1,085 | 13,602 | 12,517 |
| **1957** | 910 | 17,319 | 16,409 |
| **1958** | 6,387 | 19,832 | 13,445 |
| **1959** | 5,232 | 17,152 | 11,920 |
| **1960** | 4,910 | 18,643 | 13,733 |
| **1961** | 4,515 | 17,029 | 12,514 |
| **1962** | 3,177 | 17,078 | 13,901 |
| **1963** | 4,068 | 15,611 | 11,543 |
| **1964** | 992 | 15,266 | 14,274 |
| **1965**[1] | 1,066 | 19,014 | 17,948 |
| **1966**[1] | 7,789 | 27,223 | 19,434 |
| **1967**[1] | 7,872 | 14,533 | 6,661 |
| **1968** | 11,301 | 19,098 | 7,797 |
| **1969** | 8,772 | 20,223 | 11,451 |
| **1970** | 6,349 | 17,800 | 11,451 |
| **1971** | 6,349 | 16,087 | 9,738 |
| **1972** | 9,315 | 21,010 | 11,695 |
| **1973** | 8,183 | 21,236 | 13,053 |
| **1974** | 7,836 | 20,399 | 12,563 |
| **1975** | 6,697 | 21,675 | 14,978 |
| **1976** | 8,904 | 22,404 | 13,500 |
| **1977** | 5,018 | 15,679 | 10,661 |
| **1978** | 5,055 | 20,411 | 15,356 |
| **1979** | 5,881 | 23,433 | 17,552 |
| **1980** | 7,730 | 23,324 | 15,594 |
| **1981** | 7,262 | 18,142 | 10,880 |
| **1982** | 5,103 | 20,143 | 15,039 |
| **1983** | 12,956 | 18,710 | 5,754 |
| **1984** | 11,773 | 17,544 | 5,771 |
| **1985** | 9,079 | 17,973 | 8,894 |
| **1986** | 3,273 | 18,361 | 15,088 |
| **1987** | 4,410 | 13,850 | 9,440 |
| **1988** | 4,354 | 17,871 | 13,517 |
| **1989** | 4,023 | 12,139 | 8,116 |
| **1990** | 3,607 | 15,067 | 11,459 |
| **1991** | 3,246 | 16,146 | 12,900 |
| **1992** | 3,846 | 15,052 | 11,206 |

**Table 2. Water Stored for Irrigation Purposes Reservoir above Pathfinder in Wyoming (cont.)**

| Water Year | Carry Over<br>acre-feet | Estim. Max Water Stored[3]<br>acre-feet | Reported Accrual[2]<br>acre-feet |
|---|---|---|---|
| **1993** | 2,889 | 16,784 | 13,895 |
| **1994** | 4,378 | 15,153 | 10,775 |
| **1995** | 1,521 | 15,629 | 14,108 |
| **1996** | 5,878 | 16,009 | 10,131 |
| **1997** | 3,444 | 18,223 | 14,779 |
| **1998** | 7,595 | 19,374 | 11,779 |
| **1999** | 6,540 | 16,448 | 9,908 |
| **2000** | 5,978 | 16,633 | 10,655 |
| **2001** | 2,059 | 15,142 | 13,083 |
| **2002** | 2,464 | 8,412 | 5,429 |
| **2003** | 3,598 | 15,737 | 13,273 |
| **2004** | 3,133 | 9,520 | 5,922 |
| **2005** | 3222 | 16,033 | 12,811 |
| **2006** | 4707 | 16,731 | 12,024 |
| **2007** | 5,111 | 19,427 | 14,316 |
| **2008** | 6,571 | 22,238 | 15,667 |
| **2009** | 8,921 | 21,646 | 12,736 |
| **2010** | 9,561 | 21,874 | 12,313 |
| **2011** | 10,713 | 18,815 | 8,107 |
| **2012** | 9,136 | 15,506 | 6,642 |
| **2013** | 4,772 | 16,373 | 11,626 |
| **2014** | 5,869 | 22,744 | 16,875 |

**Notes:** 1) The Wyoming State Engineer's reports for 1965, 1966, and 1967 mistakenly reported storage that included Seminoe Reservoir storage. Some of the WSEO records were destroyed in a fire in the Torrington field office on February 22, 1969 (WSEO July 1998). The reported values for these three years were not included in the statistics for accruals and estimated maximum storage in Table 5 below.

2) The above accrual reporting was often discussed at the annual Natural Flow and Ownership (NFO) meetings held between 1946 and 2001. Following the issuance of the Final Settlement Stipulation and the Modified Decree, the North Platte Decree Committee meetings are held twice a year in the spring and fall with annual accruals reported annually during the spring meeting.

3) The WSEO reservoir records of the maximum water stored were not available for 1956 through 2002. For the table above, the maximum storage is estimated by adding the carryover from the previous water year to the total accrual amount in the current water year. The maximum storage in the table for 2003 through 2014 is the actual WSEO storage quantities measured in the spring of each year.

## Table 3. New and Enlarged Reservoir Permits

| Platte Subbasin | SEO Permit No. | Reservoir Name | Priority Date | Overall Capacity | Permitted Uses |
|---|---|---|---|---|---|
| Above Path | P13044R | RED DESERT RECLAMATION 1-2-3 RESERVOIR | 12/7/2007 | 54.72 | IND_SW |
| Above Path | P13579R | CHAPMAN | 1/11/2008 | 68.16 | FIS; REC; STO; WL |
| Above Path | P13681R | ENL. TURPIN PARK RESERVOIR | 8/10/2010 | 186.56 | IRR_SW |
| Above Path | P13895R | ENL. SULLIVAN PIT RESERVOIR | 4/26/2011 | 73,762 | IND_SW |
| Upper Laramie | P14093R | SPIEGELBERG SPRINGS | 4/22/2013 | 131.4 | CMU; STO; WL |
| Lower Laramie | P14249R | WHEATLAND WASTEWATER LAGOON SYS | 5/23/2013 | 418.8 | IND_SW; IRR_SW |
| Path to Guern | P12606R | REESE RESERVOIR | 2/22/2006 | 53 | CMU; FIS; WL |
| Path to Guern | P13125R | EASTDALE CREEK DETENTION RESERVOIR NO. 2 | 9/17/2007 | 57.15 | FLO |
| Path to Guern | P13232R | CCI | 11/1/2006 | 240.4 | CMU; STO; WL |
| Path to Guern | P13409R | EASTGATE RESERVOIR | 2/10/2009 | 575.32 | DOM_SW; IRR_SW; REC; STO; WL |
| Path to Guern | P13729R | MCMURRY NO. 2 RESERVOIR | 2/3/2011 | 92.35 | FIS; REC; STO |
| Path to Guern | P14106R | MCMURRY NO. 4 RESERVOIR | 3/19/2013 | 367.16 | CMU; FIS; IND_SW; IRR_SW; REC; STO |
| Path to Guern | P14174R | HENRIE NO. 2 | 10/14/2013 | 51.95 | STO; FIS, WL |
| Guern to S.L. | P12936R | FRONTIER RESERVOIR | 10/13/2006 | 331.8 | REC |
| South Platte | P12527R | WARREN AIR FORCE BASE BNSF POND RESERVOIR | 3/20/2006 | 130.5 | FLO |
| South Platte | P12970R | BURNETT DAIRY NO. 1 RESERVOIR | 6/27/2007 | 93.18 | IND_SW; IRR_SW |
| South Platte | P13794R | SOUTH LAKE PEARSON RESERVOIR | 8/18/2011 | 84.5 | DSP; FIS; IND_SW; REC |
| South Platte | P13795R | NORTH LAKE PEARSON RESERVOIR | 8/18/2011 | 125.88 | DSP; FIS; IND_SW; REC |

Notes: 1. Permitted Uses: CMU - Combined uses, DSP - domestic supply, FIS - fish propagation, IND_SW - Industrial, REC - recreation, IRR_SW - Irrigation, WL - wildlife.
2. No Appropriation was granted for P13895R since the appropriation was originally permitted under P12415R.

## Table 4. Reservoirs in the Pathfinder to Guernsey Subbasin

| Permit number | Reservoir name | Priority date | Active capacity acre-feet | Inactive capacity acre-feet | Enlargement capacity acre-feet | Total capacity acre-feet |
|---|---|---|---|---|---|---|
| P728R | LaPrele Reservoir | 9/21/1905 | | | | 15,106.0 |
| P1581R | LaPrele Reservoir, Enl. | 7/7/1909 | | | 4,894.0 | 20,000.0 |
| P1708R | Johnson No. 1 Reservoir | 10/11/1909 | | | | 11,865.0 |
| P6279R | Soda Lake Reservoir | 1/20/1956 | | | | 8,815.0 |
| P549R | Bates Creek Reservoir | 2/16/1904 | | | | 3,112.0 |
| P5144R | Bates Creek Reservoir, Enl. | 9/29/1939 | | | 1,605.0 | 4,717.0 |
| P5199R | J. and J. Reservoir | 10/19/1939 | | | | 1,423.1 |
| P1067R | Reynolds No. 2 Reservoir | 6/27/1907 | | | | 1,008.0 |
| P13409R | Eastgate Reservoir | 2/10/2009 | | | | 575.3 |
| P14106R | McMurry No. 4 Reservoir | 3/19/2013 | | | | 367.2 |
| P13232R | CCI | 11/1/2006 | | | | 240.4 |
| P13729R | McMurry No. 2 Reservoir | 2/3/2011 | | | | 92.4 |
| P13125R | Eastdale Creek Detention Reservoir no. 2 | 9/17/2007 | | | | 57.2 |
| P12606R | Reese Reservoir | 2/22/2006 | | | | 53.0 |
| P14174R | Henrie No. 2 | 10/14/2013 | | | | 51.1 |
| Source: Wyoming State Engineer's Office. | | | | | | |

## Table 5. Reservoirs in the Guernsey to State Line Subbasin

| Permit number | Reservoir name | Priority date | Active capacity acre-feet | Inactive capacity acre-feet | Enlargement capacity acre-feet | Total capacity acre-feet |
|---|---|---|---|---|---|---|
| P6423R | Detention Reservoir Pine Ridge - 1 | 4/24/1958 | | | | 2,207.72 |
| P6422R | Detention Reservoir Case Bier - 1 | 4/24/1958 | | | | 1,458.88 |
| P1310R | Harris Reservoir | 6/17/1908 | | | | 292.81 |
| P2110R | Harris Reservoir, Enl. | 4/8/1911 | | | 1,013.04 | 1,305.85 |
| P4594R | Arnold Reservoir | 8/7/1934 | | | | 770.00 |
| P6879R | Arnold Reservoir, Enl. | 7/1/1963 | | | 364.45 | 1,134.45 |
| P12936R | Frontier Reservoir | 10/13/2006 | | | | 331.80 |
| Source: Wyoming State Engineer's Office. | | | | | | |

**Table 6. Reservoirs in the Upper Laramie Subbasin**

| Permit number | Reservoir name | Priority date | Active capacity acre-feet | Inactive capacity acre-feet | Enlargement capacity acre-feet | Total capacity acre-feet |
|---|---|---|---|---|---|---|
| P1724D | Wyoming Development Company No. 2 Reservoir (Wheatland No. 2) | 1/29/1898 | | | | 98,934.00 |
| P4978R | Wheatland Irrigation District No. 3 Reservoir | 5/31/1929 | 47,429.80 | 23,889.00 | | 71,318.80 |
| P1372R | Lake Hattie Reservoir | 5/11/1908 | | | | 28,426.00 |
| P9250R | Lake Hattie Reservoir, Enl. | 5/1/1986 | | | 36,834.00 | 65,260.00 |
| P1279R | James Lake Reservoir | 3/27/1908 | | | | 8,990.00 |
| P7435R | Twin Buttes Reservoir | 2/3/1972 | 936.90 | 2,975.40 | | 3,912.30 |
| P4156R | Twelve Mile Reservoir | 1/31/1929 | | | | 3,420.50 |
| P528R | Dutton Creek Reservoir | 7/1/1904 | | | | |
| P1215R | Dutton Creek Reservoir, Enl. | 2/17/1908 | | | | |
| P2375R | Dutton Creek Reservoir, 2nd Enl. | 8/2/1912 | | | | |
| P3617R | King No. 1 Reservoir | 2/7/1920 | | | | |
| P5641R | Sportsman Lake Reservoir | 10/12/1948 | | | | 1,459.00 |
| P761R | Willow Creek Reservoir (as changed to Willow Creek No. 2 Reservoir) | 10/17/1905 | | | | 284.27 |
| P5620R | Willow Creek Reservoir, 1st Enl. (as changed to Willow Creek No. 2 Reservoir) | 9/15/1947 | | | 472.36 | 756.63 |
| P8026R | Willow Creek No. 2 Reservoir | 8/2/1978 | | | | 473.71 |
| P6537R | Berg (Lake Owen) Reservoir | 5/8/1956 | | | | 750.68 |
| P14093R | Spiegelberg Springs | 4/22/2013 | | | | 131.40 |

Source: Wyoming State Engineer's Office.

## Table 7. Reservoirs in the Lower Laramie Subbasin

| Permit number | Reservoir name | Priority date | Active capacity acre-feet | Inactive capacity acre-feet | Enlargement capacity acre-feet | Total capacity acre-feet |
|---|---|---|---|---|---|---|
| P7649R | Grayrocks Reservoir | 4/24/1973 | 101,551.50 | 2,558.10 | | 104,109.60 |
| P79R | Wyoming Development Company No. 1 Reservoir | 3/00/1897 | | | | 5,360.00 |
| P5387R | Wyoming Development Company No. 1 Reservoir, Enlargement | 8/18/1938 | | | 1,795.75 | 7,155.75 |
| P6470R | Wyoming Development Company No. 1 Reservoir, 2nd Enl. | 7/10/1958 | | | 2,214.00 | 9,369.75 |
| P1515R | North Laramie Land Co. No. 1 Reservoir | 5/1/1909 | | | | 1,909.60 |
| P1517R | North Laramie Land Co. No. 3 Reservoir | 5/1/1909 | | | | 3,064.89 |
| P7252R | Toltec Reservoir | 3/27/1967 | | | | 2,945.00 |
| P7810R | MBPP Ash Pond Reservoir | 11/16/1976 | | | | 2,111.10 |
| P1989R | Glomill Reservoir | 11/17/1910 | 810.00 | | | 810.00 |
| P7670R | Glomill Reservoir, Enlargement of the | 3/11/1975 | | | 486.40 | 1,296.40 |
| P14249R | Wheatland Wastewater Lagoon Sys. | 5/23/2013 | | | | 418.80 |

Source: Wyoming State Engineer's Office.

## Table 8. Reservoirs in the Horse Creek Subbasin

| Permit number | Reservoir name | Priority date | Active capacity acre-feet | Inactive capacity acre-feet | Enlargement capacity acre-feet | Total capacity acre-feet |
|---|---|---|---|---|---|---|
| P1307R | Hawk Springs Reservoir | 5/25/1908 | | | | 15,718.00 |
| P2568R | Hawk Springs Reservoir, Enlargement | 10/13/1913 | | | 1,017.00 | 16,735.00 |
| P349R | Goshen Hole Reservoir | 11/5/1902 | | | | 3,327.24 |
| P4425R | Goshen Hole Reservoir, Enlargement | 6/7/1930 | | | 1,633.95 | 4,961.19 |
| P941R | J.H.D. No. 1 Reservoir | 10/19/1906 | | | | 2,040.85 |
| P2140R | Goshen Reservoir | 5/22/1911 | | | | 765.60 |
| P3517R | Goshen Nos. 1 and 2 Reservoir, Enlargement | 1/8/1919 | | | 287.40 | 1,929.00 |
| P2716R | Goshen No. 2 Reservoir | 7/16/1914 | | | | 876.00 |
| P3605R | Sinnard Reservoir | 2/11/1920 | | | | 1,358.31 |

Source: Wyoming State Engineer's Office.

## Table 9. Reservoirs in the South Platte Subbasin

| Permit number | Reservoir name | Priority date | Active capacity acre-feet | Inactive capacity acre-feet | Enlargement capacity acre-feet | Total capacity acre-feet |
|---|---|---|---|---|---|---|
| P261R | Cheyenne No. 2 Reservoir (Granite Springs Reservoir) | 11/9/1901 | | | | 7,367.00 |
| P1317R | Crystal Lake Reservoir | 10/10/1906 | | | | 3,618.00 |
| P3684R | Crystal Lake Reservoir, Enl. | 1/31/1921 | | | 894.70 | 4,512.70 |
| P928R | One Mile Reservoir | 10/5/1906 | | | | 127.16 |
| P1060R | One Mile Reservoir,Enl. | 6/8/1907 | | | 2,120.00 | 2,247.16 |
| P4152R | Upper Van Tassell Reservoir | 10/24/1912 | | | | 1,867.90 |
| P3984R | W.H.R. Reservoir | 9/25/1924 | | | | 674.29 |
| P4402R | W.H.R. Reservoir, Enl. | 10/8/1929 | | | 203.75 | 878.04 |
| P4032R | W.H.R. No. 2 Reservoir | 12/11/1925 | | | | 794.65 |
| P4640R | W.H.R. No. 2 Reservoir, 1st Enl. | 2/10/1936 | | | 82.70 | 877.35 |
| P994R | Polaris Reservoir | 12/22/1906 | | | | 440.00 |
| P1476R | Polaris Reservoir | 3/30/1909 | | | 607.62 | 1,047.62 |
| P12527R | Warren Air Force Base BNSF Pond Reservoir | 3/20/2006 | | | | 130.50 |
| P13795R | North Lake Pearson Reservoir | 8/18/2011 | | | | 125.88 |
| P12970R | Burnett Diary No. 1 Reservoir | 6/27/2007 | | | | 93.18 |
| P13794R | South Lake Pearson Reservoir | 8/18/2011 | | | | 84.50 |

Source: Wyoming State Engineer's Office.

## APPENDIX 3-D

Industrial Water Wells Yielding 50+ GPM Completed After January 1, 2005 with Priority Dates Since 2006

Oil and Gas Water Wells and CBM Wells with Priority Dates after 2006 Completed After January 1, 2014

Industrial Reservoirs Permitted by the Wyoming SEO Since the 2006 Platte River Basin Plan

**Table 1: Industrial Water Wells Yielding 50+ GPM Completed After January 1, 2004 with Priority Dates Since 2006**

| | Permit No | Priority Date | Company/Name | Facility Name | Latitude | Longitude | Twn | Rng | Sec | Qtr Qtr | Total Flow | Subcategory |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **Above Pathfinder Dam Subbasin** | | | | | | | | | | | |
| 1 | P189879.0W | 2/23/2009 | WYDOT | BROKAW PIT | 41.595167 | -106.1995 | 019N | 078W | 30 | NW1/4NE1/4 | 50 | Agg |
| 2 | P201721.0W | 12/19/2013 | ENERGY FUELS WYOMING INC. | SHEEP II SHAFT | 42.3758 | -107.82111 | 028N | 092W | 28 | NW1/4NE1/4 | 1,000 | Mine |
| 3 | P201720.0W | 12/19/2013 | ENERGY FUELS WYOMING INC. | SHEEP I SHAFT | 42.38293 | -107.8113 | 028N | 092W | 22 | NW1/4SW1/4 | 1,000 | Mine |
| 4 | P200271.0W | 2/21/2013 | ARCH OF WYOMING, LLC | SBH-SOUTH PORTAL #1 | 41.738964 | -106.390869 | 020N | 080W | 4 | SW1/4NE1/4 | 1,000 | Mine |
| 5 | P200270.0W | 2/21/2013 | ARCH OF WYOMING, LLC | SBH-EAST PORTAL #1 | 41.752336 | -106.444008 | 021N | 080W | 31 | NE1/4NE1/4 | 1,300 | Mine |
| 6 | P181753.0W | 6/5/2007 | KENNECUTT URANIUM COMPANY | BE-001 | 42.34625 | -107.74412 | 027N | 091W | 6 | NW1/4NE1/4 | 150 | Mine |
| 7 | P191170.0W | 7/1/2009 | MCMURRY READY MIX | PIT SEC. 14 | 41.791469 | -107.3052 | 021N | 088W | 14 | NE1/4SW1/4 | 100 | Road |
| 8 | P200679.0W | 5/1/2013 | ARCH OF WYOMING, LLC | ROSEBUDPIT #1 | 41.874631 | -106.584519 | 022N | 082W | 13 | NW1/4SE1/4 | 200 | Stk |
| 9 | P173173.0W | 1/9/2006 | Wyo State Game & Fish Dept. | PENNOCK SECTION 34 | 41.48356 | -106.72524 | 018N | 083W | 34 | SW1/4SW1/4 | 75 | Stk |
| | **Pathfinder to Guernsey Subbasin** | | | | | | | | | | | |
| | **Permit_No** | **Priority_Date** | **Company/Name** | **Facility_Name** | **Latitude** | **Longitude** | **Twn** | **Rng** | **Sec** | **Qtr_Qtr** | **Total_Flow** | **Subcategory** |
| 1 | P203146.0W | 10/17/2014 | GGH AGGREGATE LLC | JOE BRIGHT G.A. #1 | 42.67944 | -105.02162 | 031N | 068W | 9 | NE1/4NW1/4 | 1,000 | Agg |
| 2 | P194726.0W | 1/4/2011 | CROELL REDI-MIX INC | ELKHORN SAND & GRAVEL PIT #1 | 42.573275 | -105.075272 | 030N | 069W | 13 | SW1/4NE1/4 | 200 | Agg |
| 3 | P198424.0W | 6/26/2012 | CROELL REDI MIX, INC. | ENL. ELKHORN SAND & GRAVEL PIT #1 | 42.57285 | -105.075039 | 030N | 069W | 13 | SW1/4NE1/4 | 300 | Agg |
| 4 | P203080.0W | 10/27/2014 | CAMECO RESOURCES | SWNE 21-35-74 (UP TO 56 WELLS) MINE UNIT 10 EXT | 42.99193 | -105.73938 | 035N | 074W | 21 | SW1/4NE1/4 | 1,400 | Mine |
| 5 | P203079.0W | 10/27/2014 | CAMECO RESOURCES | NWNE 21-35-74 (UP TO 87 WELLS) MINE UNIT 10 EXT | 42.99578 | -105.73939 | 035N | 074W | 21 | NW1/4NE1/4 | 2,175 | Mine |
| 6 | P203078.0W | 10/27/2014 | CAMECO RESOURCES | NENW 21-35-74 (UP TO 70 WELLS) MINE UNIT 10 EXT | 42.99575 | -105.74432 | 035N | 074W | 21 | NE1/4NW1/4 | 1,750 | Mine |
| 7 | P203077.0W | 10/27/2014 | CAMECO RESOURCES | SWSE 16-35-74 (UP TO 52 WELLS) MINE UNIT 10 EXT | 42.99927 | -105.73953 | 035N | 074W | 16 | SW1/4SE1/4 | 1,300 | Mine |
| 8 | P203076.0W | 10/27/2014 | CAMECO RESOURCES | SESW 16-35-74 (UP TO 81 WELLS) MINE UNIT 10 EXT | 42.99927 | -105.74418 | 035N | 074W | 16 | SE1/4SW1/4 | 2,025 | Mine |
| 9 | P203075.0W | 10/27/2014 | CAMECO RESOURCES | NESW 16-35-74 (UP TO 117 WELLS) MINE UNIT 10 EXT | 43.00293 | -105.74427 | 035N | 074W | 16 | NE1/4SW1/4 | 2,925 | Mine |
| 10 | P203074.0W | 10/27/2014 | CAMECO RESOURCES | NWSW 16-35-74 (UP TO 11 WELLS) MINE UNIT 10 EXT | 43.00296 | -105.75153 | 035N | 074W | 16 | NW1/4SW1/4 | 275 | Mine |
| 11 | P201526.0W | 1/29/2014 | CAMECO RESOURCES | SE/SE 7-35-74 (UP TO 15 WELLS)-MINE UNIT 9 (I & P) | 43.01339 | -105.7741 | 035N | 074W | 7 | SE1/4SE1/4 | 375 | Mine |
| 12 | P199096.0W | 8/30/2012 | CAMECO RESOURCES | 3674-36-CPPWW-1 | 43.05326 | -105.68603 | 036N | 074W | 36 | NE1/4NW1/4 | 50 | Mine |
| 13 | P198125.0W | 5/4/2012 | CAMECO RESOURCES | SE/NW 26-36-74(UP TO 15 WELLS) - MINE UNIT 3 (I&P) | 43.06415 | -105.69914 | 036N | 074W | 26 | SW1/4NE1/4 | 375 | Mine |
| 14 | P198124.0W | 5/4/2012 | CAMECO RESOURCES | SE/NW 26-36-74(UP TO 20 WELLS) - MINE UNIT 3 (I&P) | 43.06402 | -105.70565 | 036N | 074W | 26 | SE1/4NW1/4 | 500 | Mine |
| 15 | P197323.0W | 1/9/2012 | CAMECO RESOURCES | SW/SE 27-36-74 (UP TO 66 WELLS)-MINE UNIT 7(I&P) | 43.056881 | -105.720261 | 036N | 074W | 27 | SW1/4SE1/4 | 1,650 | Mine |
| 16 | P197317.0W | 1/9/2012 | CAMECO RESOURCES | NW/SE 27-36-74 (UP TO 25 WELLS)-MINE UNIT 7(I&P) | 43.060467 | -105.720328 | 036N | 074W | 27 | NW1/4SE1/4 | 625 | Mine |
| 17 | P196924.0W | 10/5/2011 | CAMECO RESOURCES | SE/NE 11-35-74(16 WELLS)-MINE UNIT 15A (I&P WELLS) | 43.021953 | -105.695233 | 035N | 074W | 11 | SE1/4NE1/4 | 160 | Mine |
| 18 | P195811.0W | 5/2/2011 | CAMECO RESOURCES | SE/NE 26-36-74 (75 WELLS)-MINE UNIT 3 (I&P WELLS) | 43.06467 | -105.69738 | 036N | 074W | 26 | SE1/4NE1/4 | 1,125 | Mine |
| 19 | P195810.0W | 5/2/2011 | CAMECO RESOURCES | SW/NE 26-36-74 (4 WELLS) - MINE UNIT 3 (I&P WELLS) | 43.06425 | -105.69925 | 036N | 074W | 26 | SW1/4NE1/4 | 60 | Mine |
| 20 | P191231.0W | 6/22/2009 | CAMECO RESOURCES | ENL. NE/SW 11-35-74 - MINE UNIT 15A | 43.016856 | -105.705169 | 035N | 074W | 11 | NE1/4SW1/4 | 1,155 | Mine |
| 21 | P189700.0W | 1/7/2009 | CAMECO RESOURCES | WELLFIELD 3 SW/NW/26 | 43.062778 | -105.708656 | 036N | 074W | 26 | SW1/4NW1/4 | 120 | Mine |
| 22 | P189699.0W | 1/7/2009 | CAMECO RESOURCES | WELLFIELD 3 SE/NW/26 | 43.062903 | -105.707369 | 036N | 074W | 26 | SE1/4NW1/4 | 210 | Mine |
| 23 | P189698.0W | 1/7/2009 | CAMECO RESOURCES | WELLFIELD 3 NW/SW/26 | 43.062069 | -105.709608 | 036N | 074W | 26 | NW1/4SW1/4 | 930 | Mine |
| 24 | P189697.0W | 1/7/2009 | CAMECO RESOURCES | WELLFIELD 3 NE/SW/26 | 43.061153 | -105.705483 | 036N | 074W | 26 | NE1/4SW1/4 | 1,695 | Mine |
| 25 | P189696.0W | 1/7/2009 | CAMECO RESOURCES | WELLFIELD 3 SW/NE/26 | 43.062806 | -105.70325 | 036N | 074W | 26 | SW1/4NE1/4 | 75 | Mine |
| | | | | | | | | | | | | |
| | **Pathfinder to Guernsey Subbasin (cont'd)** | | | | | | | | | | | |

**Table 1: Industrial Water Wells Yielding 50+ GPM Completed After January 1, 2004 with Priority Dates Since 2006**

| | Permit No | Priority Date | Company/Name | Facility Name | Latitude | Longitude | Twn | Rng | Sec | Qtr Qtr | Total Flow | Subcategory |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 26 | P189695.0W | 1/7/2009 | CAMECO RESOURCES | WELLFIELD 3 SW/SE/26 | 43.058975 | -105.701725 | 036N | 074W | 26 | SW1/4SE1/4 | 285 | Mine |
| 27 | P189694.0W | 1/7/2009 | CAMECO RESOURCES | WELLFIELD 3 NW/SE/26 | 43.060889 | -105.702114 | 036N | 074W | 26 | NW1/4SE1/4 | 1,680 | Mine |
| 28 | P185943.0W | 2/26/2008 | CAMECO RESOURCES | ENL. NW/SW 11-35-74 (60 WELLS) - MINE UNIT 15A | 43.016772 | -105.712517 | 035N | 074W | 11 | NW1/4SW1/4 | 900 | Mine |
| 29 | P185942.0W | 2/26/2008 | CAMECO RESOURCES | ENL. SW/NW 11-35-74 (90 WELLS) - MINE UNIT 15A | 43.020428 | -105.710061 | 035N | 074W | 11 | SW1/4NW1/4 | 1,350 | Mine |
| 30 | P194965.0W | 1/20/2011 | POWER RESOURCES DBA CAMECO RESOURCES | WELLFIELD 1 NE/NW/36 | 43.05238 | -105.68368 | 036N | 074W | 36 | NE1/4NW1/4 | 225 | Mine |
| 31 | P194964.0W | 1/20/2011 | POWER RESOURCES DBA CAMECO RESOURCES | WELLFIELD 1 SW/NE/36 | 43.05021 | -105.68066 | 036N | 074W | 36 | SW1/4NE1/4 | 1,200 | Mine |
| 32 | P194963.0W | 1/20/2011 | POWER RESOURCES DBA CAMECO RESOURCES | WELL FIELD 1 SE/NW/36 | 43.05114 | -105.68562 | 036N | 074W | 36 | SE1/4NW1/4 | 1,450 | Mine |
| 33 | P193386.0W | 7/12/2010 | POWER RESOURCES INC | NE/SW 16-35-74 (35 WELLS) - MU 10 (I&P WELLS) | 43.0025 | -105.7443 | 035N | 074W | 16 | NE1/4SW1/4 | 195 | Mine |
| 34 | P193384.0W | 7/12/2010 | POWER RESOURCES INC | SW/NW 16-35-74-(94 WELLS) - MU 10 (I&P WELLS) | 43.00675 | -105.75001 | 035N | 074W | 16 | SW1/4NW1/4 | 525 | Mine |
| 35 | P193382.0W | 7/12/2010 | POWER RESOURCES INC | SW/NE 17-35-74 (51 WELLS) - MU 10 (I&P WELLS) | 43.00717 | -105.75961 | 035N | 074W | 17 | SW1/4NE1/4 | 270 | Mine |
| 36 | P193380.0W | 7/12/2010 | POWER RESOURCES INC | SW/NW 17-35-74 (55 WELLS) - MU 10 (I&P WELLS) | 43.00529 | -105.76889 | 035N | 074W | 17 | SW1/4NW1/4 | 300 | Mine |
| 37 | P182216.0W | 6/20/2007 | POWER RESOURCES, INC | SE/SE 7-35-74 (11 WELLS) - MINE UNIT 9 (I&P WELLS) | 43.01524 | -105.77416 | 035N | 074W | 7 | SE1/4SE1/4 | 165 | Mine |
| 38 | P182210.0W | 6/20/2007 | POWER RESOURCES, INC | SW/NE 18-35-74 (11 WELLS) - MINE UNIT 9 (I&P WELLS) | 43.004747 | -105.777047 | 035N | 074W | 18 | SW1/4NE1/4 | 110 | Mine |
| 39 | P182207.0W | 6/20/2007 | POWER RESOURCES, INC | NE/SW 18-35-74 (51 WELLS) - MINE UNIT 9 (I&P WELLS) | 43.001433 | -105.783731 | 035N | 074W | 18 | NE1/4SW1/4 | 510 | Mine |
| 40 | P182206.0W | 6/20/2007 | POWER RESOURCES, INC | NW/SE 18-35-74 (45 WELLS) - MINE UNIT 9 (I&P WELLS) | 43.003681 | -105.779225 | 035N | 074W | 18 | NW1/4SE1/4 | 450 | Mine |
| 41 | P182205.0W | 6/20/2007 | POWER RESOURCES, INC | SW/SW 18-35-74 (53 WELLS) - MINE UNIT 9 (I&P WELLS) | 42.999508 | -105.786686 | 035N | 074W | 18 | SW1/4SW1/4 | 795 | Mine |
| 42 | P182204.0W | 6/20/2007 | POWER RESOURCES, INC | SE/SW 18-35-74 (12 WELLS) - MINE UNIT 9 (I&P WELLS) | 43.000367 | -105.785714 | 035N | 074W | 18 | SE1/4SW1/4 | 120 | Mine |
| | **Pathfinder to Guernsey Subbasin** | | | | | | | | | | | |
| | **Permit No** | **Priority Date** | **Company/Name** | **Facility Name** | **Latitude** | **Longitude** | **Twn** | **Rng** | **Sec** | **Qtr Qtr** | **Total Flow** | **Subcategory** |
| 43 | P172673.0W | 9/21/2005 | POWER RESOURCES, INC | SW/NW 11-35-74 (7 WELLS)-MINE UNIT 15 (I&P WELLS) | 43.0203 | -105.7125 | 035N | 074W | 11 | SW1/4NW1/4 | 105 | Mine |
| 44 | P172669.0W | 9/21/2005 | POWER RESOURCES, INC | NE/SE 10-35-74 (114 WELLS)-MINE UNIT 15 (I&P WELLS) | 43.017342 | -105.715028 | 035N | 074W | 10 | NE1/4SE1/4 | 1,710 | Mine |
| 45 | P172666.0W | 9/21/2005 | POWER RESOURCES, INC | NW/SW 10-35-74 (50 WELLS)-MINE UNIT 15 (I&P WELLS) | 43.01736 | -105.72979 | 035N | 074W | 10 | NW1/4SW1/4 | 750 | Mine |
| 46 | P197081.0W | 11/7/2011 | POWER RESOURCES, INC. | SE/NE 18-35-74 (85 WELLS)- MINE UNIT 9 (I&P WELLS) | 43.006386 | -105.773892 | 035N | 074W | 18 | SE1/4NE1/4 | 850 | Mine |
| 47 | P195273.0W | 2/2/2011 | CHESAPEAKE OPERATING | SOUTH HYLTON RANCH 34-74 24-1H WW | 42.908353 | -105.680028 | 034N | 074W | 24 | NW1/4NE1/4 | 150 | Mine |
| 48 | P198801.0W | 8/9/2012 | DENBURY ONSHORE, LLC | MORTON 1-22-1 | 42.7325 | -107.0056 | 032N | 085W | 22 | SE1/4NW1/4 | 150 | Mine |
| 49 | P198881.0W | 9/11/2012 | PINNACLE MATERIALS, LLC | SHAWNEE QUARRY NO. 1 WELL | 42.678886 | -105.021567 | 031N | 068W | 9 | NE1/4NW1/4 | 250 | Mine |
| 50 | P202033.0W | 11/27/2013 | TEXACO DOWNSTREAM PROPERTIES INC | EW-3B | 42.86263 | -106.26101 | 033N | 079W | 1 | NE1/4NE1/4 | 120 | Mine |
| 51 | P199729.0W | 1/31/2013 | FULLSPEED SERVICE, LLC | CAND1 | 42.88685 | -106.339247 | 034N | 079W | 29 | SE1/4NE1/4 | 50 | Misc |
| 52 | P197879.0W | 3/23/2012 | ACME HOLDINGS LLC | BUCKSHOT 1 | 42.77715 | -105.37908 | 032N | 071W | 4 | SE1/4NW1/4 | 75 | Misc |
| 53 | P202124.0W | 5/29/2014 | WYDOT | ENL. BIG HOLE #1 WELL | 42.74961 | -104.81842 | 032N | 066W | 18 | SE1/4NE1/4 | 50 | Road |
| 54 | P199867.0W | 1/10/2013 | WYDOT | EL RANCHO WELL #1 | 42.26499 | -105.03857 | 027N | 068W | 32 | SE1/4SW1/4 | 150 | Road |
| 55 | P199866.0W | 1/9/2013 | WYDOT | CASSA NORTH WELL #1 | 42.34533 | -105.04371 | 027N | 068W | 5 | SW1/4NW1/4 | 150 | Road |
| 56 | P176949.0W | 5/15/2006 | TRUE DRILLING LLC | SUSIE NO. 5 WELL | 42.79678 | -106.34921 | 033N | 079W | 29 | NE1/4SW1/4 | 50 | Stk |
| 57 | P155944.0W | 12/15/2003 | WAGONHOUND LAND AND LIVESTOCK CO LLC | ENL MAIN HOUSE WELL | 42.58188 | -105.56247 | 030N | 073W | 11 | NE1/4SE1/4 | 100 | Stk |
| | **Guernsey to State Line Subbasin** | | | | | | | | | | | |
| | **Permit No** | **Priority Date** | **Company/Name** | **Facility Name** | **Latitude** | **Longitude** | **Twn** | **Rng** | **Sec** | **Qtr Qtr** | **Total Flow** | **Subcategory** |
| 1 | P185107.0W | 1/28/2008 | SIMPLOT GROWER SOLUTIONS | SIMPLOT GROWER SOLUTIONS #1 | 42.042222 | -104.187222 | 024N | 061W | 22 | NW1/4NW1/4 | 50 | Misc |
| 2 | P201378.0W | 11/19/2013 | PANHANDLE COOP | PANHANDLE COOP#1 | 42.06678 | -104.19452 | 024N | 061W | 9 | NW1/4SE1/4 | 100 | Misc |

**Table 1: Industrial Water Wells Yielding 50+ GPM Completed After January 1, 2004 with Priority Dates Since 2006**

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3 | P200320.0W | 5/20/2013 | HERITAGE MATERIALS & SUPPLY, LLC | STOCK #1 | 42.033667 | -104.198972 | 024N | 061W | 21 | SE1/4SW1/4 | 200 | Misc |
| 4 | P195704.0W | 10/15/2010 | DENNIS R AND CYNTHIA L HUCKFELDT | HUCKFELDT WEST PIT NO. 2 WELL | 42.06519 | -104.19251 | 024N | 061W | 9 | NE1/4SE1/4 | 80 | Misc |
| 5 | P195703.0W | 10/15/2010 | DENNIS R AND CYNTHIA L HUCKFELDT | HUCKFELDT EAST PIT NO. 1 WELL | 42.06523 | -104.19227 | 024N | 061W | 9 | NE1/4SE1/4 | 80 | Misc |
| 6 | P165511.0W | 1/19/2005 | | GOSHEN COUNTY WEED AND PEST DISTRICT WELL NO. 1 | 42.080236 | -104.224683 | 024N | 061W | 5 | NW1/4SW1/4 | 50 | Misc |
| 7 | P169879.0W | 6/10/2005 | LEROY & SALLY LAMB | LAMB NO. 1 | 42.08709 | -104.2442 | 024N | 061W | 6 | NW1/4NW1/4 | 100 | Stk |
| 8 | P169598.0W | 7/29/2004 | BLAIR J MERRIAM | BIG PRAIRIE #2 | 42.51511 | -104.15589 | 029N | 061W | 2 | NE1/4SW1/4 | 400 | Stk |
| 9 | P160985.0W | 7/23/2004 | WYOMING STOCKYARDS, INC | WYOMING STOCKYARD INC. #2 | 42.0694 | -104.19088 | 024N | 061W | 9 | SE1/4NE1/4 | 60 | Stk |
| 10 | P154977.0W | 10/6/2003 | MAKE BEBO | BEBO #5 | 42.16995 | -104.43728 | 025N | 063W | 4 | SW1/4NW1/4 | 200 | Stk |
| | **Upper Laramie Subbasin** | | | | | | | | | | | |
| | **Permit No** | **Priority Date** | **Company/Name** | **Facility Name** | **Latitude** | **Longitude** | **Twn** | **Rng** | **Sec** | **Qtr Qtr** | **Total Flow** | **Subcategory** |
| 1 | P200785.0W | 5/20/2013 | PETE LIEN & SONS, INC. | JONATHON WELL NO. 1 | 41.462783 | -105.584086 | 017N | 073W | 9 | SW1/4NE1/4 | 500 | Agg |
| | **Lower Laramie Subbasin** | | | | | | | | | | | |
| | **Permit No** | **Priority Date** | **Company/Name** | **Facility Name** | **Latitude** | **Longitude** | **Twn** | **Rng** | **Sec** | **Qtr Qtr** | **Total Flow** | **Subcategory** |
| 1 | P198469.0W | 12/12/2011 | CHRISTOPHER WRIGHT | WRIGHT NO. 1 | 42.09063 | -104.96948 | 025N | 068W | 35 | SE1/4SE1/4 | 50 | Agg |
| 2 | P171681.0W | 6/27/2005 | BASIN ELECTRIC POWER COOPERATIVE | FORELL BAUMGARDNER NO.2 WELL | 42.113319 | -104.874346 | 025N | 067W | 27 | SW1/4NE1/4 | 950 | Power |
| 3 | P198529.0W | 4/6/2012 | FLYING H LAND AND CATTLE | FLYING H NO. 2 | 41.953253 | -105.043025 | 023N | 068W | 19 | SE1/4NE1/4 | 100 | Stk |
| 4 | P169878.0W | 4/27/2005 | | MURIEL #1 | 42.0762 | -104.97535 | 024N | 068W | 2 | SE1/4SW1/4 | 100 | Stk |
| | **Horse Creek Subbasin** | | | | | | | | | | | |
| | **Permit No** | **Priority Date** | **Company/Name** | **Facility Name** | **Latitude** | **Longitude** | **Twn** | **Rng** | **Sec** | **Qtr Qtr** | **Total Flow** | **Subcategory** |
| 1 | P202295.0W | 4/12/2014 | | FEEDYARD WELL #3 | 41.92061 | -104.129 | 023N | 060W | 31 | NW1/4SW1/4 | 85 | Stk |
| | **South Platte Subbasin** | | | | | | | | | | | |
| | **Permit No** | **Priority Date** | **Company/Name** | **Facility Name** | **Latitude** | **Longitude** | **Twn** | **Rng** | **Sec** | **Qtr Qtr** | **Total Flow** | **Subcategory** |
| 1 | P200088.0W | 3/1/2013 | GRANITE CANYON QUARRY, MARTIN MARIETTA MATERIALS | SECONDARY #2 | 41.104664 | -105.175922 | 013N | 070W | 12 | SE1/4SE1/4 | 50 | Agg |
| 2 | P189917.0W | 1/21/2009 | POLO RANCH COMPANY | ENL POLO 18-3 | 41.180717 | -104.931347 | 014N | 067W | 18 | NW1/4SE1/4 | 75 | Agg |
| 3 | P200770.0W | 7/16/2013 | WILLITS COMPANY INC | HARRIMAN #1 | 41.097483 | -105.175789 | 013N | 070W | 13 | SE1/4NE1/4 | 125 | Agg |
| 4 | P194604.0W | 11/12/2010 | JEBRO INC | JEBRO SITE NO. 2 | 41.06042 | -104.88864 | 013N | 067W | 28 | SE1/4SE1/4 | 200 | Agg |
| 5 | P194603.0W | 11/12/2010 | JEBRO INC | JEBRO SITE NO. 1 | 41.06009 | -104.89066 | 013N | 067W | 28 | SE1/4SE1/4 | 200 | Agg |
| 6 | P195611.0W | 2/18/2011 | CHEYENNE-LARAMIE COUNTY CORP FOR ECONOMIC DEVELOPM | CHEYENNE LEADS SWAN RANCH WELL # 1 | 41.056847 | -104.889144 | 013N | 067W | 33 | NE1/4NE1/4 | 50 | Misc |
| 7 | P202799.0W | 8/26/2013 | GENERATION DEVELOPMENT COMPANY, LLC | CPGS 1 | 41.11826 | -104.72539 | 013N | 066W | 1 | SE1/4SW1/4 | 400 | Power |
| 8 | P167488.0W | 4/25/2005 | | HEREFORD PIT #1 | 41.13608 | -104.68709 | 014N | 065W | 32 | NE1/4SW1/4 | 50 | Road |
| 9 | P164656.0W | 1/3/2005 | Wyo State Dept. of Transportation | LONE TREE #1 | 41.13406 | -105.35019 | 014N | 071W | 33 | SE1/4SE1/4 | 50 | Road |
| 10 | P194170.0W | 4/16/2010 | DAVID DUELLO | DUELLO 2010 | 41.22005 | -104.08855 | 015N | 060W | 33 | NW1/4SE1/4 | 50 | Stk |
| 11 | P168103.0W | 12/30/2004 | BURNETT LAND & LIVESTOCK LTD LLLP | BURNETT DAIRY #4 (SW) | 41.025422 | -104.2503 | 012N | 061W | 7 | SE1/4NW1/4 | 60 | Stk |
| 12 | P168102.0W | 12/30/2004 | BURNETT LAND & LIVESTOCK LTD LLLP | BURNETT DAIRY #3 (SE) | 41.0254 | -104.250258 | 012N | 061W | 7 | SE1/4NW1/4 | 60 | Stk |
| 13 | P168101.0W | 12/30/2004 | BURNETT LAND & LIVESTOCK LTD LLLP | BURNETT DAIRY #2 (NE) | 41.025406 | -104.245531 | 012N | 061W | 7 | SW1/4NE1/4 | 60 | Stk |

**Table 2: Oil and Gas Water Wells and CBM Wells with Priority Dates After 2006 Completed After January 1, 2014**

| | Permit No | Priority Date | Company | Facility Name | Latitude | Longitude | Twn | Rng | Sec | Qtr Qtr | Total Flow |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | **Above Pathfinder Dam Subbasin** | | | | | | | | | | |
| 1 | P186571.0W | 7/25/2006 | MEDICINE BOW FUEL AND POWER, LLC | MBFP #29-4 | 41.756283 | -106.308503 | 021N | 079W | 29 | SE1/4SE1/4 | 1000 |
| 2 | P186570.0W | 7/25/2006 | MEDICINE BOW FUEL AND POWER, LLC | MBFP #29-1 | 41.759897 | -106.308544 | 021N | 079W | 29 | NE1/4SE1/4 | 1000 |
| 3 | P186568.0W | 7/25/2006 | MEDICINE BOW FUEL AND POWER, LLC | MBFP #20-2 | 41.77075 | -106.313414 | 021N | 079W | 20 | SW1/4SE1/4 | 1000 |
| 4 | P186569.0W | 7/25/2006 | MEDICINE BOW FUEL AND POWER, LLC | MBFP #21-1 | 41.778114 | -106.289372 | 021N | 079W | 21 | SE1/4NE1/4 | 1000 |
| 5 | P201252.0W | 8/16/2013 | ELLEN FOX | ELLEN FOX NO. 1 | 42.32635 | -108.25353 | 027N | 096W | 11 | NE1/4SW1/4 | 80 |
| 6 | P198802.0W | 8/13/2012 | STRATHMORE RESOURCES | STM-WS-1 | 42.725617 | -107.599669 | 032N | 090W | 22 | SW1/4SW1/4 | 150 |
| | **Pathfinder to Guernsey Subbasin** | | | | | | | | | | |
| | **Permit No** | **Priority Date** | **Company** | **Facility Name** | **Latitude** | **Longitude** | **Twn** | **Rng** | **Sec** | **Qtr Qtr** | **Total Flow** |
| 1 | P199106.0W | 8/20/2010 | CHESAPEAKE OPERATING INC | SMITH CREEK UNIT 32-70 6WW | 42.77985 | -105.29056 | 032N | 070W | 6 | NE1/4NE1/4 | 150 |
| 2 | P196624.0W | 8/20/2010 | CHESAPEAKE OPERATING INC | COMBS RANCH UNIT 33-70 29-1HWW | 42.7979 | -105.28341 | 033N | 070W | 29 | SW1/4SE1/4 | 150 |
| 3 | P201432.0W | 12/18/2013 | CHESAPEAKE OPERATING INC | CZAR BENNETT WSW | 42.80489 | -105.38647 | 033N | 071W | 28 | SE1/4NW1/4 | 500 |
| 4 | P199881.0W | 3/8/2013 | CHESAPEAKE OPERATING INC | COMBS RANCH 24-33-71 WW | 42.81285 | -105.32435 | 033N | 071W | 24 | SW1/4SE1/4 | 180 |
| 5 | P199095.0W | 6/7/2012 | CHESAPEAKE OPERATING INC | COMBS 22-33-70 A 1H WW | 42.81914 | -105.23873 | 033N | 070W | 22 | SE1/4NE1/4 | 150 |
| 6 | P199134.0W | 9/28/2012 | CHESAPEAKE OPERATING INC | YORK RANCH 19-33-69 WW | 42.82375 | -105.18067 | 033N | 069W | 19 | NE1/4NE1/4 | 180 |
| 7 | P201596.0W | 2/19/2014 | CHESAPEAKE OPERATING INC | COMBS RANCH 10-33-70 WSW | 42.85172 | -105.24133 | 033N | 070W | 10 | NW1/4NE1/4 | 150 |
| 8 | P198889.0W | 9/14/2012 | CHESAPEAKE OPERATING, INC. | MVL 34-33-71 WW | 42.79468 | -105.36422 | 033N | 071W | 34 | NW1/4NE1/4 | 130 |
| 9 | P200976.0W | 5/24/2013 | CHESAPEAKE OPERATING, INC. | COMBS RANCH 28-33-70 WW | 42.801297 | -105.268528 | 033N | 070W | 28 | NE1/4SW1/4 | 180 |
| 10 | P200202.0W | 3/8/2013 | CHESAPEAKE OPERATING, INC. | YORK RANCH 17-33-69 WW | 42.833839 | -105.169219 | 033N | 069W | 17 | SE1/4NW1/4 | 180 |
| 11 | P198835.0W | 8/29/2012 | CHESAPEAKE OPERATING, INC. | KRAUSE 10-33-69 WW | 42.84094 | -105.13159 | 033N | 069W | 10 | SE1/4SW1/4 | 80 |
| 12 | P198775.0W | 7/31/2012 | CHESAPEAKE OPERATING, INC. | COMBS RANCH 7-33-70 WW | 42.84759 | -105.308 | 033N | 070W | 7 | SE1/4NW1/4 | 150 |
| 13 | P200201.0W | 2/21/2013 | CHESAPEAKE OPERATING, INC. | COMBS RANCH 11-33-70 WW | 42.847806 | -105.223658 | 033N | 070W | 11 | SW1/4NE1/4 | 200 |
| 14 | P200199.0W | 1/22/2013 | CHESAPEAKE OPERATING, INC. | YORK RANCH 4-33-69 WW | 42.859369 | -105.149647 | 033N | 069W | 4 | NE1/4SW1/4 | 180 |
| 15 | P200448.0W | 6/3/2013 | CHESAPEAKE OPERATING, INC. | SUNDQUIST FLATS 12-34-72 WW | 42.927886 | -105.449464 | 034N | 072W | 12 | SE1/4SW1/4 | 180 |
| 16 | P202711.0W | 8/6/2014 | CONTANGO ROCKY MOUNTAIN INC | CONTANGO-FORGEY #1 | 43.00928 | -106.34048 | 035N | 079W | 8 | SE1/4SE1/4 | 120 |
| 17 | P177515.0W | 8/11/2006 | FIDELITY EXPLORATION & PRODUCTIN COMPANY | OXBOW WSW #1 | 42.778417 | -106.94815 | 032N | 084W | 6 | NE1/4NW1/4 | 50 |
| 18 | P201652.0W | 3/12/2014 | HOUT FENCING OF WYOMING INC. | HOUT # 1 | 42.68082 | -105.2304 | 031N | 070W | 3 | SE1/4SE1/4 | 100 |
| 19 | P197201.0W | 11/10/2011 | JIM'S WATER SERVICE | JIM'S WATER SERVICE NO. 1 | 42.785833 | -105.370278 | 033N | 071W | 34 | NE1/4SW1/4 | 56 |
| 20 | P199963.0W | 3/14/2013 | LEBAR RANCH LLC | DW BILL HALL #2 | 42.826139 | -105.298031 | 033N | 070W | 18 | SE1/4SE1/4 | 250 |
| 21 | P199964.0W | 3/14/2013 | LEBAR RANCH LLC | DW FLAT TOP #3 | 42.851194 | -105.268603 | 033N | 070W | 9 | NE1/4NW1/4 | 250 |
| 22 | P198905.0W | 8/29/2012 | OXBOW PROPERTIES, INC. | OXBOW WSW #1 | 42.778417 | -106.94815 | 032N | 084W | 6 | NE1/4NW1/4 | 50 |
| 23 | P200087.0W | 6/1/2011 | PARKERTON RANCH, INC. | ENL. #22 SOUTH BIG MUDDY MADISON WATER WELL | 42.827253 | -105.978247 | 033N | 076W | 16 | NE1/4SW1/4 | 160 |
| 24 | P193308.0W | 2/5/2010 | RKI EXPLORATION & PRODUCTION LLC | SPILLMAN DRAW UNIT 35-73 15 - 1H WATER WELL | 43.00263 | -105.60671 | 035N | 073W | 15 | NE1/4SW1/4 | 150 |
| 25 | P198907.0W | 9/6/2012 | THE SOD FARM LLC | ENL. HOME RANCH NO. 3 WELL | 42.867811 | -105.895439 | 034N | 075W | 31 | SW1/4SE1/4 | 110 |
| 26 | P198909.0W | 9/6/2012 | THE SOD FARM LLC | 2ND. ENL. HOME RANCH #1 | 42.867833 | -105.895542 | 034N | 075W | 31 | SW1/4SE1/4 | 100 |
| 27 | P198908.0W | 9/6/2012 | THE SOD FARM LLC | ENL. HOME RANCH NO. 2 WELL | 42.867856 | -105.895458 | 034N | 075W | 31 | SW1/4SE1/4 | 120 |
| | **Pathfinder to Guernsey Subbasin** | | | | | | | | | | |
| | **Permit No** | **Priority Date** | **Company** | **Facility Name** | **Latitude** | **Longitude** | **Twn** | **Rng** | **Sec** | **Qtr Qtr** | **Total Flow** |
| 28 | P199368.0W | 12/4/2012 | WESTERN CABLE, LLC | WESTERN SKY 1 | 42.804328 | -105.3478 | 033N | 071W | 26 | SE1/4NW1/4 | 300 |

**Table 2: Oil and Gas Water Wells and CBM Wells with Priority Dates After 2006 Completed After January 1, 2014**

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 29 | P202882.0W | 9/8/2014 | | ENSERCO DEPOT #2 | 42.67884 | -105.34076 | 031N | 071W | 2 | NW1/4SW1/4 | 200 |
| 30 | P197086.0W | 11/28/2011 | BRAD REESE | ENL HIGH HOPES #2 | 42.73087 | -104.80799 | 032N | 066W | 20 | NE1/4SW1/4 | 250 |
| 31 | P197087.0W | 11/28/2011 | BRAD REESE | ENL HIGH HOPES #3 | 42.73803 | -104.80813 | 032N | 066W | 20 | NE1/4NW1/4 | 250 |
| 32 | P202008.0W | 4/10/2014 | BRIAN MENSING | K & M #1 | 42.78321 | -105.36786 | 033N | 071W | 34 | SE1/4SW1/4 | 200 |
| 33 | P199728.0W | 1/28/2013 | JAY BAUMANN | BAUMANN #1 | 42.82606 | -105.30799 | 033N | 070W | 18 | SE1/4SW1/4 | 250 |
| 34 | P202250.0W | 5/29/2014 | MARTY TILLARD | ENL. TILLARD 15 | 42.89389 | -105.83227 | 034N | 075W | 27 | NE1/4NE1/4 | 50 |
| 35 | P202032.0W | 11/27/2013 | TEXACO DOWNSTREAM PROPERTIES INC | EW-4B | 42.86265 | -106.26099 | 033N | 079W | 1 | NE1/4NE1/4 | 120 |
| 36 | P202031.0W | 11/27/2013 | TEXACO DOWNSTREAM PROPERTIES INC | EW-2B | 42.86265 | -106.25622 | 033N | 078W | 6 | NW1/4NW1/4 | 70 |
| 37 | P202030.0W | 11/27/2013 | TEXACO DOWNSTREAM PROPERTIES INC | EW-1B | 42.86272 | -106.26099 | 033N | 079W | 1 | NE1/4NE1/4 | 80 |
| 38 | P202029.0W | 11/27/2013 | TEXACO DOWNSTREAM PROPERTIES INC | EW-4A | 42.86259 | -106.2609 | 033N | 079W | 1 | NE1/4NE1/4 | 120 |
| 39 | P202028.0W | 11/27/2013 | TEXACO DOWNSTREAM PROPERTIES INC | EW-3A | 42.86263 | -106.26097 | 033N | 079W | 1 | NE1/4NE1/4 | 120 |
| 40 | P202027.0W | 11/27/2013 | TEXACO DOWNSTREAM PROPERTIES INC | EW-2A | 42.86273 | -106.25618 | 033N | 078W | 6 | NW1/4NW1/4 | 70 |
| 41 | P202026.0W | 11/27/2013 | TEXACO DOWNSTREAM PROPERTIES INC | EW-1A | 42.86265 | -106.26095 | 033N | 079W | 1 | NE1/4NE1/4 | 120 |
| 42 | P200447.0W | 5/15/2013 | BP PRODUCTS NORTH AMERICA INC | R-132 | 42.84596 | -106.33726 | 033N | 079W | 8 | SE1/4NE1/4 | 75 |
| 43 | P200446.0W | 5/15/2013 | BP PRODUCTS NORTH AMERICA INC | R-131 | 42.8449 | -106.34279 | 033N | 079W | 8 | SW1/4NE1/4 | 75 |
| 44 | P200445.0W | 5/15/2013 | BP PRODUCTS NORTH AMERICA, INC. | R-130 | 42.84477 | -106.34381 | 033N | 079W | 8 | SW1/4NE1/4 | 75 |
| 45 | P200444.0W | 5/15/2013 | BP PRODUCTS NORTH AMERICA INC | R-129 | 42.84467 | -106.34458 | 033N | 079W | 8 | SW1/4NE1/4 | 75 |
| 46 | P200443.0W | 5/15/2013 | BP PRODUCTS NORTH AMERICA INC | R-128 | 42.84445 | -106.34559 | 033N | 079W | 8 | SW1/4NE1/4 | 75 |
| 47 | P200442.0W | 5/15/2013 | BP PRODUCTS NORTH AMERICA INC | R-127 | 42.84428 | -106.3464 | 033N | 079W | 8 | SW1/4NE1/4 | 75 |
| | **Guernsey to State Line Subbasin** | | | | | | | | | | |
| | **Permit No** | **Priority Date** | **Company** | **Facility Name** | **Latitude** | **Longitude** | **Twn** | **Rng** | **Sec** | **Qtr Qtr** | **Total Flow** |
| 1 | P191906.0W | 8/21/2009 | WYOMING ETHANOL LLC | ENL BRIMM NO. 2 WELL | 42.03991 | -104.19125 | 024N | 061W | 21 | SE1/4NE1/4 | 65 |
| 2 | P191907.0W | 8/21/2009 | WYOMING ETHANOL LLC | WYOMING ETHANOL #1 MISC. | 42.04075 | -104.19189 | 024N | 061W | 21 | SE1/4NE1/4 | 100 |
| 3 | P199077.0W | 8/16/2011 | WYOMING ETHANOL LLC | ENL BRIMM #6 | 42.03981 | -104.19114 | 024N | 061W | 21 | SE1/4NE1/4 | 600 |
| 4 | P200364.0W | 5/17/2013 | | JOHNS PUMP SERVICE #1 | 42.046978 | -104.182692 | 024N | 061W | 15 | SE1/4SW1/4 | 500 |
| | **Upper Laramie Subbasin** | | | | | | | | | | |
| | **Permit No** | **Priority Date** | **Company** | **Facility Name** | **Latitude** | **Longitude** | **Twn** | **Rng** | **Sec** | **Qtr Qtr** | **Total Flow** |
| 1 | P194147.0W | 10/4/2010 | CHESAPEAKE OPERATING INC | ENTERPRISE-US 27 STATE 1-36H-WW | 41.929056 | -104.374056 | 023N | 063W | 36 | NE1/4NE1/4 | 150 |
| 2 | P199862.0W | 3/7/2013 | H & T RANCH COMPANY | H & T WATER WELL #1 | 42.038817 | -104.50875 | 024N | 064W | 23 | SE1/4NW1/4 | 85 |
| 3 | P195844.0W | 2/28/2011 | Y-O INVESTMENTS INC | Y-O TRACTS #1 WELL PERMIT NO UW 44727 | 42.03187 | -104.94147 | 024N | 067W | 19 | SW1/4SW1/4 | 250 |
| | **Horse Creek Subbasin** | | | | | | | | | | |
| | **Permit No** | **Priority Date** | **Company** | **Facility Name** | **Latitude** | **Longitude** | **Twn** | **Rng** | **Sec** | **Qtr Qtr** | **Total Flow** |
| 1 | P197157.0W | 11/3/2011 | JACOBSON RANCH INC. | DUVALL IRRIGATION NO. 11 | 41.560983 | -104.917417 | 018N | 067W | 5 | SE1/4NW1/4 | 50 |
| 2 | P194099.0W | 10/14/2010 | HEART BENT ARROW, LLC | HEART BENT ARROW, LLC #3 | 41.7418 | -104.5455 | 021N | 064W | 33 | SW1/4SE1/4 | 150 |
| | **South Platte Subbasin** | | | | | | | | | | |
| | **Permit No** | **Priority Date** | **Company** | **Facility Name** | **Latitude** | **Longitude** | **Twn** | **Rng** | **Sec** | **Qtr Qtr** | **Total Flow** |
| 1 | P203370.0W | 4/22/2014 | EOG RESOURCES, INC. | BIG SANDY 132-33 WSW | 41.13636 | -104.67014 | 014N | 065W | 33 | NE1/4SW1/4 | 300 |
| 2 | P166808.0W | 4/11/2005 | PALADIN ENERGY PARTNERS | WALLEYE #1 | 41.27625 | -104.55683 | 015N | 064W | 9 | SW1/4SW1/4 | 200 |
| 3 | P196444.0W | 11/18/2010 | SM ENERGY | HERRINGTON SEC.20 WSW | 41.170244 | -104.560622 | 014N | 064W | 20 | NE1/4NE1/4 | 200 |
| 4 | P191850.0W | 10/19/2009 | ST. MARY LAND & EXPLORATION COMPANY | SUNLIGHT 41-20 WSW - OVER-FILING | 41.259142 | -104.562683 | 015N | 064W | 20 | NE1/4NE1/4 | 80 |
| 5 | P192629.0W | 2/16/2010 | SUNCOR ENERGY (U.S.A.) PIPELINE CO. | ENL OF WATER WELL#1 | 41.123233 | -104.781783 | 013N | 066W | 4 | NE1/4SW1/4 | 485 |
| 6 | P175177.0W | 4/19/2006 | TEXAS AMERICAN RESOURCES | WATER SUPPLY WELL #2 | 41.11181 | -104.97003 | 013N | 068W | 11 | SW1/4NE1/4 | 50 |

**Table 2: Oil and Gas Water Wells and CBM Wells with Priority Dates After 2006 Completed After January 1, 2014**

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 7 | P177384.0W | 9/1/2006 | TEXAS AMERICAN RESOURCES CO. | SQUIRE 22-11-WATER SUPPLY WELL #2 | 41.11178 | -104.97482 | 013N | 068W | 11 | SE1/4NW1/4 | 2500 |
| 8 | P197393.0W | 9/28/2011 | UNITED SURFACE AND MINERALS, LLC | DIAMOND K LANCE-FOX HILLS #2 | 41.079333 | -104.118769 | 013N | 060W | 20 | SW1/4NW1/4 | 400 |
| 9 | P197392.0W | 9/28/2011 | UNITED SURFACE AND MINERALS, LLC | DIAMOND K LANCE - FOX HILLS #1 | 41.086642 | -104.118761 | 013N | 060W | 17 | SW1/4SW1/4 | 400 |
| 10 | P202090.0W | 12/10/2013 | JANET SHATTO | SHATTO 1-10 WSW | 41.11483 | -104.64456 | 013N | 065W | 10 | NW1/4NE1/4 | 600 |



WENCK ASSOCIATES Responsive partner. Exceptional outcomes.

Table 3: Industrial Reservoirs Permitted by the Wyoming SEO Since the 2006 Platte River Basin Plan

| WR Number | Priority Date | Summary / WR Status | Company | Facility Name | Uses | Twn | Rng | Sec | Qtr-Qtr | Longitude | Latitude |
|---|---|---|---|---|---|---|---|---|---|---|---|
| P12497.0R | 03/15/2006 | Complete | WILLITS COMPANY INC | POLO RANCH RESERVOIR | IND_SW | 014N | 067W | 18 | SE1/4NW1/4 | -104.936 | 41.18423 |
| P12963.0R | 07/02/2007 | Complete | CITY OF DOUGLAS | DOUGLAS WATER TREATMENT PLANT RESERVOIR | IND_SW | 032N | 071W | 08 | NW1/4NE1/4 | -105.393 | 42.7657 |
| P12970.0R | 06/27/2007 | Complete | BURNETT LAND & LIVESTOCK, LTD, LLLP | BURNETT DAIRY NO. 1 RESERVOIR | IND_SW; IRR_SW | 012N | 061W | 07 | NE1/4NE1/4 | -104.239 | 41.03122 |
| P13008.0R | 09/10/2007 | Complete | AQUA TERRA CONSULTANTS | SEDIMENTATION POND SP1 | IND_SW | 027N | 066W | 33 | SE1/4NW1/4 | -104.783 | 42.2713 |
| P13346.0R | 09/12/2008 | Complete | WILLITS COMPANY INC | HARRIMAN QUARRY RESERVOIR | IND_SW | 013N | 070W | 13 | SE1/4NE1/4 | -105.178 | 41.09888 |
| P13479.0R | 07/06/2009 | Complete | WWC ENGINEERING | SEDIMENT POND NO. 2 | IND_SW | 021N | 088W | 14 | NW1/4SE1/4 | -107.302 | 41.7905 |
| P13603.0R | 03/31/2010 | Complete | NEW FASHION PORK LLP | NEW FASHION PORK NO. 2 | IND_SW | 017N | 062W | 26 | NE1/4SW1/4 | -104.277 | 41.40799 |
| P13612.0R | 11/10/2009 | Complete | WWC ENGINEERING | MONOLITH SHALE QUARRY SEDIMENT POND | IND_SW; WET | 014N | 075W | 12 | NW1/4NE1/4 | -105.76 | 41.20147 |
| P13615.0R | 05/14/2010 | Complete | TRIHYDRO CORPORATION | SURFACE IMPOUNDMENT NO. 1 | IND_SW | 013N | 066W | 04 | SW1/4NW1/4 | -104.789 | 41.12547 |
| P13616.0R | 05/14/2010 | Complete | TRIHYDRO CORPORATION | SURFACE IMPOUNDMENT NO. 3/4 | IND_SW | 013N | 066W | 04 | SW1/4NW1/4 | -104.787 | 41.12624 |
| P13617.0R | 05/14/2010 | Complete | TRIHYDRO CORPORATION | SURFACE IMPOUNDMENT NO. 5 | IND_SW | 013N | 066W | 04 | SW1/4NW1/4 | -104.786 | 41.12637 |
| P13703.0R | 11/09/2010 | Complete | COFFEY ENGINEERING AND SURVEYING | POLAR BEAR WATER RESERVOIR | IND_SW | 021N | 090W | 29 | SE1/4SE1/4 | -107.587 | 41.75658 |
| P13750.0R | 03/24/2011 | Complete | DYNO NOBEL INC | CELL 7 RESERVOIR | IND_SW | 013N | 067W | 16 | SW1/4NW1/4 | -104.905 | 41.09636 |
| P13762.0R | 01/28/2011 | Complete | UINTA ENGINEERING AND SURVEYING | RED DESERT RECLAMATION 1-2-3 RESERVOIR | IND_SW | 021N | 090W | 11 | SE1/4SW1/4 | -107.535 | 41.80064 |
| P13764.0R | 06/16/2011 | Complete | R360 NIOBRARA INC | R360 SILO FIELD FACILITY RESERVOIR | IND_SW | 015N | 065W | 12 | SW1/4NE1/4 | -104.605 | 41.28522 |
| P13771.0R | 10/26/2010 | Complete | ARCH OF WYOMING LLC | ENL OF 29-23-1 RESERVOIR | IND_SW; STO | 024N | 083W | 29 | NW1/4NW1/4 | -106.789 | 42.02759 |
| P13772.0R | 10/26/2010 | Complete | ARCH OF WYOMING LLC | ENL OF 29-35-4 RESERVOIR | IND_SW; STO | 024N | 083W | 29 | SE1/4SE1/4 | -106.774 | 42.01619 |
| P13794.0R | 08/18/2011 | Complete | 90 CES CEAN | SOUTH LAKE PEARSON RESERVOIR | DSP; FIS; IND_SW; REC | 014N | 067W | 23 | SW1/4SE1/4 | -104.856 | 41.16289 |
| P13795.0R | 08/18/2011 | Complete | 90 CES CEAN | NORTH LAKE PEARSON RESERVOIR | DSP; FIS; IND_SW; REC | 014N | 067W | 23 | NW1/4SE1/4 | -104.857 | 41.16483 |
| P13839.0R | 09/02/2011 | Complete | LARAMIE COUNTY | ARCHER COMPLEX RESERVOIR | DSP; IND_SW | 014N | 065W | 28 | NE1/4SW1/4 | -104.666 | 41.14944 |
| P13895.0R | 04/26/2011 | Complete | HAGEMAN & BRIGHTON PC | ENLARGEMENT OF THE SULLIVAN PIT | IND_SW | 027N | 078W | 14 | SW1/4NW1/4 | -106.159 | 42.31395 |
| P14052.0R | 02/27/2013 | Complete | R & R SERVICES, INC | BAUMANN POND | IND_SW | 033N | 070W | 18 | SE1/4SW1/4 | -105.31 | 42.8257 |
| P14106.0R | 03/19/2013 | Complete | JLM ENGINEERING, INC | MCMURRY NO. 4 | CMU; FIS; IND_SW; IRR_SW; REC; STO | 033N | 079W | 24 | SE1/4SW1/4 | -106.272 | 42.80736 |
| P14164.0R | 09/11/2013 | Complete | CHESAPEAKE OPERATING INC | COMBS RANCH 29 FRAC POND | IND_SW | 033N | 070W | 29 | SE1/4SW1/4 | -105.286 | 42.7971 |
| P14177.0R | 10/04/2013 | Complete | CHESAPEAKE OPERATING, INC. | MOUNTAIN VALLEY WTR IMP | IND_SW | 033N | 071W | 34 | NW1/4NE1/4 | -105.365 | 42.7945 |
| P14222.0R | 11/18/2013 | Complete | CHESAPEAKE OPERATING INC | NORTHWEST FETTER WTR IMP | IND_SW | 033N | 072W | 01 | SW1/4NW1/4 | -105.454 | 42.8634 |
| P14241.0R | 03/20/2014 | Complete | COFFEY ENGINEERING & SURVEYING | ENLARGEMENT OF THE POLAR BEAR WATER RESERVOIR | IND_SW | 021N | 090W | 29 | SE1/4SE1/4 | -107.587 | 41.75658 |
| P14249.0R | 05/23/2013 | Complete | K2 ENGINEERING | STORAGE ENL OF THE WHEATLAND WASTEWATER LAGOON SYS | IND_SW; IRR_SW | 024N | 067W | 06 | SE1/4NE1/4 | -104.929 | 42.08148 |
| P14260.0R | 06/30/2014 | Complete | SUNRISE ENGINEERING | RESERVOIR NUMBER 6 | FLO; IND_SW | 013N | 066W | 04 | NE1/4NW1/4 | -104.781 | 41.1278 |
| CR CR19/214 | 07/06/2009 | Fully Adjudicated | MCMURRY READY MIX | SEDIMENT POND NO. 2 | IND_SW | 021N | 088W | 14 | NW1/4SE1/4 | -107.301 | 41.79055 |
| CR CR20/054 | 07/02/2007 | Fully Adjudicated | CITY OF DOUGLAS | DOUGLAS WATER TREATMENT PLANT RESERVOIR | IND_SW | 032N | 071W | 08 | NW1/4NE1/4 | -105.393 | 42.7657 |
| CR CR20/165 | 05/14/2010 | Fully Adjudicated | FRONTIER REFINING INC | SURFACE IMPOUNDMENT NO. 1 RESERVOIR | IND_SW | 013N | 066W | 04 | SW1/4NW1/4 | -104.789 | 41.12547 |

**Table 3: Industrial Reservoirs Permitted by the Wyoming SEO Since the 2006 Platte River Basin Plan**

| WR Number | Priority Date | Summary / WR Status | Company | Facility Name | Uses | Twn | Rng | Sec | Qtr-Qtr | Longitude | Latitude |
|---|---|---|---|---|---|---|---|---|---|---|---|
| CR CR20/166 | 05/14/2010 | Fully Adjudicated | FRONTIER REFINING INC | SURFACE IMPOUNDMENT NO. 3/4 RESERVOIR | IND_SW | 013N | 066W | 04 | SW1/4NW1/4 | -104.787 | 41.12624 |
| CR CR20/167 | 05/14/2010 | Fully Adjudicated | FRONTIER REFINING INC | SURFACE IMPOUNDMENT NO. 5 RESERVOIR | IND_SW | 013N | 066W | 04 | SW1/4NW1/4 | -104.786 | 41.12637 |
| CR CR21/241 | 08/18/2011 | Fully Adjudicated | USAF FE WARREN AIR FORCE BASE | SOUTH LAKE PEARSON RESERVOIR | DSP; FIS; IND_SW; REC | 014N | 067W | 23 | SW1/4SE1/4 | -104.856 | 41.16289 |
| CR CR21/242 | 08/18/2011 | Fully Adjudicated | USAF FE WARREN AIR FORCE BASE | NORTH LAKE PEARSON RESERVOIR | DSP; FIS; IND_SW; REC | 014N | 067W | 23 | NW1/4SE1/4 | -104.856 | 41.166 |
| CR CR23/179 | 05/23/2013 | Fully Adjudicated | | ENL. WHEATLAND WASTEWATER LAGOON SYSTEM | IND_SW; IRR_SW | 025N | 067W | 06 | NE1/4SW1/4 | -104.938 | 42.16831 |
| CR CR23/219 | 03/19/2013 | Fully Adjudicated | EAST ELKHORN RANCH LLC | MCMURRY NO. 4 RESERVOIR | CMU; FIS; IND_SW; IRR_SW; REC; STO | 033N | 079W | 24 | SE1/4SW1/4 | -106.272 | 42.80731 |
| CR CR23/229 | 04/26/2011 | Fully Adjudicated | HAGEMAN & BRIGHTON PC | ENL. SULLIVAN PIT RESERVOIR | IND_SW | 027N | 078W | 14 | SW1/4NW1/4 | -106.159 | 42.314 |
| P12391.0R | 01/04/2006 | Incomplete | ARCH OF WYOMING LLC | S2-1 RESERVOIR | IND_SW | 021N | 080W | 34 | NE1/4SE1/4 | -106.386 | 41.74463 |
| P13247.0R | 02/29/2008 | Incomplete | ARCH OF WYOMING LLC | SC3-1 RESERVOIR | IND_SW | 021N | 079W | 32 | NE1/4NW1/4 | -106.32 | 41.75158 |
| P13248.0R | 02/29/2008 | Incomplete | ARCH OF WYOMING LLC | SC3-2 RESERVOIR | IND_SW | 021N | 079W | 32 | NE1/4NW1/4 | -106.317 | 41.75331 |
| P13249.0R | 02/29/2008 | Incomplete | ARCH OF WYOMING LLC | SC3-3 RESERVOIR | IND_SW | 021N | 079W | 32 | NW1/4NW1/4 | -106.323 | 41.75247 |
| P13602.0R | 03/31/2010 | Incomplete | NEW FASHION PORK LLP | NEW FASHION PORK WETLANDS NO. 1 | IND_SW; WET | 017N | 062W | 26 | NE1/4SW1/4 | -104.28 | 41.40881 |
| P13759.0R | 04/26/2011 | Incomplete | UNITED SURFACE & MINERALS | EAST RESERVOIR | IND_SW; STO | 021N | 064W | 02 | NW1/4NW1/4 | -104.516 | 41.82675 |
| P13760.0R | 04/26/2011 | Incomplete | UNITED SURFACE & MINERALS | CANYON VIEW RESERVOIR | IND_SW; STO | 022N | 064W | 34 | SE1/4NE1/4 | -104.522 | 41.83681 |
| P13761.0R | 04/26/2011 | Incomplete | UNITED SURFACE & MINERALS | WEST RESERVOIR | IND_SW; STO | 021N | 064W | 03 | NW1/4NE1/4 | -104.526 | 41.82697 |
| P14389.0R | 09/25/2014 | Incomplete | EARTH WORK SOLUTIONS | PRBIC | IND_SW | 031N | 071W | 000 | | -105.338 | 42.6797 |
| P14461.0R | 05/16/2014 | Incomplete | TRIHYDRO CORP | NORTH PROPERTY EVAPORATION AND INLET RESERVOIR | IND_SW | 034N | 078W | 29 | SW1/4SW1/4 | -106.239 | 42.88238 |
| P14481.0R | 02/05/2016 | Incomplete | R360 ENVIRONMENTAL SOLUTIONS LLC | ENLARGED R360 SILO FIELD FACILITY | IND_SW | 015N | 065W | 12 | SW1/4NE1/4 | -104.605 | 41.28522 |
| P14501.0R | 05/13/2016 | Incomplete | TRIHYDRO CORPORATION | FINCH RESERVOIR | IND_SW; STO | 021N | 080W | 32 | NE1/4NE1/4 | -106.425 | 41.7543 |
| P14526.0R | 08/08/2016 | Incomplete | BP AMERICA PRODUCTION COMPANY | SECTION 5 FRESHWATER PITS | IND_SW | 017N | 093W | 05 | NW1/4NE1/4 | -107.898 | 41.48392 |
| P7834.0E | 07/07/2016 | Incomplete | | SECOND ENLARGEMENT OF COXBILL PORTABLE IRR SYSTEM ACIPT COXBILL PUMP&PL | IND_SW | 023N | 061W | 34 | SW1/4SW1/4 | -104.183 | 41.9175 |

# Platte River Basin Plan 2016 Update
# Volume 4
# Water Demand Projections




*Prepared for:*

Wyoming Water Development Commission

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Cheyenne, WY 82002


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Lidstone & Associates, a Wenck Company
Harvey Economics
HDR Engineering

# PLATTE RIVER BASIN PLAN 2016 UPDATE
# VOLUME 4
# WATER DEMAND PROJECTIONS

December 2016

## Explanation of Cover Photos

Lake Marie in the Snowy Range Mountains. Lake Marie lies south in the shadow of the quartzite massif of 12,847-foot Medicine Bow Peak at an elevation of 11,000-feet. Winter and Spring precipitation in the Snowing Range constitutes an important portion of the water supply in the Platte River Basin.

The bald eagle (*Haliaeetus leucocephalus*, from Greek hali "sea", aiētos "eagle", leuco "white", cephalos "head"). It is a common, frequently observed breeding and winter resident in the North Platte Basin of Wyoming. The bird is strongly associated with large rivers, lakes and reservoirs with an abundant food supply and riparian environments with large trees used for roosting and nesting. The bald eagle is an opportunistic predator which subsists primarily on fish. During the winter, they also feed on dead or injured waterfowl and road or winter killed deer and antelope. The bald eagle is both the national bird and national animal of the United States of America. It is the most familiar success story of the Federal Endangered Species Act. During the latter half of the 20th century it was on the brink of extirpation in the contiguous United States and was one of the first species to receive protections under the precursor to the Endangered Species Act in 1967. Populations have since recovered and the species was removed from the U.S. government's list of endangered species on July 12, 1995 and transferred to the list of threatened species. It was removed from the List of Endangered and Threatened Wildlife in the Lower 48 States on June 28, 2007 but remains protected under the provisions of the Bald and Golden Eagle Protection Act.

Historical photo of flood irrigation. Flood irrigation is an ancient method of irrigating crops and was the first form of irrigation used by humans as they began cultivating crops. In the Platte River Basin, it is still commonly used to irrigate grass hay. In areas of the Platte River Basin where higher value crops are raised such as corn, sugar beets and alfalfa hay, conversion to sprinkler irrigation has the dual benefits of improved crop yields while conserving water.

The Dave Johnston Power Plant is named for W.D. “Dave” Johnston a former PacifiCorp Vice-President. The plant generates power by burning coal that produces steam under high pressure. The steam drives turbines and the turbine blades to engage generator that produce electricity. The plant was commissioned in 1958. There have been four phases of plant expansion to-date and numerous upgrades to comply with changing environmental requirements. The present power generation capacity is 817 megawatts.

# PLATTE RIVER BASIN PLAN 2016 UPDATE
# VOLUME 4
# WATER DEMAND PROJECTIONS

December 2016

**PREPARED FOR:**

Wyoming Water Development Commission
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**The Platte River Basin Plan 2016 Update is a planning tool developed for the Wyoming Water Development Office. It presents estimated current and estimated future uses of water in Wyoming's Platte River Basin. The Plan is not intended to be used to determine compliance with the administration of state law, federal law, court decrees, interstate compacts, or interstate agreements.**

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## Appendices

# 4.0 Water Demand Projections

## 4.1 SUMMARY

***"Hindsight is always 20/20"***
- Billy Wilder

### 4.1.1 Platte Basin Population and Demographics

As of 2014, there were about 257,000 people living in the Platte River Basin (Basin), approximately 44 percent of Wyoming's total population. Between 2000 and 2014, the Basin's population increased by over 36,000 people, or about 16.3%. In comparison, the State of Wyoming as a whole grew slightly faster than the Basin, with total population growth of about 18.3% over that period. The Pathfinder to Guernsey and the South Platte subbasins grew the fastest and added the most people during that time. Eighty percent of the Basin's growth occurred in the South Platte and Pathfinder to Guernsey subbasins. The Lower Laramie experienced the smallest amount of growth.

Over the course of the last decade, natural population growth and in-migration have each accounted for about half of that growth. When compared to more historical periods, in-migration has been a much more important component of population growth over the last decade. Other demographic changes include an aging population and decreasing household size. Overall, the population of the Basin is aging, as indicated by an increasing median age for all Basin counties. The slight decrease in labor force participation rates is also likely the result of the aging population.

| Subbasin/City | Population | | Total Growth | Percent Growth |
|---|---|---|---|---|
| | 2000 | 2014 | 2000 - 2014 | 2000 - 2014 |
| Above Pathfinder Dam | 16,381 | 16,909 | 527 | 3.2% |
| Guernsey to State Line | 9,967 | 10,839 | 873 | 8.8% |
| Horse Creek | 2,389 | 2,676 | 287 | 12.0% |
| Lower Laramie | 7,844 | 8,002 | 158 | 2.0% |
| Pathfinder to Guernsey | 73,662 | 87,915 | 14,253 | 19.3% |
| South Platte | 80,349 | 94,909 | 14,560 | 18.1% |
| Upper Laramie | 30,299 | 35,745 | 5,446 | 18.0% |
| **Total** | **220,891** | **256,996** | **36,105** | **16.3%** |
| **State of Wyoming** | **493,782** | **584,153** | **90,371** | **18.30%** |

### 4.1.2 Employment and Key Economic Sectors

There were about 172,800 jobs within the Basin as of 2014, about 43% of all jobs statewide. As of late 2015, only one subbasin had an unemployment rate higher than the state average. The largest employment sector in the Basin is government, followed by retail trade and healthcare. As the largest employment sector by far, the government sector (federal, military, state and local government jobs); included about 37,400 jobs, or about 22% of total Basin jobs, in 2014. Mining accounts for about 5.5% of Basin jobs; the majority of those are located in the Above Pathfinder Dam and the Pathfinder to Guernsey subbasins. Agriculture contributes 3.0% of total Platte Basin employment. However, while employment in agriculture is relatively small, the sector accounts for the overwhelming majority of water use. Between 2002 and 2014, the total number of jobs in the Basin increased by about 27,200, from 145,600 full and part-time positions in 2002 to 172,800 total positions in 2014. Over this period, Basin jobs accounted for about 43% of total jobs in

Wyoming. Employment growth in individual Basin counties ranged from 0.6% per year up to 2.6% per year over this period; both Basin employment and statewide employment grew at an average rate of about 1.6% annually. Annual earnings within each economic sector vary widely, but averaged about $51,800 in 2014, slightly lower than the statewide average.

From a water use standpoint, important sectors in the Basin include agriculture, energy, minerals, utilities and recreation. Among the economic sectors, changes in the agricultural sector drive overall water demands for the Basin since that sector comprises a relatively large portion of total diversions and consumptive use. The agricultural sector also drives monthly water use patterns for the Basin. Under the High and Low Scenarios, water demands for that sector change substantially, largely dwarfing changes in other sectors. However, it is important to note that municipal demands increase by 18% under the Low Scenario and 70% under the High Scenario, given the projected population growth in the Basin. Industrial demands have the potential to grow by as much as 34% under the High Scenario. Although water demands in those sectors make up small portions of total demands, it was necessary to address those future needs.

**Agriculture*.*** Agriculture is comprised primarily of cattle ranching and hay production. Irrigated acreage has decreased in recent years (a 14% reduction over the last decade), likely due to increases in technology and changes in commodity prices, among other factors. Currently, there were about 524,000 irrigated acres in the Basin and about 656,000 head of livestock, compared to about 613,000 irrigated acres and 686,000 head of livestock at the time of the previous Basin Plan. As a result, Basin wide agricultural water use has decreased somewhat in recent years, although fluctuations in water use do occur from year to year.

**Oil and Gas*.*** A large portion of the State's oil production comes from within the Basin (about 21% produced in Basin counties in 2002 and about 38% by 2014). Oil production from Basin counties has increased annually through 2015, with crude oil production reaching over 34.5 million barrels in that year. There are three oil refineries in the Basin, which use large amounts of water for cooling towers and steam generation. In 2015, about 16% of the State's natural gas was produced in Basin counties. Annual production in those counties has generally declined in recent years, mainly in response to changes in commodity prices; however, both 2014 and 2015 saw small increases in natural gas production in the Basin, even as total statewide production continued to decline. Basin wide, permitted water use in this industrial sector increased by more than 50% over the last 10 years.

**Minerals*.*** Although the amount of uranium produced in the Basin has remained relatively constant over the last decade, increasing prices have increased recent interest and investment in potential new uranium mining activity across the state, including within the Basin. Permitted water use for uranium recovery and processing operations has increased substantially in the Basin in recent years. All coal mines in the Basin have now closed and no coal is currently produced within the Basin.

**Power Generation*.*** In terms of major power generation facilities, the U.S. Bureau of Reclamation (USBR) operates six hydropower facilities within the Basin and the Laramie River Station and Dave Johnston Power Plant are also located in the Basin. In 2014, the 132 MW natural-gas fired Cheyenne Prairie Generating Station began operation. Water demands for power generation have increased slightly in the interim since the previous Basin Plan.

**Other Economic Activity*.*** In addition to the activities described above, the Basin is home to the University of Wyoming in Albany, the Wyoming State Penitentiary in Rawlins and several large retailers and distribution facilities located in larger cities. However, the

Wyoming Ethanol facility in Torrington closed in 2015 and the Western Sugar Cooperative plans on closing its Torrington location by 2017.

### 4.1.3 Consumptive Water Demands

Between 2005 and 2015, total estimated consumptive use in the Basin (under normal year conditions) decreased by about 6.5%. That net decrease was made up of changes in individual sectors: a 16% decrease in total agricultural water demand (due to a reduction of about 88,000 irrigated acres and 30,000 fewer head of livestock); about a 4.5% increase in municipal/rural domestic demand (population growth and changes in per capita water usage); and an almost 51% increase in industrial demands (increased water demands for oil and gas production, mining activity, power generation, aggregate production and other miscellaneous industrial demands).

| Economic Sector | Estimated Consumptive Use (AF) | |
|---|---|---|
| | 2005 | 2015 |
| Irrigated Agriculture | 662,000 | 556,000 |
| Livestock | 6,300 | 5,800 |
| Municipal/ Rural Domestic | 28,910 | 30,200 |
| Industrial | 104,200 | 157,300 |
| **Total Water Usage** | **801,410** | **749,300** |

Current consumptive water demands in the Basin are estimated to be about 749,300 AF per year, with about 75% of that demand coming from the agricultural sector.

Three future scenarios for economic and demographic growth in the Platte River Basin were projected through the year 2045. All three scenarios employed an economic base modeling approach, in which prospects for key economic sectors that either bring money into the region and/or are the source of substantial water use were analyzed in detail along with prospects for regional growth. Based upon these analyses, High, Low, and Mid Scenarios were developed for the Basin, leading to total employment and population projections. The High and Low Scenarios presented in the document are intended to bracket optimistic and pessimistic assumptions about the future, but they represent useful bounds for water planners. It is Harvey Economics' (HE) judgment that the Mid Scenario is the most realistic and is the most likely scenario to occur.

**The three scenarios presented in this volume portray markedly different potential futures for the region. They reflect varying assumptions for agricultural activity, mineral prices, recreational demands and other economic activities. Projected Platte River Basin population in 2045 under the High Scenario would reach 440,000 residents, compared with 307,000 residents under the Low Scenario and about 347,000 residents under the Mid Scenario.**

As shown in the two tables below, projected water demands (consumptive demands in a normal year) under the High, Low and Mid Scenarios have been revised since the previous Basin Plan. Current projections for 2045 reflect higher consumptive use under the High Scenario and lower consumptive demands under the Low and Mid Scenarios. Year 2045 water demands, in terms of consumptive use, range from 633,200 AF up to 939,100 AF. Those estimates reflect a change in consumptive use demands ranging from -15.5% to +25.3%, as compared to 2015 water demands; Mid Scenario changes represent about a 4% decrease in consumptive use. The reduction in total consumptive use demands under the Low and Mid Scenarios is largely due to an assumed reduction in irrigated acres over time.

| Economic Sector | Estimated Consumptive Use (AF) | | | |
|---|---|---|---|---|
| | 2006 Basin Plan | | | |
| | 2005 | Year 2035 | | |
| | | High Scenario | Low Scenario | Mid Scenario |
| Irrigated Agriculture | 662,000 | 700,000 | 650,000 | 661,000 |
| Livestock | 6,300 | 7,600 | 5,200 | 6,600 |
| Municipal/Rural Domestic | 28,910 | 50,910 | 39,810 | 42,810 |
| Industrial | 104,200 | 115,760 | 75,290 | 92,450 |
| **Total Water Usage** | **801,410** | **874,270** | **770,300** | **802,860** |

| Economic Sector | Estimated Consumptive Use (AF) | | | |
|---|---|---|---|---|
| | 2016 Basin Plan | | | |
| | 2015 | Year 2045 | | |
| | | High Scenario | Low Scenario | Mid Scenario |
| Irrigated Agriculture | 556,000 | 671,000 | 436,000 | 497,000 |
| Livestock | 5,800 | 6,900 | 5,000 | 5,800 |
| Municipal/Rural Domestic | 30,200 | 51,200 | 35,500 | 41,100 |
| Industrial | 157,300 | 210,000 | 156,700 | 174,700 |
| **Total Water Usage** | **749,300** | **939,100** | **633,200** | **718,600** |

### 4.1.4 Environmental and Recreational Water Demands

Non-consumptive environmental and recreational water uses in the Basin are very important to anglers, rafters, those who participate in a wide variety of outdoor activities and those who value the natural environment. Those uses are correlated to traditional diversions, while demand is driven by population levels. Numerous rivers, streams, reservoirs, mountains and forest lands in the Basin provide ample opportunities for these endeavors. Water in the Basin provides for a number of environmental and recreational (E and R) uses, including the existence of wetlands; support of other aquatic habitat; and fishing, boating and other recreational activities. E and R water uses exist throughout the Basin, although some subbasins include a greater concentration of E and R amenities than others. The Basin contains a number of major recreational reservoirs, as well as blue, red and yellow ribbon trout streams. E and R water uses are highly dependent on traditional water uses. Specific locations and water uses are categorized as protected, complementary or competing with existing traditional uses in each subbasin. As a result, the analysis of future demands for this sector is a reflection of the interactions of traditional water uses and these non-consumptive uses. Under the Low Scenario, recreational water use will be stable or will decline modestly; environmental water use is likely to expand. The High Scenario will have mostly positive effects on recreational water use, but the outlook for environmental water uses is mixed. E and R uses under the Mid Scenario would largely remain similar to current conditions.

**Water demand projections were developed for the Platte River Basin under three alternative scenarios. Quantitative relationships (water use factors) for each water use sector together with projected demographic and economic information were applied to develop annual water use projections by sector under three alternative scenarios. Estimated monthly distributions of annual totals for each sector enabled derivation of monthly aggregate water use projections for each scenario.**

Succinct summaries of recent economic conditions in the Platte River Basin are presented below.

| Above Pathfinder Dam Subbasin | |
|---|---|
| Population (2014) | 16,909 |
| Households (2014) | 6,706 |
| Total Jobs | 10,900 |
| Unemployment Rate (Dec 2015) | 3.9% |
| Agricultural Activity | |
| Irrigated Acres | 124,000 |
| Head of Livestock | 108,000 |
| Non-Agricultural Activity | |
| Oil and Gas Production | Uranium Mining |
| Wyoming State Penitentiary | Recreational Activity |
| Transportation Industry | Government Services |
| Retail/Commercial Mix | Construction |

| Pathfinder to Guernsey Subbasin | |
|---|---|
| Population (2014) | 87,915 |
| Households (2014) | 36,220 |
| Total Jobs | 62,700 |
| Unemployment Rate (Dec 2015) | 5.4% |
| Agricultural Activity | |
| Irrigated Acres | 65,000 |
| Head of Livestock | 199,000 |
| Non-Agricultural Activity | |
| Oil and Gas Production | Uranium Mining |
| Power Generation (Dave Johnston Power Plant) | |
| Aggregate Production | Recreational Activity |
| Government Services | Health Care |

| Guernsey to State Line Subbasin | |
|---|---|
| Population (2014) | 10,839 |
| Households (2014) | 4,265 |
| Total Jobs | 5,900 |
| Unemployment Rate (Dec 2015) | 3.2% |
| Agricultural Activity | |
| Irrigated Acres | 81,000 |
| Head of Livestock | 68,000 |
| Non-Agricultural Activity | |
| Government Services | Health Care |
| Specialty manufacturing | Retail/Commercial Mix |
| Western Sugar Cooperative (will close by 2017) | |

| Upper Laramie Subbasin | |
|---|---|
| Population (2014) | 35,745 |
| Households (2014) | 15,527 |
| Total Jobs | 20,600 |
| Unemployment Rate (Dec 2015) | 3.0% |
| Agricultural Activity | |
| Irrigated Acres | 104,000 |
| Head of Livestock | 60,000 |
| Non-Agricultural Activity | |
| University of Wyoming | Government Services |
| Retail/Commercial Mix | Health Care |
| Recreational Activity | |

| Lower Laramie Subbasin | |
|---|---|
| Population (2014) | 8,002 |
| Households (2014) | 3,534 |
| Total Jobs | 5,300 |
| Unemployment Rate (Dec 2015) | 3.9% |
| Agricultural Activity | |
| Irrigated Acres | 66,000 |
| Head of Livestock | 85,000 |
| Non-Agricultural Activity | |
| Power Generation (Laramie River Station) | |
| Government Services | Transportation |
| Health Care | Retail/Commercial Mix |

| Horse Creek Subbasin | |
|---|---|
| Population (2014) | 2,676 |
| Households (2014) | 1,112 |
| Total Jobs | 1,600 |
| Unemployment Rate (Dec 2015) | 3.9% |
| Agricultural Activity | |
| Irrigated Acres | 41,000 |
| Head of Livestock | 57,000 |
| Non-Agricultural Activity | |
| Hawk Springs Reservoir and State Park | |

| South Platte Subbasin | |
|---|---|
| Population (2014) | 94,909 |
| Households (2014) | 40,941 |
| Total Jobs | 65,600 |
| Unemployment Rate (Dec 2015) | 4.2% |
| Agricultural Activity | |
| Irrigated Acres | 43,000 |
| Head of Livestock | 77,000 |
| Non-Agricultural Activity | |
| Oil and Gas Production | Government Services |
| Power Generation (Cheyenne Generating Station) | |
| Aggregate Production | Retail/Commercial Mix |
| Recreational Activity | Health Care |

| Platte Basin Summary | |
|---|---|
| Population (2014) | 256,996 |
| Households (2014) | 108,306 |
| Total Jobs | 172,600 |
| Unemployment Rate (Dec 2015) | |
| Agricultural Activity | |
| Irrigated Acres | 524,000 |
| Head of Livestock | 656,000 |
| Non-Agricultural Activity | |

## 4.2 FUTURE ECONOMIC AND DEMOGRAPHIC SCENARIOS TO SUPPORT UPDATED WATER DEMAND PROJECTIONS

"***The only function of economic forecasting is to make astrology look respectable.***"
- John Kenneth Galbraith

Between 2000 and 2014, the Basin's population increased by over 36,000 people, or about 16.3%. In comparison, the State of Wyoming as a whole grew slightly faster than the Basin, with total population growth of about 18.3% over that period. Eighty percent of the Basin's growth occurred in the South Platte and Pathfinder to Guernsey subbasins; other subbasins grew by much smaller amounts. As shown in **Table 4.1**, the Basin makes up about 44% of the State's population (also see **Figure 4.2** for a graphical depiction of current population distribution). In-migration has been a much more important component of population growth over the last decade, as compared to more historical periods. Between 2000 and 2013, in-migration comprised about half the Basin's population growth. Other demographic changes include an aging population and decreasing household size. The slight decrease in labor force participation rates is also likely the result of the aging population.

**Table 4.1: Population Distribution and Growth in the Platte Basin from 2000 to 2014**

| Subbasin/City | Population | | Total Growth | Percent Growth |
|---|---|---|---|---|
| | 2000 | 2014 | 2000 – 2014 | 2000 - 2014 |
| Above Pathfinder Dam | 16,381 | 16,999 | 527 | 3.2% |
| Guernsey to State Line | 9,967 | 10,839 | 873 | 8.8% |
| Horse Creek | 2,389 | 2,676 | 287 | 12.0% |
| Lower Laramie | 7,844 | 8,002 | 158 | 2.0% |
| Pathfinder to Guernsey | 73,662 | 87,915 | 14,253 | 19.3% |
| South Platte | 80,349 | 94,909 | 14,560 | 18.1% |
| Upper Laramie | 30,299 | 35,745 | 5,446 | 18.0% |
| **Total** | **220,891** | **256,996** | **36,105** | **16.3%** |
| **State of Wyoming** | **493,782** | **584,153** | **90,371** | **18.30%** |

### 4.2.1 Employment and Key Economic Sectors

Between 2002 and 2014, the total number of jobs in the Basin increased by about 27,200, from 145,600 full and part-time positions in 2002 to 172,800 total positions in 2014. Over this period, Basin jobs accounted for about 43% of total jobs in Wyoming. Employment growth in individual Basin counties ranged from 0.6% per year up to 2.6% per year over this period; both Basin employment and statewide employment grew at an average rate of about 1.6% annually.

The Basin's largest employment sectors include the government sector, followed by retail trade; healthcare; accommodation and food service; construction and mining. As the largest employment sector by far, the government sector (federal, military, state and local government jobs); included about 37,400 jobs, or about 22% of total Basin jobs, in 2014. Mining accounts for about 5.5% of Basin jobs; the majority of those are located in the Above Pathfinder Dam and the Pathfinder to Guernsey subbasins. Agriculture is a key sector in the Basin in terms of water use; however, employment in that sector is relatively small. Annual earnings within each economic sector vary widely, but averaged about $51,800 in 2014.

From a water use standpoint, important sectors in the Basin include agriculture, energy, minerals, utilities and recreation.

**Agriculture.** Agriculture is comprised primarily of cattle ranching and hay production. Irrigated acreage has decreased in recent years (a 14% reduction over about the last decade), likely due to increases in technology and changes in commodity prices, among other factors. Currently, there were about 524,000 irrigated acres in the Basin and about 656,000 head of livestock, compared to about 613,000 irrigated acres and 686,000 head of livestock at the time of the previous Basin Plan. As a result, Basin-wide agricultural water use has decreased somewhat in recent years, although fluctuations in water use do occur from year to year.

**Oil and Gas.** A large portion of the State's oil production comes from within the Basin (about 21% produced in Basin counties in 2002 and about 38% by 2014). Oil production from Basin counties has increased annually through 2015, with crude oil production reaching over 34.5 million barrels in that year. There are three oil refineries in the Basin, which use large amounts of water for cooling towers and steam generation. In 2015, about 16% of the State's natural gas was produced in Basin counties. Annual production in those counties has generally declined in recent years, mainly in response to changes in commodity prices; however, both 2014 and 2015 saw small increases in natural gas production in the Basin, even as total statewide production continued to decline. Basin-wide, permitted water use in the industrial sector increased by more than 50% during the last 10 years.

**Minerals.** Although the amount of uranium produced in the Basin has remained relatively constant over the last decade, increasing prices have increased recent interest and investment in potential new uranium mining activity across the state, including within the Basin. Permitted water use for uranium recovery and processing operations has increased substantially in the Basin in recent years. All coal mines in the Basin have now closed and no coal is currently produced within the Basin.

**Power Generation.** In terms of major power generation facilities, the USBR operates six hydropower facilities within the Basin and the Laramie River Station and Dave Johnston Power Plant are also located in the Basin. In 2014, the 132 MW natural-gas fired Cheyenne Prairie Generating Station began operation. Water demands for power generation have increased slightly in the interim since the previous Basin Plan.

**Other Economic Activity.** In addition to the activities described above, the Basin is home to the University of Wyoming in Albany, the Wyoming State Penitentiary in Rawlins and several large retailers and distribution facilities located in larger cities. However, the Wyoming Ethanol facility in Torrington closed in 2015 and the Western Sugar Cooperative plans on closing its Torrington location by 2017.

### 4.2.2 Consumptive Water Demands

Between 2005 and 2015, total estimated consumptive use in the Basin (under normal year conditions) decreased by about 6.5%. That net decrease was made up of changes in individual sectors: a 16% decrease in total agricultural water demand (due to a reduction of about 88,000 irrigated acres and 30,000 fewer head of livestock); about a 4.5% increase in municipal/rural domestic demand (population growth and changes in per capita water usage); and an almost 51% increase in industrial demands (increased water demands for oil and gas production, mining activity, power generation, aggregate production and other miscellaneous industrial demands). The change in total consumptive use is skewed by the fact that irrigated agriculture accounts for between 74% and 83% of total water use in the basin as shown in **Table 4.2**.

**Table 4.2: Change in Consumptive Use Between 2005 and 2015 in the Platte River Basin by Economic Sector**

| Economic Sector | Estimated Consumptive Use (AF) | |
|---|---|---|
| | 2005 | 2015 |
| Irrigated Agriculture | 662,000 | 556,000 |
| Livestock | 6,300 | 5,800 |
| Municipal/Rural Domestic | 28,910 | 30,200 |
| Industrial | 104,200 | 157,300 |
| **Total Water Usage** | **801,410** | **749,300** |

Current consumptive water demands in the Basin are estimated to be about 749,300 AF per year, with about 75 percent of that demand coming from the agricultural sector. Projected water demands (consumptive demands in a normal year) under the High, Low and Mid Scenarios have also been revised since the previous Basin Plan. Current projections for 2045 reflect higher consumptive use under the High Scenario and lower consumptive demands under the Low and Mid Scenarios. Year 2045 water demands, in terms of consumptive use, range from 633,200 AF up to 939,100 AF. Those estimates reflect a change in consumptive use demands ranging from -15.5 percent to +25.3 percent, as compared to 2015 water demands; Mid Scenario changes represent about a 4 percent decrease in consumptive use. As shown in tables 4.3 and 4.4, the reduction in total consumptive use demands under the Low and Mid Scenarios is largely due to an assumed reduction in irrigated acres over time.

**Table 4.3: Projected Changes in Consumptive Use in 2035 in the Platte River Basin by Economic Sector for the High, Low, and Mid Growth Scenarios Based on the 2005 Consumptive Use Data**

| Economic Sector | Estimated Consumptive Use (AF) | | | |
|---|---|---|---|---|
| | 2006 Basin Plan | | | |
| | 2005 | Year 2035 | | |
| | | High Scenario | Low Scenario | Mid Scenario |
| Irrigated Agriculture | 662,000 | 700,000 | 650,000 | 661,000 |
| Livestock | 6,300 | 7,600 | 5,200 | 6,600 |
| Municipal/Rural Domestic | 28,910 | 50,910 | 39,810 | 42,810 |
| Industrial | 104,200 | 115,760 | 75,290 | 92,450 |
| **Total Water Usage** | **801,410** | **874,270** | **770,300** | **802,860** |

**Table 4.4: Projected Changes in Consumptive Use in 2045 in the Platte River Basin by Economic Sector for the High, Low and Mid Growth Scenarios Based on the 2016 Consumptive Use Data**

| Economic Sector | Estimated Consumptive Use (AF) | | | |
|---|---|---|---|---|
| | 2016 Basin Plan | | | |
| | 2015 | Year 2045 | | |
| | | High Scenario | Low Scenario | Mid Scenario |
| Irrigated Agriculture | 556,000 | 671,000 | 436,000 | 497,000 |
| Livestock | 5,800 | 6,900 | 5,000 | 5,800 |
| Municipal/Rural Domestic | 30,200 | 51,200 | 35,500 | 41,100 |
| Industrial | 157,300 | 210,000 | 156,700 | 174,700 |
| **Total Water Usage** | **749,300** | **939,100** | **633,200** | **718,600** |

### 4.2.3 Environmental and Recreational Water Demands

Water in the Basin provides for a number of E and R uses, including the existence of wetlands; support of other aquatic habitat; and fishing, boating and other recreational activities. E and R water uses exist throughout the Basin, although some subbasins include a greater concentration of E and R amenities than others. The Basin contains a number of major recreational reservoirs, as well as blue, red and yellow ribbon trout streams. E and R water uses are highly dependent on traditional water uses. Specific locations and water uses are categorized as protected, complementary or competing with existing traditional uses in each subbasin. As a result, the analysis of future demands for this sector is a reflection of the interactions of traditional water uses and these non-consumptive uses. Under the High Scenario, recreational water use will be stable or will decline modestly; environmental water use is likely to expand. The Low Scenario will have mostly positive effects on recreational water use, but the outlook for environmental water uses is mixed. E and R uses under the Mid Scenario would largely remain similar to current conditions.

### 4.2.4 Current Economic and Demographic Conditions

#### Introduction

This portion of Section 4.2 describes the current economic and demographic conditions and physical characteristics of Wyoming's Platte River Basin (Basin) and the seven subbasins located within that Basin. The data and information herein provides an update to the work conducted as part of the 2006 Basin Plan. At that time, HE developed a memo in support of the Basin Plan which described the longer term historical economic and demographic trends. This section focuses on the changes that have taken place since that previous work and on current conditions. The information included here is used to establish a baseline for projecting long-term economic and demographic activity, evaluating future water use opportunities and projecting future water demand.

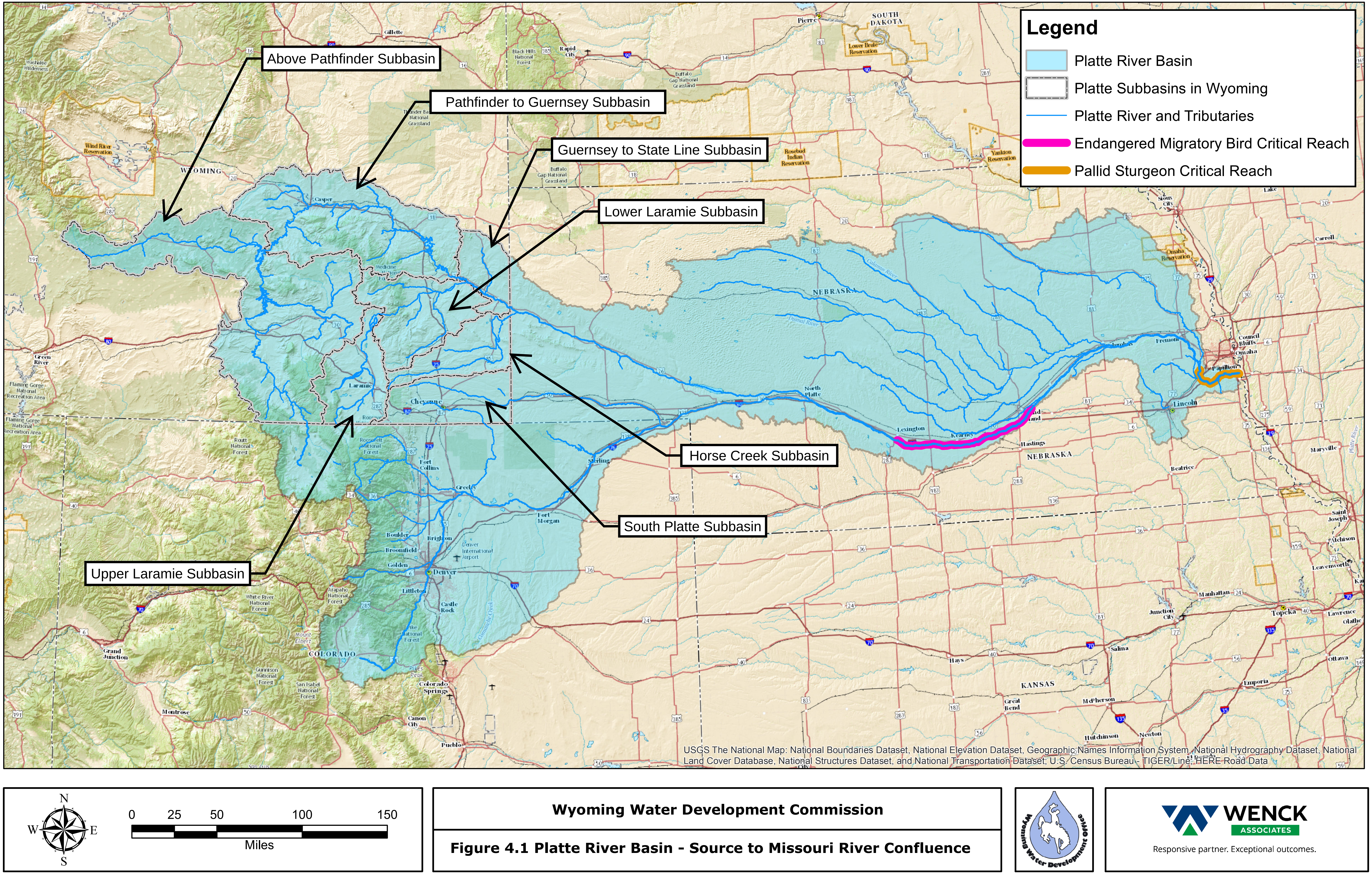
#### A Brief Overview of Basin Geography

The Platte River Basin encompasses all or part of 10 Wyoming counties, including Albany, Carbon, Converse, Fremont, Goshen, Laramie, Natrona, Niobrara, Platte and Sublette. However, only about 1% of the total land mass of Sublette County is within the Basin, and there are no towns within that area. Therefore, the demographic and economic analysis of the Basin excludes Sublette County. Sublette County was excluded from the descriptions of current conditions in HE's previous work; that approach was retained for this update.

The remaining nine counties represent divergent geographic areas with distinct conditions, rendering basin-wide generalizations less useful. HE has considered the data at the basin, subbasin and county level where possible to provide the most appropriate picture of the geographic area under examination. As described below, we have derived subbasin demographics to further develop our insights into the forces that influence growth and development in these areas. A map of the Platte River Basin in Wyoming, Colorado, and Nebraska, and the subbasins in Wyoming is illustrated in **Figure 4.1**.

#### Basin and Subbasin Allocations of Demographic and Economic Activity

Almost all demographic data are compiled by political units, such as cities and counties, and most of the economic data are reported at the county, state or national level. However, several counties include land area, population centers and jobs both inside and outside the Basin. For this update, HE approached the allocation of population, households and jobs within the Basin in the same manner as in the work previously completed for the 2006 Basin Plan. That is, HE determined population at the county and city levels and then based the rural population on the percentage of land in each county that was included in the Basin.




**Wyoming Water Development Commission**

**Figure 4.1 Platte River Basin - Source to Missouri River Confluence**

Wyoming Water Development Office

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Other demographic and economic characteristics were estimated for the Basin by applying the portion of the population in Basin to those resources.

A similar process was followed to derive subbasin figures. Each subbasin includes portions of a number of counties, with the Pathfinder to Guernsey subbasin including portions of seven different counties. For the Basin as a whole, HE assigned the populations of incorporated cities and towns with each county to specific subbasins and then determined the remaining population based on the portion of land within that subbasin. Other demographic and economic characteristics were assigned in a similar manner. Specific adjustments were then made to account for the effects of topography and urban area concentrations. For example, a large land area may not support the commensurate population due to certain topography. Likewise, a concentration of unincorporated areas located in a small area may be undercounted by a land allocation approach. The adjustments made are a best effort to most accurately reflect individual subbasin conditions.

### Demographic Overview

As of 2014, the Platte River Basin was home to almost 257,000 people, living in over 108,300 households. At that time, the Basin included about 44% Wyoming's 584,000 residents. Almost 74% of Basin residents resided in the Basin's ten largest communities, and roughly 60% of the Basin's residents lived in Cheyenne, Casper and Laramie, the three largest cities. Populations and households for each of the seven subbasins and the ten largest cities in the Basin are shown in **Table 4.5**.

**Table 4.5: Subbasin Population and Households, 2000 and 2014**

| Subbasin / City | Population | | Households | |
|---|---|---|---|---|
| | 2000 | 2014 | 2000 | 2014 |
| **Above Pathfinder Dam** | **16,381** | **16,909** | **6,369** | **6,706** |
| Rawlins | 8,538 | 9,227 | 3,320 | 3,431 |
| Saratoga | 1,726 | 1,692 | 757 | 803 |
| **Guernsey to State Line** | **9,967** | **10,839** | **4,107** | **4,265** |
| Torrington | 5,776 | 6,736 | 2,436 | 2,618 |
| **Horse Creek** | **2,389** | **2,676** | **827** | **1,112** |
| **Lower Laramie** | **7,844** | **8,002** | **3,140** | **3,534** |
| Wheatland | 3,548 | 3,659 | 1,539 | 1,672 |
| **Pathfinder to Guernsey** | **73,662** | **87,915** | **29,796** | **36,220** |
| Casper | 49,644 | 60,086 | 20,343 | 24,760 |
| Douglas | 5,288 | 6,423 | 2,118 | 2,672 |
| Evansville | 2,255 | 2,831 | 848 | 1,076 |
| Mills | 2,591 | 3,690 | 1,161 | 1,613 |
| **South Platte** | **80,349** | **94,909** | **31,528** | **40,941** |
| Cheyenne | 53,011 | 62,845 | 22,324 | 27,009 |
| **Upper Laramie** | **30,299** | **35,745** | **12,580** | **15,527** |
| Laramie | 27,204 | 32,081 | 11,336 | 13,944 |
| **Total** | **220,891** | **256,996** | **88,346** | **108,306** |
| **Basin-wide increase** | | **36,105** | | **19,960** |
| **% Change** | | **16.3%** | | **22.6%** |
| Source: US Census Bureau, Wyoming Economic Analysis Division and Harvey Economics, 2016. | | | | |

### Historic Population Growth

Between 2000 and 2014, the Basin's population increased by over 36,000 people, or about 16.3%. At that same time, the number of households increased by almost 20,000, or about 22.6%. The faster rate of growth for households as compared to population indicates that individual household size is decreasing in the Basin, suggesting an aging of the population


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base. In comparison, the State of Wyoming as a whole grew slightly faster than the Basin, with total population growth of about 18.3% over that period.

The counties that comprise the Basin grew at varying rates, ranging from about 23%, or an increase of over 15,000 people in Natrona County to a loss of about 8 people, or less than one tenth of one percent, in Platte County. Each of the seven subbasins also experienced varying rates of growth between 2000 and 2014. The Upper Laramie, South Platte and Pathfinder to Guernsey subbasins each grew by a total of between 17% and 18% over that period. Although the Horse Creek subbasin grew by 12%, it only added about 300 people. The Guernsey to State Line subbasin grew by about 9%, adding less than 1,000 people and the Lower Laramie and Above Pathfinder Dam subbasins each grew by between 2% and 3%.

The distribution of the population throughout the Basin remained relatively constant over the past 15 years. As illustrated in **Figure 4.2**, the South Platte and Pathfinder to Guernsey subbasins comprise the majority of the Basin's total population; over 70% of the Basin's population resides in one of those two Basins. Other subbasins include much smaller portions of Basin population, ranging from about 14% in the Upper Laramie subbasin to about 1% in the Horse Creek subbasin.

The population increases seen in the Basin since 2000 incorporate both natural population changes (births minus deaths) and net migration (in-migration minus out-migration). Between 2000 and 2013, natural population change accounted for an increase of over 20,800 people in Basin counties, while net migration added about another 22,600 people. Therefore, each of those components generally made up about half of the population increases experienced in the Basin.

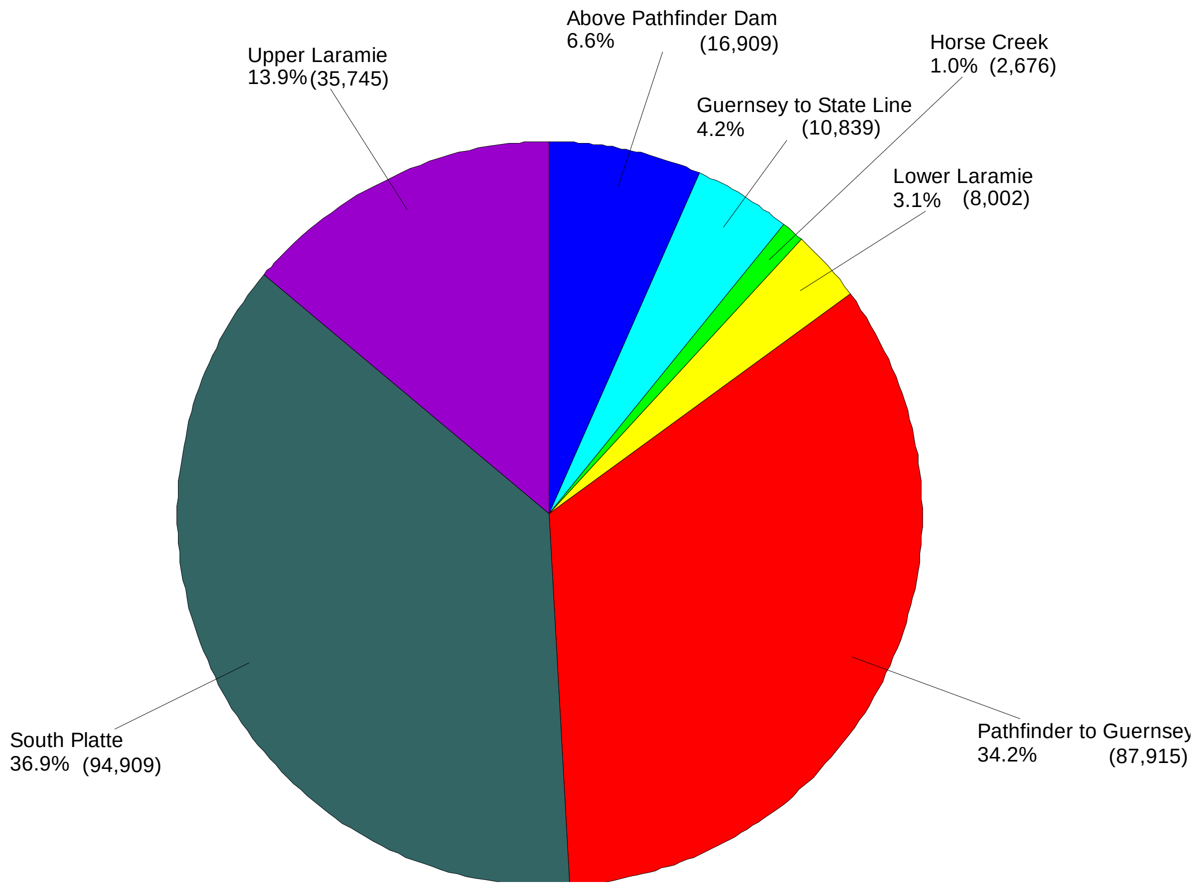
Although natural population change varied among individual Basin counties, the change for all Basin counties combined remained relatively constant over time, averaging an increase of about 1,500 people per year. In contrast, net migration, both for individual counties and for all Basin counties combined experienced large changes from year to year. For example, in 2000, net migration data for the counties showed an overall loss of about 400 people, while in 2012, those same counties experienced an influx of about 4,200 people. Net migration was positive in all years since 2001, indicating that more people moved into the area than left the area in each year since 2001. Net annual net migration data for Basin counties is depicted in **Figure 4.3**.

### The Aging Population

In general, Basin residents are older than the average Wyoming resident, as indicated by the age comparisons provided in **Table 4.6**. The median ages of residents living in the majority of Basin counties (six of the nine) are greater than the median age of all Wyoming residents. Many of those counties are smaller in terms of population, and are more rural, with larger agricultural bases. The age distribution of Laramie County residents is about the same as for the state, while residents of Albany and Natrona Counties are generally younger than the average Wyoming resident.

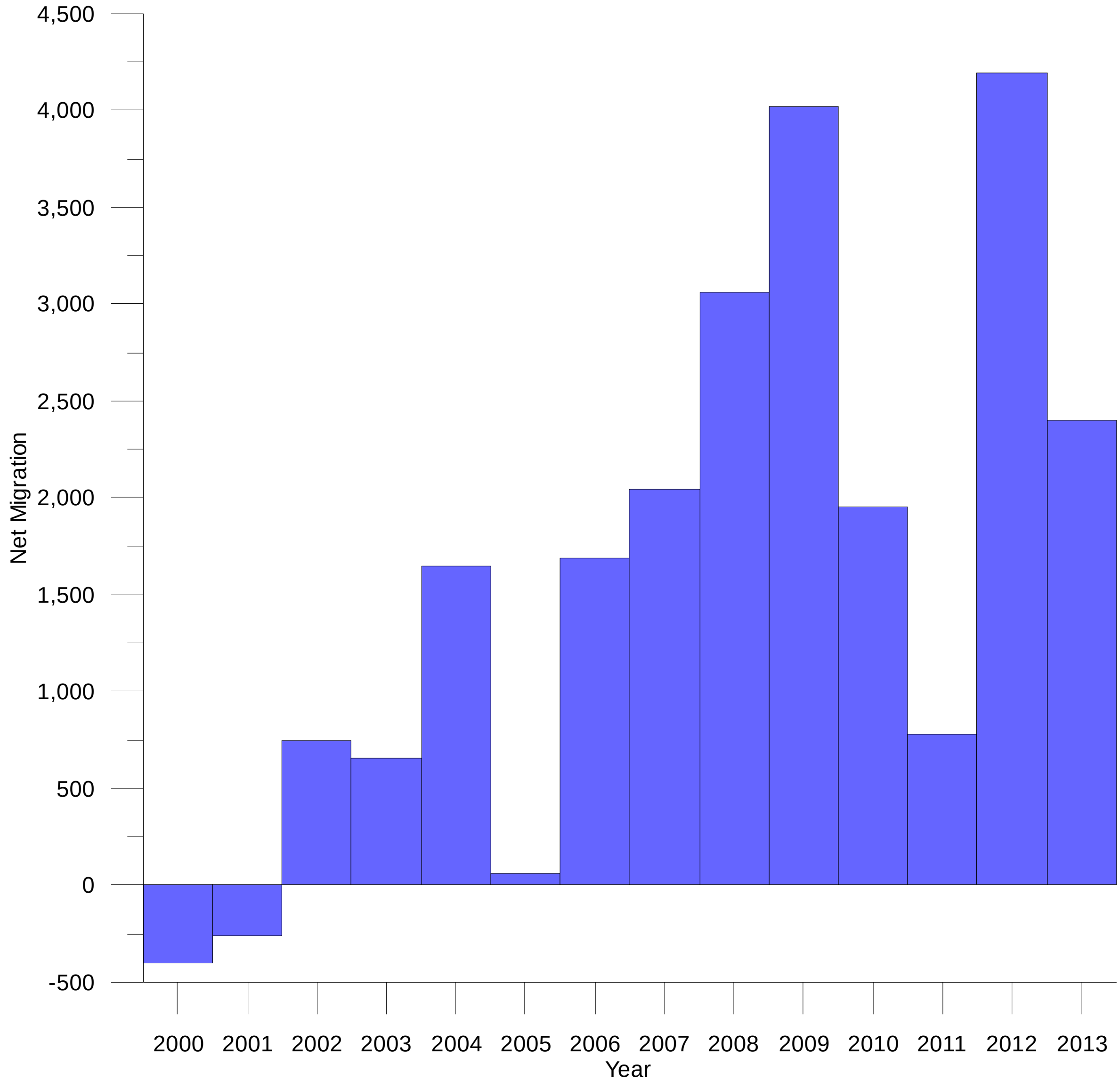
Not only are Basin residents older than the statewide average, but the median age of Basin residents has increased over time as well. Only in Carbon and Natrona Counties did the median ages of residents decrease, as compared to 2000; that may be due, in part, to the younger workers required in the oil and gas industry. Median ages of residents increased in all other counties.

**Figure 4-2: Distribution of Population, by Subbasin, 2014**




Source: US Census Bureau, Wyoming Economic Analysis Division and Harvey Economics, 2016.

**Figure 4-3: Net Migration in Platte River Basin Counties, 2000 to 2013**




Source: Wyoming Department of Administration and Information, Economic Analysis Division.

**Table 4.6: Age Cohorts by Percentage for the U.S., Wyoming and Basin Counties, 2014**

| Age Group | US | WY | Albany | Carbon | Converse | Fremont | Goshen | Laramie | Natrona | Niobrara | Platte |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 - 19 | 26 | 26 | 23 | 26 | 27 | 28 | 23 | 26 | 26 | 18 | 22 |
| 20 - 34 | 21 | 22 | 39 | 21 | 19 | 19 | 19 | 22 | 23 | 20 | 15 |
| 35 - 54 | 26 | 25 | 19 | 25 | 26 | 23 | 23 | 25 | 25 | 25 | 24 |
| 55 - 64 | 13 | 14 | 11 | 15 | 14 | 14 | 15 | 13 | 13 | 17 | 16 |
| 65 & Older | 15 | 14 | 10 | 14 | 14 | 16 | 21 | 14 | 13 | 21 | 23 |
| Median Age, 2014 | 37.7 | 36.8 | 27.5 | 37.6 | 38.7 | 38.1 | 42.9 | 36.8 | 35.8 | 45 | 47.4 |
| Median Age, 2000 | 35.3 | 36.2 | 26.7 | 38.9 | 37.5 | 37.7 | 40 | 35.3 | 36.4 | 42.8 | 41.2 |
| Source: US Census Bureau | | | | | | | | | | | |

The age distribution of Wyoming and Wyoming counties is explained by a number of factors, including the aging of the large baby boom generation as seen across the U.S., the in-migration of retirees seeking Wyoming's low cost of living; and the out-migration of young people looking for employment opportunities. An older population can have a number of effects on a region, particularly in a rural environment. For example, increased demand for healthcare may induce a concentration of older residents in areas convenient to doctors and hospitals.

### Unemployment and Labor Force Participation

As of December 2015, unemployment rates across the Basin ranged from a high of 6% in Fremont County to a low of 2.9% percent in both Albany and Niobrara Counties. Only Fremont and Natrona Counties experienced higher unemployment rates than the 2015 statewide average of 4.5% percent; the remaining counties experienced relatively low unemployment rates at that time. Unemployment rates by subbasin are provided in **Table 4.7**.

**Table 4.7: Unemployment Rates in the Platte River Basin, by Subbasin, 2015**

| Subbasin | Unemployment Rate |
|---|---|
| Above Pathfinder | 3.9% |
| Guernsey to State Line | 3.2% |
| Horse Creek | 3.9% |
| Lower Laramie | 3.9% |
| Pathfinder to Guernsey | 5.4% |
| South Platte | 4.2% |
| Upper Laramie | 3.0% |
| Sources: Bureau of Labor Statistics and Harvey Economics, 2016 | |

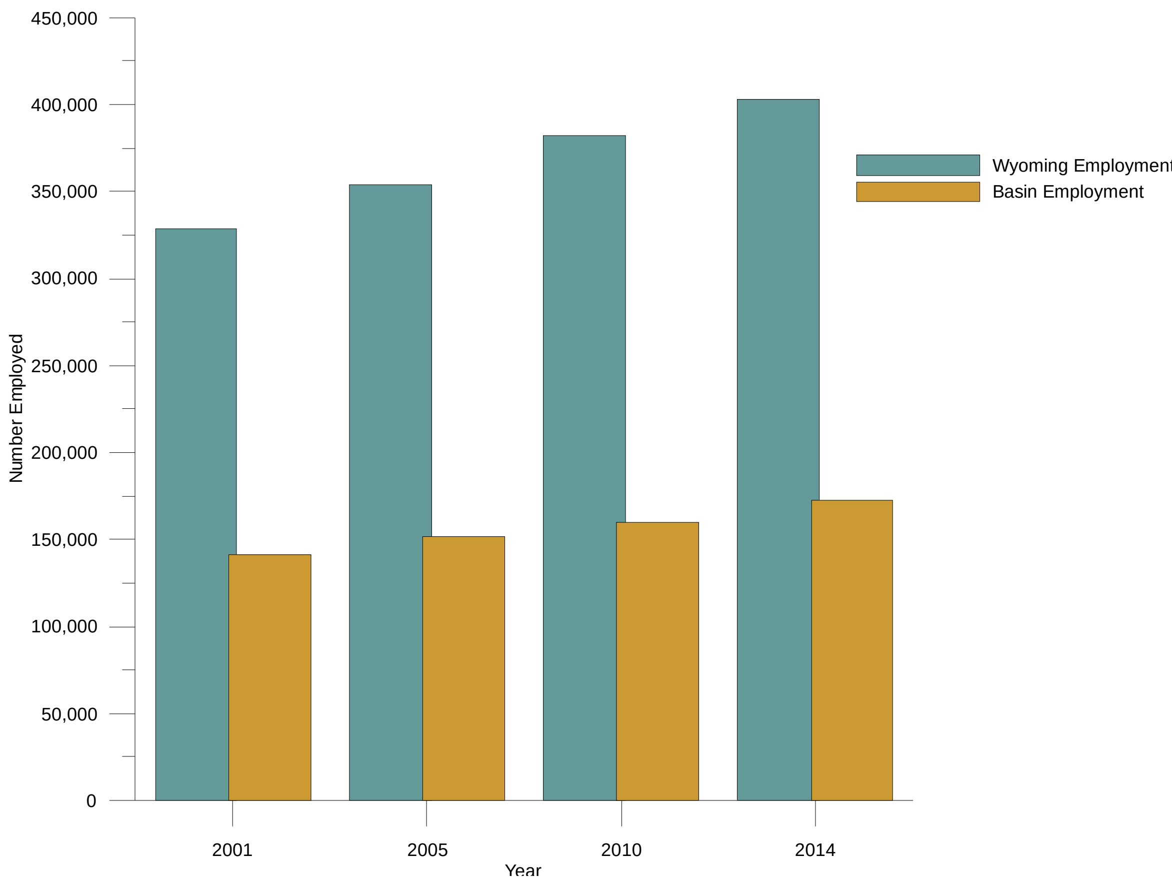
The labor force participation rate is the percentage of residents in a given region over the age of 16 who are employed or actively seeking work. As of 2014, the labor participation rate for Wyoming was 68.4 percent, down slightly from 70 percent in 2000; that decrease is likely due to the aging of the population in Wyoming. Within the Basin, only Natrona County (70.6 percent) and Converse County (71.9 percent) had participation rates higher than the state average; those higher rates may be due to oil and gas industry activity in those areas and the demand for services to support those workers. Carbon (65.9 percent), Fremont (66.4 percent), Goshen (61.3 percent), Laramie (65.1 percent) and Platte (61.5 percent)

Counties lagged behind the statewide average. Many Basin counties experienced decreasing labor force participation rates between 2000 and 2014.

### Platte Basin Employment Overview

As of 2014, there were a total of about 206,400 full and part-time jobs in the nine Basin counties. The study team estimates that 172,800 of those positions were within the Basin area. At that time, Basin jobs accounted for about 43% of total jobs in Wyoming; that rate has remained generally constant since 2001. Between 2001 and 2014, both statewide employment and Basin employment grew at an average rate of 1.6% annually, although employment growth in individual Basin counties ranged from 0.6% to 2.6% per year. **Figure 4.4** depicts total employment in Wyoming and the Platte River Basin between 2001 and 2014.

**Figure 4-4: Total Employment in Wyoming and the Platte River Basin, 2001 to 2014**




Sources: U.S. Bureau of Economic Analysis, Regional Economic Information System, http://www.bea.doc.gov/bea/regional/reis/ and Harvey Economics, 2016.

### Employment and Earnings by Sector

The proportion of employment by economic sector within the Basin, as compared to the state and the nation, provides insight into which sectors are most important to the regional economic base. The Basin's largest employment sector is the government sector, including federal, military, state and local government jobs; about 22% of Basin employment occurs in that sector, compared with 19% of statewide employment and 13% of national employment. Although the federal government, through various agencies such as the BLM and USFS, controls a large amount of land in the state and Basin, the majority of government sector jobs are in local government. The government sector currently employs about 37,400 people in the Basin.

Mining currently accounts for about 9% of all jobs in Wyoming and about 5.5% of jobs within the Basin, compared with less than 1% of jobs nationwide. About 66% of Basin mining employment takes place in Natrona County, with Converse, Laramie and Carbon Counties making up roughly 30%, indicating that mining is most important in Above Pathfinder Dam and Pathfinder to Guernsey Subbasins. The other counties have little or no mining employment. Total mining employment in the Basin amounts to over 9,300 people.

Agriculture also plays a larger role in Wyoming than in the nation as a whole, contributing about 3.5% of statewide employment and 2.7% in the Basin, as compared to 1.4% nationally. About 4,700 people are employed in agriculture Basin wide. On the other hand, the manufacturing sector in both Wyoming and the Basin is smaller than the national average, accounting for only about 3% of total employment in the Basin and the state, versus 7% nationally. Manufacturing employs about 5,300 people throughout the Basin.

For other economic sectors, Basin employment is generally similar in proportion to that of the state and the U.S. as a whole, with the notable exceptions of health care and professional/scientific and technical services. The percentage of Basin and state employment in those sectors is smaller than at the national level.

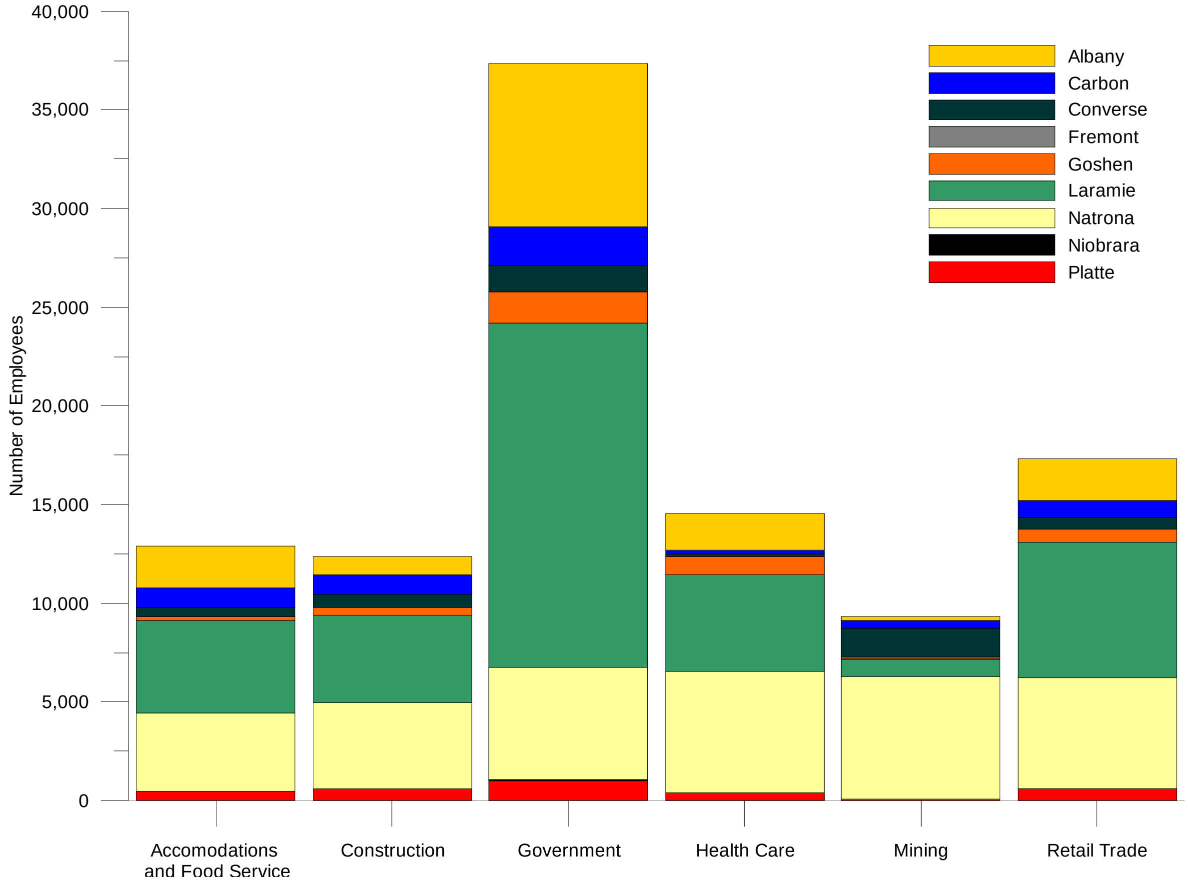
**Figure 4.5** illustrates current employment in the Platte River Basin for the six largest economic sectors, including government; retail trade; health care; accommodations and food service; construction; and mining. Together, those sectors employ about 104,000 people Basin wide, about 60% of total Basin employment. Employment in the government sector is more than double the next largest sector, retail trade. As discussed previously, although agriculture is important to the area in terms of culture, identity and water use, agricultural employment within the Basin is relatively small. **Figure 4.5** also illustrates employment by sector for each Basin county; therefore, the relative importance of each of those key sectors can be identified by county.

The economic sectors with the largest employment numbers are not necessarily the ones that generate that largest amount of earnings. The top six sectors, in terms of earnings, exclude accommodations and food service, which are typically lower paid jobs, and instead include transportation and warehousing. **Figure 4.6** depicts the earnings in each Basin county for the six highest earning employment sectors. Total earnings in the government sector were by far greater than for any other sector due both to the large amount of employment in that sector, as well as higher than average earnings in that sector.

Overall, the average earnings per employee in the Basin amounted to about $51,800 in 2014. However, average earnings per employee within each economic sector varied widely. For example, the average annual earnings for farm employment in Basin counties was about $32,900, while government employees averaged wages of about $68,200.[1] Mining provided the highest wage with average annual earnings of $90,600. Accommodations and food service workers earned some of the lowest wages, at about $22,200 per worker.

[1] Earnings estimates include that of proprietors.

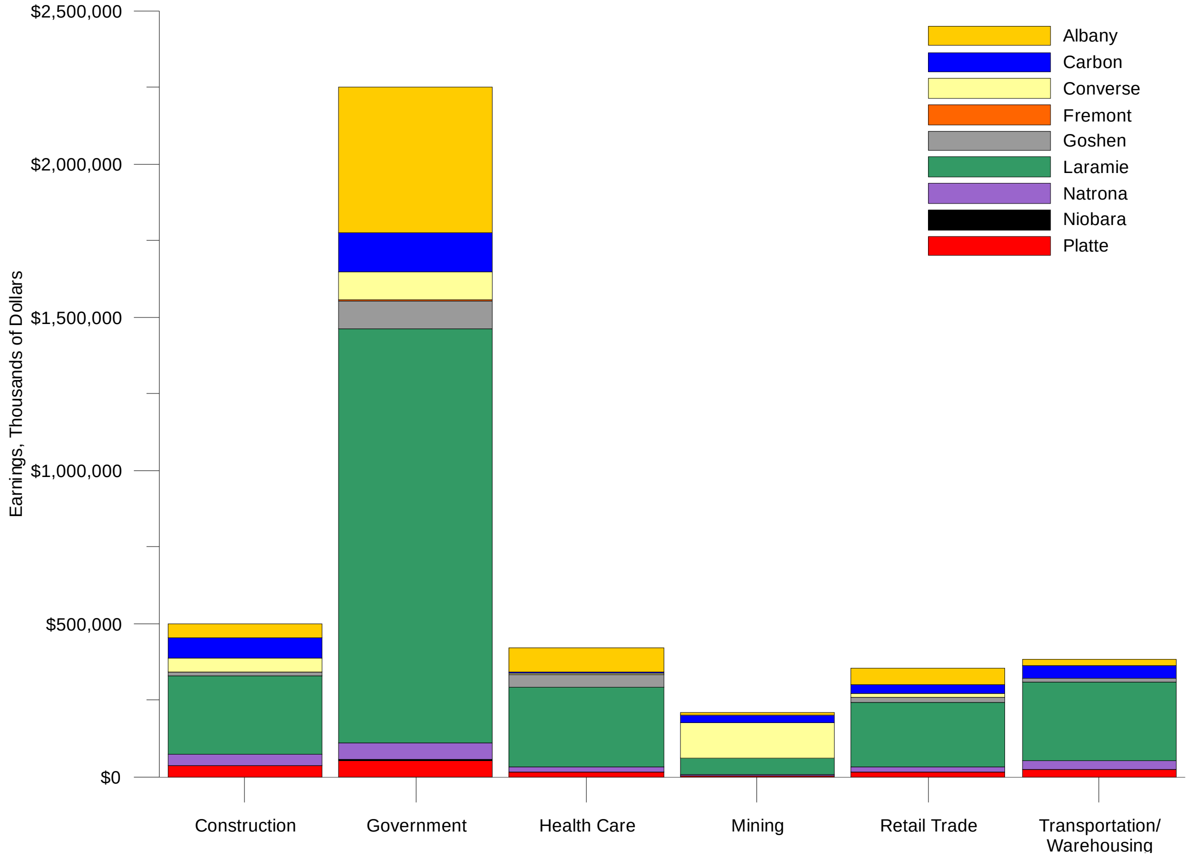
## Figure 4-5: Platte River Basin Employment by Key Economic Sector, 2014




Note: Only small portions of Niobrara and Fremont Counties are included in the Basin; therefore, Basin employment in those counties is extremely limited.

Sources: U.S. Bureau of Economic Analysis, Regional Economic Information System, http://www.bea.doc.gov/bea/regional/reis/and Harvey Economics, 2016.

**Figure 4-6: Platte River Basin Earnings for Key Economic Sectors, 2014**




Note: Only small portions of Niobrara and Fremont Counties are included in the Basin; therefore, Basin earnings from those counties are extremely limited.

Sources: US Bureau of Economic Analysis, Regional Economic Information System, Local Area Annual Estimates, http://www.bea.doc.gov/bea/regional/data.htm and Harvey Economics, 2016.

## Key Economic and Water Use Sectors

Agriculture's impact on the Basin's land and water use is significant. The energy and mineral sectors have historically added volatility to the Basin economy but also provide high paying jobs and often require a comparatively large amount of water. While municipal water consumption is a small percentage of the overall water used in the Basin, cities and towns have unique requirements that demand quality and reliability. Travel, tourism and recreation contribute to the Basin economy and water plays an important, but somewhat different, role in this sector. Environmental water use is notable and indirectly affects the economy. Finally, there is an ongoing effort to attract new business and manufacturing interests into the area, which in the long run may increase the Basin's economic base and may create new demand for water supplies. A discussion follows of each of these sectors.

The future of each of these sectors is integral to economic, demographic and water demand projections for the Platte River Basin. In Sections 2 and 3 of this volume (Volume 4), low, medium and high growth scenarios have been developed to forecast water demands.

**Agriculture**

**Overview**. Over a third of Wyoming's irrigated acres lie within the Platte River Basin, and over 40% of the State's livestock are raised in the Basin.[2] To gain an understanding of the current status and future trends in this sector, HE gathered agricultural data for the Basin, primarily from the Wyoming Department of Agriculture and other federal and State sources. In addition, Lidstone and Associates, Inc. provided data on current irrigated agricultural acreage for the Basin and for each subbasin.

As agricultural owner/operators age and farms/ranches change hands in the region, two seemingly contradictory trends have emerged. One is the consolidation of ranches, often to corporations, resulting in larger ranches. The other is the subdivision of ranches, resulting in smaller operations. The latter trend is particularly evident in more populous areas where land values and incomes are higher and where the market for "hobby" farms is growing. For example, between 2002 and 2012, the number of agricultural operations climbed by 25% while the number of farm acres declined by 10% in Basin counties (USDA 2012).

**Crop Production***.* Cropping patterns and livestock production are closely related. Alfalfa hay, other hay, and irrigated pasture account for over 80% of the irrigated crops in the Basin; that hay is used directly to feed Basin livestock. Other irrigated crops include corn, dry beans, sugar beets, barley, winter wheat, oats and spring wheat. Most irrigation is by flood, but pivots are increasing in some areas. Surface water is the most common water source, though groundwater is increasingly prevalent.

Energy and input prices, like fertilizer and equipment, influence crop patterns and rising prices can drive production levels. About 4% of the Basin's total landmass is used for dryland and irrigated cropland; about 2% is irrigated. **Figure 4.7** provides the irrigated agricultural acreage for each subbasin in 2012. The Above Pathfinder Dam and Upper Laramie subbasins include the largest numbers of irrigated acreage, while the Horse Creek subbasin has the least.

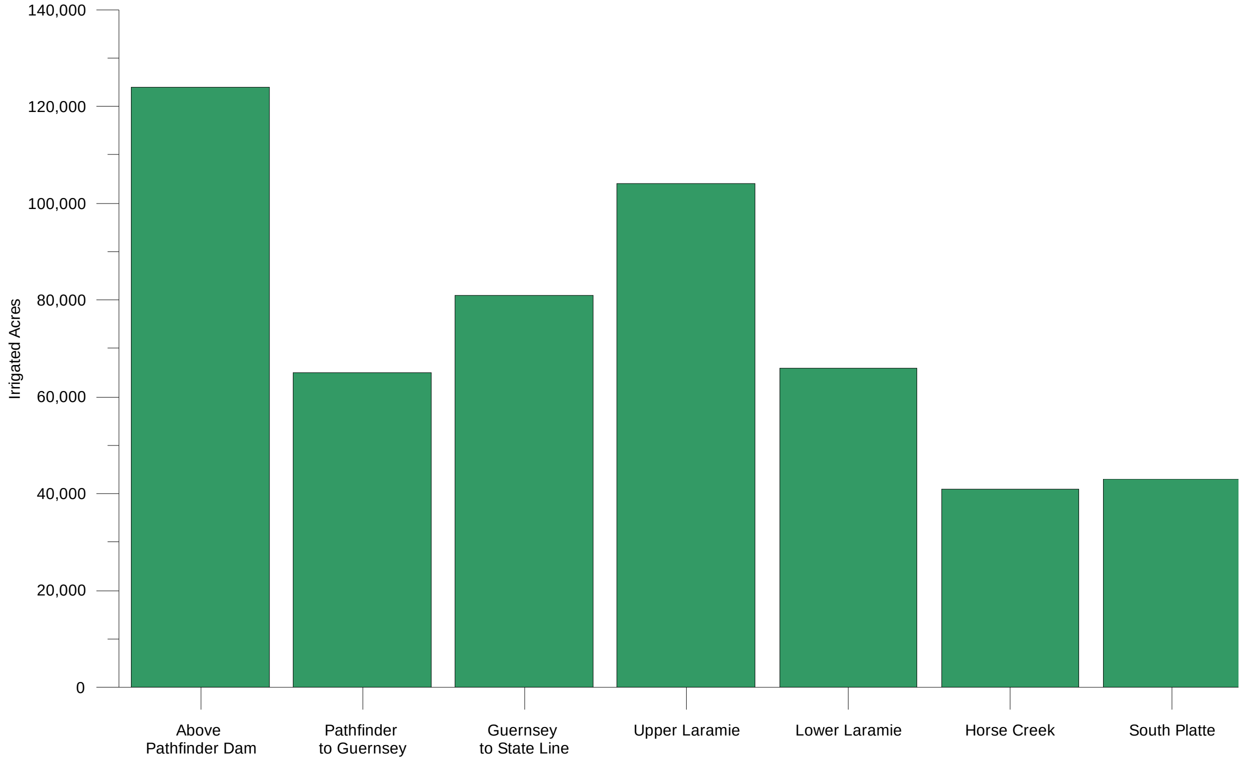
Cropping patterns by subbasin are illustrated in **Figure 4.8**. All seven subbasins include irrigated pasture, alfalfa and other hay. Irrigated acreage in the Upper Laramie subbasin only includes those three crops; the remaining six subbasins also contain other crops.

The Above Pathfinder Dam and Upper Laramie subbasins are almost entirely dependent on livestock production that consumes the hay cultivated there; those subbasins include very little in the way of cash crops. Crop production increases downstream toward Nebraska, where more favorable climate conditions justify the investment in cash crop production. Three counties, Goshen, Laramie and Platte, accounted for almost 80% of the value of crops sold in the Basin in 2012.

**Cattle***.* As of 2015, there were about 539,000 head of cattle in the Platte River Basin. This is a 0.4% decline from 2005, when there were about 541,000 head. With the exception of a larger herd in 2005 and 2006, the number of cattle in the basin has been relatively flat for the past decade. In addition to these cattle, which are counted as of January 1 each year, in some counties, yearlings from other states are brought in for grazing in April and then shipped back to those states in October. These yearlings are not included in the total cattle head counts.

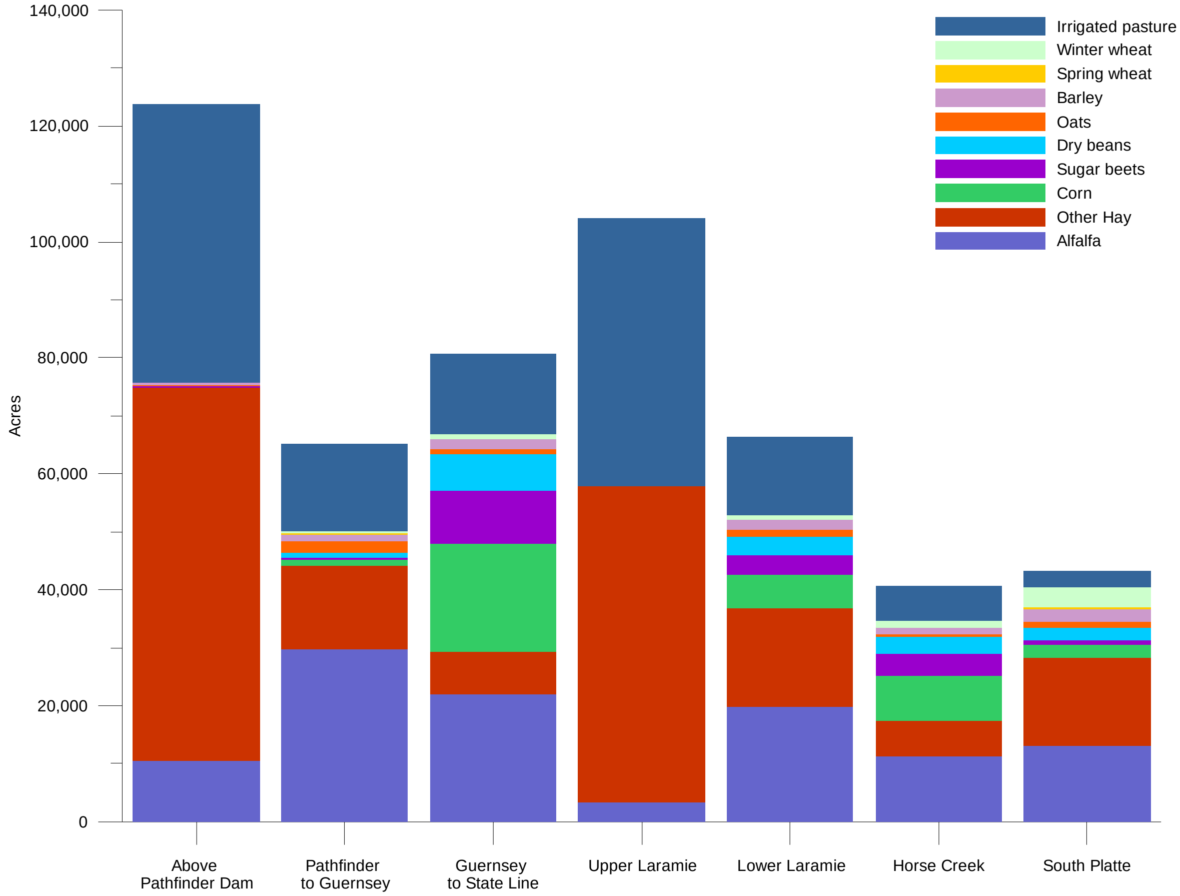
[2] Wyoming had roughly 1.4 million irrigated acres in 2012, according to the Wyoming Agricultural Statistics Service; the Platte River Basin included about 523,000 irrigated acres, or 36% of the state total. Wyoming had about 1.3 million head of cattle in 2015, and the Platte River Basin had roughly 539,000 head of cattle in 2015, or 41% of the state total.

**Figure 4-7: Irrigated Agricultural Acreage, by Subbasin, 2012**




Source: Lidstone and Associates, Inc., 2015.

**Figure 4-8: Cropping Patterns, by Subbasin, 2012.**



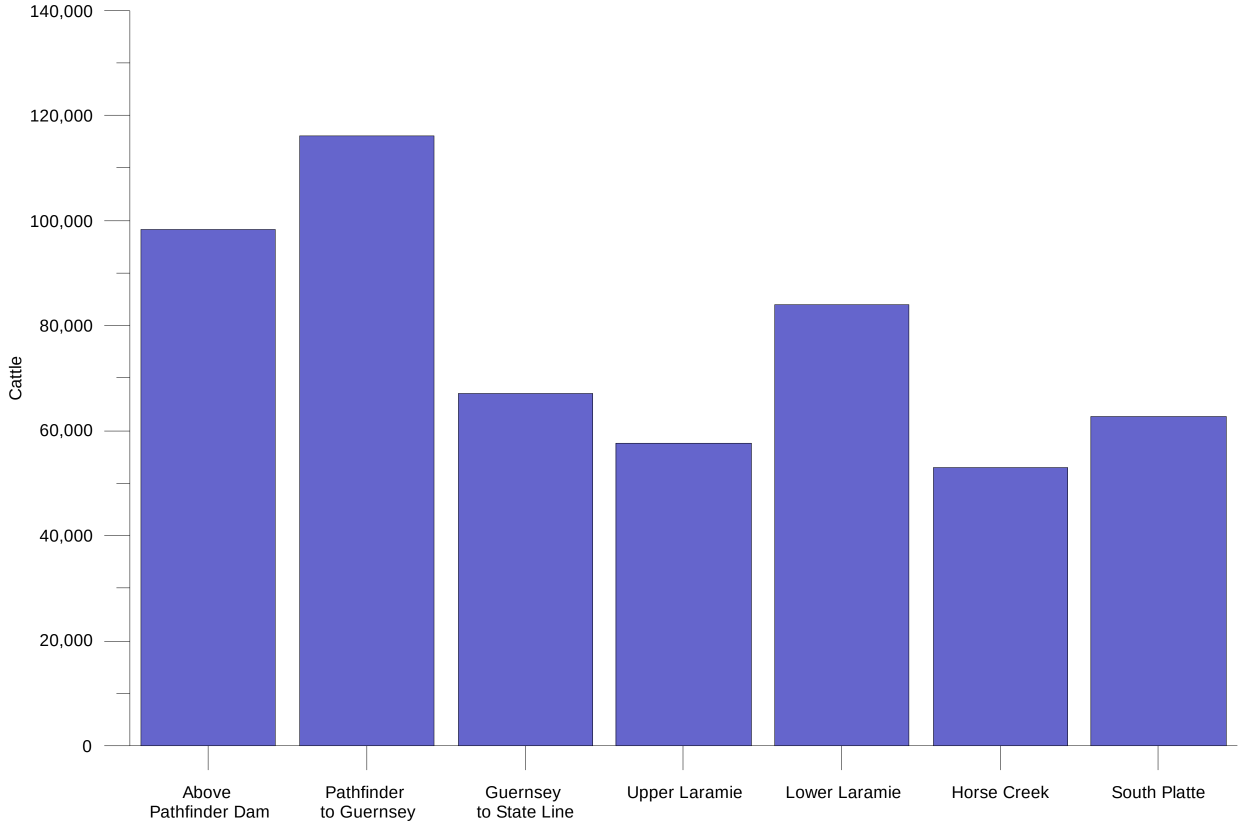

Sources: Lidstone and Associates, Inc., 2015 and Harvey Economics, 2016.

It should be noted that the average calf, presumably the same age, weighs as much as 200 pounds more per animal than it would have two decades ago, attributable to breeding and feed choice, primarily (Olson, 2011). Therefore, although cattle numbers are down slightly from 1995 (4% reduction), production, in terms of weight, has stayed about the same. This is significant because calf prices per cwt (hundred weight) are the most important driver of agricultural economics in the Basin (Mount 2005). Since 1999, cattle prices have risen sporadically, with a large spike in 2014.

Ranchers in the Basin depend on forage to supplement the hay they feed their animals. Therefore, during drought they cannot afford to raise as many cattle. Although hay and alfalfa are grown across the Basin, most areas are net importers of hay, much of it from the Wheatland area. As of 2014, hay cost $130 to $150 per ton, with a 1,000 pound cow requiring two tons to get through the winter (Wyoming Agricultural Bulletin). Most of the grazing land in the eastern portion of the Platte Basin is privately held, minimizing reliance on BLM land for grazing. However, in Natrona, Carbon and Converse Counties, public land for grazing is very important. BLM and USFS grazing policy has been fairly constant and no changes are anticipated.

**Figure 4.9** portrays the number of cattle in each subbasin. The Pathfinder to Guernsey and the Above Pathfinder Dam subbasins are home to the largest numbers of cattle, while the Horse Creek subbasin has the fewest.

**Figure 4-9: Estimated Head of Cattle in the Platte River Basin, by Subbasin, 2015**




Note: Basin abbreviations - Above Pathfinder Dam (APF), Pathfinder to Guernsey (PG), Guernsey to State Line (GSL), Upper Laramie (UL), Lower Laramie (LL), Horse Creek (HC) and South Platte (SP).

Sources: USDA National Agricultural Statistics Service Wyoming Field Office www.nass.usda.gov/wy/ and Harvey Economics, 2016.

**Sheep.** In 2004, there were about 107,000 sheep in the Basin. Since that time, the number of sheep produced in the Basin rose to over 140,000 and then declined to about 117,000 by 2015. As of 2015, over 70% of the Basin's sheep were grown in the Pathfinder to Guernsey subbasin. Each of the remaining subbasins included smaller numbers of sheep.

**Dairies.** The climate, limited growing season, distance to market and scarcity of water resources has discouraged development of a notable dairy industry in the Basin. There are a few dairies near the Nebraska border, but they are not a significant agricultural presence.

### Energy, Minerals and Utilities

Across the Basin, the importance of the energy sector varies greatly. For example, mining employment ranged from less than 20 people in Fremont County to about 6,200 people in Natrona County. On a countywide level, the 2014 production of crude oil ranged from 514 barrels in Platte County to more than 5.6 million barrels in Natrona County. Likewise, the production of natural gas ranged from zero for several Basin counties to over 97.1 million mcf in Carbon County. **Table 4.8** provides mineral production for Basin counties in 2010 and 2014.

**Table 4.8: Mineral Production by Type for the Platte River Basin, 2010 and 2014**

| Commodity | 2010 | | 2014 | |
|---|---|---|---|---|
| | Basin Total | % of State Total | Basin Total | % of State Total |
| Crude Oil, barrels | 7,450,333 | 20% | 28,331,013 | 38% |
| Stripper Oil, barrels | 6,741,934 | 46% | NA | NA |
| Natural Gas, mcf | 265,132,030 | 11% | 241,299,286 | 13% |
| Coal, tons | 26,944,748 | 6% | 23,798,965 | 6% |
| Bentonite, tons | 93,746 | 2% | 117,212 | 3% |
| Sand and Gravel, tons | 4,596,060 | 38% | 6,462,926 | 45% |
| Uranium, tons | 1,711,712 | 100% | 1,601,873 | 47% |
| Decorative Stone, tons | 22 | 0.4% | 0 | 0% |
| Granite Ballast, tons | 2,656,715 | 100% | 2,593,952 | 100% |
| Limestone, tons | 786,391 | 62% | 906,367 | 100% |
| Shale, tons | 165,775 | 100% | 163,470 | 100% |
| Gold, tons | 1 | 100% | 0 | NA |
| Leonardite, tons | 42,071 | 100% | 47,652 | 100% |
| Moss Rock, tons | 568 | 100% | 614 | 100% |

**Notes:**

1. Stripper oil production for 2014 was not included in the Department of Revenue's 2015 Annual Report.
2. No gold was produced in Wyoming in 2014.

Source: State of Wyoming Department of Revenue, annual reports, selected years.

All Basin counties produced some amount of crude oil and sand and gravel in 2014. Other minerals were produced in combinations unique to each county, with most counties producing at least three different types of minerals. In several instances, such as granite ballast, limestone and shale, production in the Basin counties constituted total statewide production of that mineral in 2014.

**Oil Production and Refining.** As of 2014, Wyoming ranked 8th in the U.S. for oil production and about 38% percent of Wyoming's production came from the Basin counties (Wyoming State Geological Survey and Wyoming Oil and Gas Conservation Commission). In those Basin counties, annual oil production has increased steadily in recent years, reaching over 28 million barrels in 2014 and over 34.5 million barrels in 2015. Oil drilling and production do not use substantial amounts of water except for injection production, drilling lubrication and well sealing. Most water for those activities is provided by nearby groundwater wells.

There are three oil refineries in the study area. Refineries require a large amount of water in cooling towers and for steam generation.

HollyFrontier's Cheyenne Refinery uses about 1,200 gallons per minute (GPM) from the city's municipal supply. The refinery's water use is constrained by the amount of effluent it is allowed to create, and the operator is thus incentivized to decrease water use. Production is expected to remain constant or decline over the long run. Even with an increase in production, the firm's expectations are that with improved technology, such as air cooling, water use will decline (Wohgnant 2004).

The Sinclair Refineries in Carbon County utilize about 1,500 GPM (4 cfs). They have a water right for about 1.5 cfs and a 50 year lease with the City of Sinclair for an additional 4.21 cfs. This lease is renewable for another 50 years. Current use is less than available supply, and unused water simply flows past the inlet. If production increases, plans are to employ air cooling as needed (Fritz 2004).

The operators of these facilities have not applied for any additional groundwater or surface water permits in recent years and therefore, it is assumed that water production at these refineries has, and will, remain relatively constant.

**Natural Gas.** Wyoming is currently the fifth largest producer of natural gas in the U.S. (Wyoming State Geological Survey). In 2015, about 16% of the state's natural gas was produced in the Basin counties (Wyoming Oil and Gas Conservation Commission, 2016). Annual production in those counties has generally declined in recent years, mainly in response to changes in commodity prices; however, both 2014 and 2015 saw small increases in natural gas production in the Basin, even as total statewide production continued to decline.

Statewide, coalbed methane (CBM) has seen annual decreases in production in recent years and by 2015 production was down by about 65%, as compared to its recent high production point in 2009. The majority of CBM is produced in the Powder River Basin. Historically, less than 1% of total CBM production has occurred outside that Basin; however, that percentage has increased slightly in recent years. Natural gas production uses minimal water supplies in drilling and may produce non-hydrologically linked groundwater in some instances with coalbed methane extraction. Water production is expected to be minimal as related to any future coalbed methane development in the Basin.

**Coal Mining.** Although coal is produced in Converse County, the Antelope coal mine in that county is not located within the boundaries of the Platte River Basin. There are currently no operating coal mines within the Basin. As of 2014, the majority of coal mining in Wyoming occurred in Campbell County (91% of statewide coal production). Only about 6% of coal was produced from within Converse County, and as stated previously, that activity occurred outside of Basin boundaries. There is currently no active coal mining or coal production taking place in Carbon County (Wyoming Mining Association). The Seminoe I, Seminoe II and Rosebud mines in that county are all now reclaimed mining sites; there is no production at the Elk Mountain Mine.

**Other Minerals.** As of 2014, Converse County produced almost half of Wyoming's uranium, down from 100% of statewide uranium production in previous years. About half of the state's sand and gravel comes from Basin counties, an increase from recent years. Laramie County produces all of the state's granite ballast and statewide production of limestone, shale, leonardite and moss rock comes from Albany County. The production of these other minerals requires relatively small amounts of water.

### Utilities

As of 2015, there were a number of electric generating facilities operating within the Basin, as well as several proposed for future development. Of these, the USBR operates six hydropower facilities, including Alcova (36 MW), Fremont Canyon (fed by Pathfinder at the upstream side of Alcova Reservoir, 67 MW), Glendo (38 MW), Guernsey (6 MW), Kortes (36 MW) and Seminoe (45 MW). The first priority for the USBR reservoirs with hydropower facilities is irrigation, followed by minimum flow agreements, and then power generation. There is almost no consumptive water use from hydrogeneration.

The Laramie River Station in Platte County is operated by Basin Electric Power Cooperative. That facility employs about 325 people and has a generating capacity of 1,710 MW from three coal-based units. This coal-fired plant uses about 23,250 acre-feet of water each year. There are no known plans for expansion.

The Dave Johnston Plant in Converse County is owned and operated by PacifiCorp and provides jobs to 191 full time employees. The plant burns coal for steam generated power and has a capacity of 817 MW. The facility consumes approximately 8,600 acre-feet of water annually. The plant owns three sets of water rights for a total of 11,266 acre-feet per year. There are no known plans for expansion.

The Cheyenne Prairie Generating Station in Laramie County is a 132 MW natural gas-fired generating power plant owned by Black Hills Corporation. The power plant includes a natural gas-fired combustion turbine generator (simple cycle) and a combined cycle unit. The simple cycle unit is wholly owned by Cheyenne Light and the combined cycle unit is a joint ownership between Cheyenne Light and Black Hills. The power generated by this facility will be used as replacement generation for Black Hills and Cheyenne Light, including 82 MW of older, coal-fired generation that cannot be economically retrofitted to meet new EPA air emissions for Black Hills and 40 MW for a terminating power supply agreement for Cheyenne Light. This project started construction in 2013 and the facility went into operation in October 2014. In the short term, the plant will require about 500 acre-feet of water per year; however, increasing future demands may result in requirements of up to 1,000 acre-feet per year (Cheyenne BOPU, 2013). The generating station requires about 10 full time employees for operations.

The Power Company of Wyoming's proposed Chokecherry and Sierra Madre Wind Energy Project is an up to 1,000-turbine wind farm to be located south of Sinclair and Rawlins in Carbon County, Wyoming. The project will generate up to 3,000 MW. This project is nearing the final stages of the federal NEPA permitting process (BLM, 2015). In general, wind energy projects require little to no water for operations.

The Pathfinder Wind Energy Project is a proposed 2,100 MW wind project to be located in Platte County, Wyoming (Pathfinder, 2016). The project is currently in the initial stages and is based on a partnership between General Electric, Duke American Transmission Company, Magnum Energy LLC and several financial companies. This project would also include an energy storage component.

#### Recreation, Travel and Tourism

Travel and tourism are important to the economy of the Basin, although the Basin lacks a large destination tourist attraction. These activities increase overall water use in the Basin due to the influx of visitors. Activities and opportunities in this sector have remained generally the same since the original Basin Plan. However, due to changes to the organization of the Current Basin Surface Water Use Profiles, non-consumptive recreational water use is discussed only briefly in this document.[3] Consumptive water use for recreation includes golf course maintenance and snow-making.

Local use and day trips from Colorado and other nearby areas account for much of the recreational activity and related travel within the Basin. Larger cities, such as Cheyenne, Casper and Laramie, also attract conventions and other business related travel. For Basin areas that lack tourist attractions or recreational facilities, there is a benefit from drive-through traffic to other tourist or recreational locations. Overall, travel spending in the Basin represented about 35% of all travel spending in the State in 2014 (Dean Runyan, 2015). These activities contribute greatly to the retail trade and accommodation and food services sectors, which are among the largest employers in the Basin. In 2014, more than 12,000 jobs were generated by travel and tourism in Basin counties. Since 2000, travel spending in the Basin has increased about 5% each year, on average.

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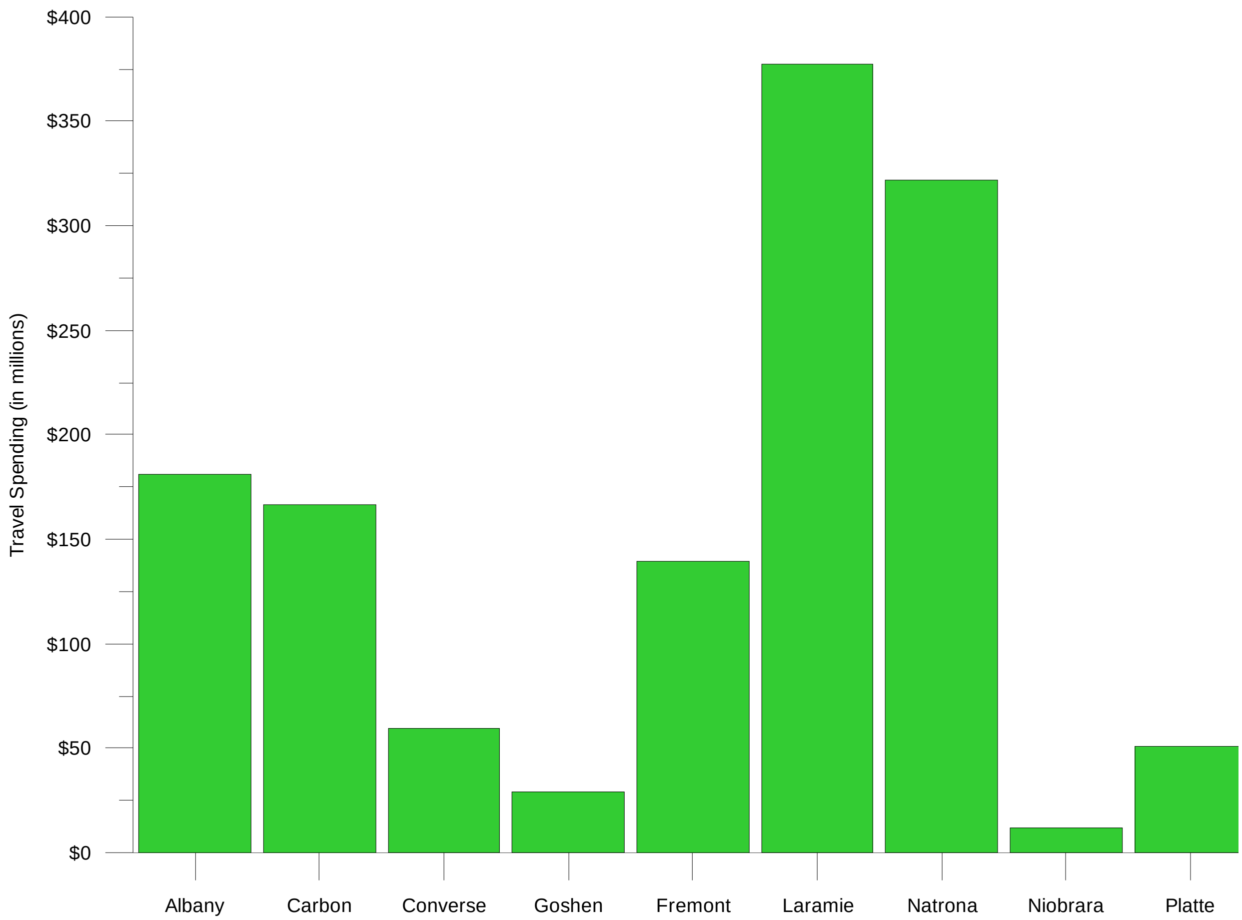
[3] The Recreation and Environmental Water Use discussion in Volume 2, Section 4 of this Platte Plan Update provides a detailed discussion of water use in those sectors.

As was true at the time of the original Basin Plan, travel related spending varies significantly within the Basin counties as shown in **Figure 4.10**. Laramie County, which includes the City of Cheyenne, and Natrona County, which includes Casper, were the recipients of the largest amounts of travel related spending in 2014.

**Figure 4-10: Travel Spending by within the Platte Basin Counties, 2014**




Note: Most of the tourist attractions in Fremont County are located outside of the Basin.

Source: Dean Runyon Associates. *Wyoming Travel Impacts, 2000 – 2014.* April 2015.

Environmental and recreational water uses in the Basin are very important to anglers, rafters those who participate in a wide variety of outdoor activities and those who value the natural environment. The numerous rivers, streams, reservoirs, mountains and forest lands in the Basin provide ample opportunities for these endeavors. Key recreational water uses in the Basin include fishing, boating and whitewater rafting. Much of this activity takes place on or near the North Platte River, its tributaries and associated reservoirs. There are numerous blue, red and yellow ribbon trout streams in the Basin, which provide excellent opportunities for anglers. In addition, USFS lands and mountainous areas provide extensive recreational options for outdoor enthusiasts. Boating occurs primarily on the reservoirs, which are assumed to be protected uses. Camping is also a popular activity in the Basin, and although it is not directly related to water use, many of the camping locations are located near streams and reservoirs and their use may be directly tied to water levels.

**Reservoirs.** There are a number of reservoirs in the Basin that provide recreational opportunities. However, the reservoirs were developed for flood control, irrigation and power, and as such, do not have a recreation reserve pool. As a result, recreational use at the reservoirs generally peaks in July and then declines as water levels are drawn down for irrigation. Drought also impacts use, not only because of reduced water levels but also because of the prohibition of campfires. Even so, three of the largest reservoirs, Pathfinder, Glendo and Guernsey, each attract thousands of visitors each year. Glendo and Guernsey also have state parks at the reservoir location. In 2014, Glendo State Park had more than 300,000 visitors and Guernsey State Park had about 78,000 (Wyoming Division of State Parks, 2014).

The potential for additional vacation homes around Basin reservoirs is limited due to federal ownership of surrounding lands. However, interest appears to exist in developing available lands around Basin Reservoirs, as feasible. For example, in 2011 Natrona County commissioned a study regarding development of properties at Alcova Reservoir and of an existing marina site, without tenant improvements, at Pathfinder Reservoir (Holthouse, 2012).

**Golfing.** There are 19 golf courses with nearly 300 holes covering more than 2,000 irrigated acres in the Basin. Unlike other recreational activities, golf courses do require consumptive use of water. Only a few new courses are anticipated in the near future across the Basin.

**Skiing.** There are two alpine ski areas that consumptively use water to make snow in the Platte River Basin. Both the Hogadon Basin near Casper and the Snowy Range ski area near Laramie have surface water rights for snowmaking.

### Manufacturing and Other Industry

As noted earlier in this analysis, Wyoming has proportionately less employment in the manufacturing sector as compared with the rest of the nation, due in part to the relatively small population base and limited workforce. However, there is a concerted effort in Basin counties to encourage location and development of manufacturing and light industry within the region and to reduce dependence on the more volatile energy sector.

**Albany County.** Manufacturing makes up less than 2% of total employment in Albany County. The University of Wyoming is located in Laramie and is both the largest employer and the largest water user in the county. Other large employers are generally related to government, education and healthcare; some larger retailers also operate in the county, mainly in or near Laramie. Mountain Cement Company in Laramie is the county's only other single large water user. Agriculture is the county's largest water consuming sector.

**Carbon County.** Historically, manufacturing has made up about 4% to 5% of County employment. Other than local government and school districts, the County's largest employers include the Sinclair Oil refinery (580 employees), Memorial Hospital (178), Union Pacific Railroad (172) and Walmart (169). The largest water users in Carbon County are parks and a golf course. The state prison in Rawlins houses 700 inmates and employs 300 and is the second largest user of water in the county. Major industries include transportation and energy, natural gas and agriculture.

**Converse County.** Manufacturing is a very small component of the Converse County economy; mining, ranching and transportation are the principal economic activities. As of 2015, there were no large manufacturing or industrial employers in the County. A food supplements manufacturer, Nutri-West, is located in Douglas, the firm has its own well and is not a large water user. A coal gasification plant has been proposed and would generate significant construction employment over several years, with ongoing employment of several hundred people. This facility may require a large amount of water, but its prospect for development is still very uncertain.

**Fremont County.** A small portion of Fremont County is located inside the Basin; that portion does not include the larger cities of Lander or Riverton, where any measurable amount of manufacturing activity might occur. Even so, only a small amount of manufacturing occurs throughout the County as a whole. The County's largest economic sectors, in terms of employment, are the government and retail trade sectors.

**Goshen County.** As of 2014, the manufacturing sector employed about 4.5% of people working in Goshen County. However, the future of manufacturing in the County is uncertain. The Wyoming Ethanol Facility in Torrington, which had been in business since 1995, closed in fall 2015. In addition, the Western Sugar Cooperative plans to close its Torrington facility within the next year or two (2017 at the latest); that facility has been a major employer and one of the County's larger water users. Other, smaller, manufacturing companies in the County include synthetic wood production and the manufacturing of specialty farm equipment. The economy is dominated by agriculture and associated businesses. Additionally, the State is currently building a correctional facility in Goshen County that will generate local employment.

**Laramie County.** Most industry in this Basin is located in and around Cheyenne. However, manufacturing accounts for only about 2.5% of employment in the area; the County's largest sources of employment are government services, including the military; health care; and education. Individual large employers include Sierra Trading Post (877 employees), Union Pacific Railroad (660), Echostar Communications (380), HollyFrontier Oil (301) and Dyno Nobel (221), an industrial fertilizer manufacturer. Additionally, both Walmart and Lowe's operate regional distribution centers in Cheyenne and the Cheyenne Prairie Generating Station is located in the area. In recent years, Microsoft has also expanded its data center operations in the Cheyenne area; the company is currently considering an additional expansion.

**Natrona County.** The health care, retail trade and mining industries employ the greatest number of people in Natrona County; only about 3.5% of the County's employment is included in the manufacturing sector. Other than school districts and local government, large employers include several health care facilities, a glass repair company (384 employees), several oil and gas service providers and Keyhole Technologies, a construction services company (270 employees). Oil and gas production drive the economy and create many jobs in the County.

**Niobrara County.** Almost no manufacturing at all occurs in Niobrara County. The County's economy is largely based on ranching and dry land agriculture, along with some oil production and retail trade activity. The school district and local governments are major employers. The Union Pacific Railroad and Wyoming Women's Center, a correctional facility, also employ larger numbers of people. Only a small portion of Niobrara County is included in the Basin.

**Platte County**. Manufacturing comprises less than 2% of total employment in Platte County. The largest employers in the County are the Basin Electric Power Cooperative that operates the Laramie River Station, the Platte County School Districts, Burlington Northern Railroad and Platte County Memorial Hospital. The Platte County Economic Development Corporation is optimistic about the potential for increased economic activity from tourism and the recent location of several oil service companies in the area. Amenities continue to be developed at Glendo State Park, which attracts an increasing number of recreational visitors each year. Agriculture is the most significant economic sector in the county, although it does not provide a great deal of direct employment.

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## 4.3 METHODOLOGY FOR UPDATING DEMAND PROJECTIONS

***"The only way to predict the future is to have power to shape the future."***
- Eric Hoffer

Section 4.2 describes the approach used to evaluate projected economic and demographic conditions in the Basin under three alternative scenarios: high, low and medium water use levels. These sections include the following:

- An evaluation of the forecasting approach used in the existing Basin Plan, including explanations of any suggested changes in approach or other revisions employed in this study;
- Alternative scenario projections for each of the key economic sectors within the Basin, including agriculture, mining and oil and gas development;
- Population and employment projections, by subbasin, under each scenario; and,
- Aggregate economic and demographic projections under each scenario incorporating the individual sector projections.

The data and information used to develop and define the alternative water use scenarios summarized in this section were largely gathered from publicly available secondary sources, along with specific interviews. Those sources are listed in the reference section at the end of this section.

### 4.3.1 Evaluation of Existing Approach and Methodology

The projections of economic and demographic conditions and the water demand projections presented in the 2006 Basin Plan were developed using an approach known as "economic base analysis". The economic base approach focuses directly on specific activities that are likely to drive economic and demographic changes in the future. HE's 2005 technical memo regarding projected economic and demographic conditions for the Basin at that time describes the application of economic base analysis as follows:

1) *Identify the existing and potential basic economic activities in the region through analysis of economic statistics and local interviews.* Basic activities are defined as businesses or governmental organizations that bring money into the region from sales of goods or services to outside areas or through transfers of public funds.

2) *Identify the current statistical relationships: a) between total employment in economic base activities and other employment in the economy (termed "local service employment"); and b) between total employment and population*. The latter relationship reflects the proportion of the population that is of working age, the labor force participation rate amongst the working age population and the unemployment rate plus in-commuting or out-commuting from the area.

3) *Conduct industry studies for each of the basic economic sectors to identify trends in employment and production and factors affecting potential future growth of those sectors.* These studies entail research and analysis of available industry data and local interviews.

4) *Develop specific projections of future basic economic activity levels*. These are based upon the results of Step 3 and clearly defined scenario assumptions.

5) *Develop overall employment and population projections built upon the basic activity projections developed in step 4 and the statistical relationships developed in Step 2.*

HE re-visited the economic base analysis approach to determine its appropriateness for use in the updated Basin Plan. HE determined that the use of an economic base analysis approach is relevant and applicable to the task of determining future Basin water demands for several reasons: (1) it can be applied to a geographic area that does not follow political or other legal boundaries, such as county lines; (2) it provides the ability to focus on specific industries or water users that are important to the Basin; and (3) it allows for the incorporation of Basin specific demographic characteristics, such as labor force participation rates and unemployment rates. Each of Wyoming's river basins comprises a unique and diverse set of economic and demographic characteristics; the characteristics of the Platte Basin are best reflected in the Basin's future water demand projections through the use of economic base analysis.

### 4.3.2 Overview of Alternative Planning Scenarios

The water demand projections included in the 2006 Basin Plan were based on HE's development of three alternative planning scenarios for growth and water use: high, low and mid scenarios. We believe that this multiple scenario approach continues to be a useful way to study, evaluate and plan for the Basin's future water needs. Therefore, the general definitions of the high, low and mid scenarios for the Basin remain unchanged:

#### High Scenario

In the simplest terms, the High Scenario incorporates HE's views of the most growth in each of the key sectors and in the region that could potentially occur over the forecast horizon. It is possible that one or more of the key sectors could grow even more than we have assumed under this case, or an unforeseen, new basic economic activity could establish itself and flourish in the region. However, it is also possible that other sectors will not develop to the maximum and so the growth in aggregate employment and population that drives future water demand will be somewhat moderated if one sector expands beyond the bounds we foresee. Therefore, the study team felt that the underlying aggressive assumption that each of the key sectors will achieve its highest reasonably likely growth at the same time makes this scenario a useful upper bound for subsequent water planning purposes.

#### Low Scenario

The Low Scenario embodies the study team's views of the lowest simultaneous growth (or largest contraction) reasonably likely to occur in each of the key sectors and in the region over the planning horizon. While even lower economic activity levels in one or more sectors are not impossible, again, the study team felt that the assumption of simultaneous low activity levels in each of the key sectors, though somewhat artificial, made this scenario a supportable lower bound for planning purposes. While the Low Scenario obviously will not impose pressure on regional water resources, this scenario is sometimes used for purposes of determining the financial risk involved with potential water resource enhancements.

#### Mid Scenario

The Mid Scenario represents the study team's views of the most realistic level of growth likely to occur in each of the key sectors and in the region over the planning horizon. As in the other two scenarios, the potential interaction between the economic sectors and the wider economy is acknowledged. Although the actual economic growth experienced in the Basin may vary somewhat from this projection, the assumed activity levels represent, in the study team's best judgment, the rate of growth most likely to be experienced in the Basin. As such, this scenario is perhaps the most useful for water planning purposes.

### 4.3.3 Economic Base Scenario Assumptions for Key Sectors

The economic base scenario assumptions for the 1) agriculture, 2) tourism and recreation,3) electric power generation, 4) mining and mine reclamation, 5) oil and gas (refining, exploration, production and reclamation; 6) aggregates, cement and concrete; and, 7) miscellaneous industry, including road construction are presented in Sections 4.2.4 through 4.2.10.

#### Agriculture - Economic Base Scenario Assumptions

The general factors that have the potential to influence the future of agriculture in the Platte River Basin have not changed since the 2006 Basin Plan was prepared. Those include (1) the demand for and price of beef; (2) changes in public land grazing policies; (3) second home and subdivision development; (4) the aging of the ranching population; (5) management and application of livestock and irrigation techniques. Although agriculture's share of the Basin's economy continues to be small in terms of employment, sales and income, it remains an important industry in the Basin and supports the character and identity of the area. Agriculture is also, by far, the largest water using sector.

**Historical Trends and Current Conditions.** Between 2002 and 2012, the number of farms in the Platte River Basin increased by about a quarter, but the number of acres of farmland declined by around 10% (USDA Census of Agriculture 2012). From 2005 to 2015, the number of cattle in the basin remained relatively flat (a decrease of 0.4%), while the number of sheep decreased by 12%.

The number of irrigated acres in the Basin decreased by about 88,000, or about 14% between the 1995-2001 time period and 2012 (Agricultural Use, Volume 2, 2016). All but one of the subbasins (Upper Laramie) experienced a drop in the number of irrigated acres during that time. Losses ranged from about 2,200 irrigated acres in the South Platte subbasin (5% of total irrigated acres in that subbasin) to almost 26,600 irrigated acres in the Above Pathfinder Dam subbasin (18% of total irrigated acres in that subbasin). The largest percentage loss occurred in the Horse Creek subbasin, which lost about 19,000 acres, or about 32% of total irrigated acres. The Upper Laramie was the only subbasin to gain irrigated acreage, experiencing a 13% increase, or about 12,000 acres.

The slight drop in overall cattle numbers in the Basin masks several large changes in cattle inventory in the subbasins. Four of the seven subbasins enlarged their cattle inventory, with increases ranging from 1% to over 38%. The two subbasins that decreased their cattle inventory (Pathfinder to Guernsey and Lower Laramie) dropped by 10% and 24% respectively. And the Guernsey to State Line subbasin remained unchanged over the 2005-2015 period.

The overall decrease in the number of sheep in the basin is fairly widespread, with all but one subbasin experiencing a drop in inventory. The South Platte subbasin increased its sheep inventory by 0.5% from 2005 to 2015. The decreases in the remaining subbasins ranged from 8% to 43%.

**Scenario Approach.** Similar to the approach used in the 2006 Basin Plan, HE projected High, Low and Mid Scenarios for livestock, irrigated acreage and crop mix in the Basin based on historic trends and assumptions about public lands grazing policies, beef productivity and prices and demand, wool and lamb prices. To standardize the analysis in terms of livestock forage levels, county level livestock inventories were converted to "animal units" by dividing estimated cattle inventories by two and sheep inventories by five for water use purposes.

For all scenarios, HE assumed that the mix of crops would not change substantively over the projection period. In reality, the crop mix is determined by a multitude of factors including relative prices of the various crops, irrigation water forecasts and individual farm circumstances such as crop rotation and equipment availability. These factors are problematic to estimates of crop mix from year-to-year, let alone 30 years into the future. Alfalfa, other hay and irrigated pasture account for over 80% of total crop acreage and, given that hay and cattle have remained as Wyoming's top crop and livestock products for over a decade, it is reasonable to assume that this will continue.

HE also assumed that the consumptive use of water for each crop has remained the same as the last plan and will persist for the future. The consumptive use of a crop depends more on environmental factors, climate conditions, irrigation schedules and water availability than the particular crop cultivar.

**High Scenario.** The High Scenario for livestock production reflects what the study team believes are the most optimistic stocking assumptions given production of feed from irrigated lands and arid rangelands and strong demand and prices for beef, wool and lamb. Under the High Scenario, HE assumed that future cattle and sheep inventories would reach the historical maximum number over the previous 10 years. To attain those numbers under the High Scenario, HE assumed that the current strong beef, sheep and wool prices would be maintained, or increase and the herds would build up in response to a long-term price signal. HE also assumed that, because these numbers have been achieved in the last decade, the infrastructure necessary to maintain herds this size is available. By the end of the planning horizon in 2045, HE projects roughly 625,000 head of cattle and 166,000 head of sheep within the Basin, up from 539,000 and 117,000 head of cattle and sheep, respectively, in 2015. These assumptions represent increases of 16% and 42%, respectively, for cattle and sheep.

Under the High Scenario, irrigated acreage in the Basin will increase by 19%, as compared to current levels, from 524,000 acres to 624,000 acres. As with the livestock, this represents the maximum number of acres irrigated in the previous decade. In fact, the strong animal numbers will drive most of the increase in hay and irrigated pasture acres, which make up the largest share of irrigated acres in the Basin. HE also assumed that the cash crop prices would be strong, allowing some of the less productive acres to be brought back into production profitably. As described above, the crop mix is projected to remain similar to current conditions, with roughly 80% of irrigated acreage planted in alfalfa, other hays and pasture. Under this scenario, ranchers bring into irrigated production some marginal lands that under normal economic conditions may not be economically viable to cultivate, given low returns on investment. HE assumed that the investment in irrigation techniques already in place indicates that the use of flood versus pivot irrigation and surface versus groundwater will remain consistent under all scenarios.

**Low Scenario.** The Low Scenario for livestock production reflects what the study team thinks are the most pessimistic stocking assumptions for the Basin, given production of feed from irrigated lands and arid rangelands and weak demand and prices for beef, wool and lamb. HE generally assumed that the declining historic trend in both cattle and sheep inventories would continue to 2045. By the end of this planning horizon, HE projects roughly 483,000 head of cattle and 62,000 head of sheep within the Platte River Basin, down from 539,000 and 117,000 head of cattle and sheep, respectively, in 2015. Those assumptions represent decreases of about 10% and 47%, respectively, for cattle and sheep.

Under the Low Scenario, irrigated acreage will decrease by 18% from current levels, from 524,000 acres to 428,000 acres. HE assumed that the declining historical trend in irrigated acres would continue, but at a declining rate, e.g. the irrigated acres in Above Pathfinder

Dam subbasin would decrease at 2% per year (the recent 10-year average decline) from 2015 to 2025, then by 1% per year from 2025 to 2035 and, finally by 0.5% per year to 2045. The basis for this reduction in acres is twofold; fewer head of livestock will require fewer acres of irrigated pasture and less hay, and as irrigation efficiencies and crop production methods improve, farmers will be able to realize the same or greater yields from fewer acres. This will result in the less-productive acres being taken out of production, while the most productive acres will be maintained throughout the forecast period.

**Mid Scenario.** The Mid Scenario for livestock production reflects what the study team feels are the most realistic stocking assumptions for lands in the Basin, given production of feed from irrigated lands and arid rangelands and steady demand and prices for beef, wool and lamb. HE assumed that the current inventory of cattle and sheep will be maintained through 2045. This is roughly the recent historical average cattle and sheep inventory in each county. Over the last decade, there have been large (positive and negative) swings in both the number of cattle and sheep, from a 9% increase to a 9% decrease in cattle and from 24% to -10% in sheep. HE assumed that these swings would continue based on fluctuations in livestock prices, but the overall trend would be flat. By the end of the planning horizon, HE projects roughly 539,000 head of cattle and 117,000 head of sheep within the Platte River Basin.

Under the Mid Scenario, irrigated acreage will decrease by 9%. While the number of livestock will remain the same, maintaining the hay and pasture acres, the efficiency trend in cash crop production will continue, allowing farmers to produce more crops on fewer acres. The marginal acres will be taken out of production in favor of the most productive acres. Additionally, acreage may be lost to ranch sales to large corporations or to developers in the more urban areas around Cheyenne, Torrington, Laramie and Casper. **Table 4.9** presents HE's projections for cattle and sheep numbers and irrigated acreage by crop type in the Basin for 2045 under the High, Low and Mid Scenarios. These same data in a more summary form by subbasin are presented in **Tables 4.10 and 4.11**.

**Table 4.9: Projected Cattle, Sheep and Irrigated Acres by Crop Type, Platte River Basin, by Scenario**

| | Current (2015) | Projected (2045) | | |
|---|---|---|---|---|
| | | Low | Mid | High |
| **Crop - Acres** | | | | |
| Alfalfa | 109,000 | 78,000 | 94,000 | 137,000 |
| Other hay | 179,000 | 156,000 | 167,000 | 209,000 |
| Irrigate pasture | 145,000 | 126,000 | 135,000 | 170,000 |
| Corn | 36,000 | 27,000 | 32,000 | 43,000 |
| Sugar beets | 17,000 | 13,000 | 15,000 | 21,000 |
| Dry beans | 16,000 | 12,000 | 14,000 | 19,000 |
| Oats | 6,000 | 4,000 | 5,000 | 7,000 |
| Barley | 8,000 | 6,000 | 7,000 | 10,000 |
| Winter wheat | 6,000 | 5,000 | 6,000 | 8,000 |
| Spring wheat | 1,000 | 1,000 | 1,000 | 1,000 |
| **Total Crops - Acres** | **524,000** | **428,000** | **475,000** | **624,000** |
| **Livestock - Head** | | | | |
| Cattle | 539,000 | 483,000 | 539,000 | 625,000 |
| Sheep | 117,000 | 62,000 | 117,000 | 166,000 |
| **Total Livestock - Head** | **656,000** | **545,000** | **656,000** | **791,000** |

**Note:** Totals may not add due to rounding.
Source: Census of Agriculture for Wyoming (USDA, 2014).
Projections made by Harvey Economics 2015.

**Table 4.10: Projected Irrigated Acres by Subbasin, by Scenario**

| | Current (2015) | Projected (2045) | | |
|---|---|---|---|---|
| | | Low | Mid | High |
| **Subbasin** | | | | |
| Above Pathfinder Dam | 124,000 | 88,011 | 106,960 | 150,238 |
| Pathfinder to Guernsey | 65,000 | 37,064 | 51,244 | 89,966 |
| Guernsey to State Line | 81,000 | 74,063 | 77,726 | 84,569 |
| Upper Laramie | 104,000 | 104,038 | 114,095 | 128,947 |
| Lower Laramie | 66,000 | 37,904 | 52,335 | 91,674 |
| Horse Creek | 41,000 | 22,031 | 31,312 | 57,652 |
| South Platte | 43,000 | 39,507 | 41,591 | 45,503 |
| **Total Basin Irrigated Acreage** | **524,000** | **428,000** | **475,000** | **624,000** |
| **Note:** Totals may not add due to rounding.<br>Source: Census of Agriculture for Wyoming (USDA, 2014).<br>Projections made by Harvey Economics 2015. | | | | |

**Table 4.11: Projected Livestock by Subbasin, by Scenario**

| | Current (2015) | Projected (2045) | | |
|---|---|---|---|---|
| | | Low | Mid | High |
| **Subbasin** | | | | |
| Above Pathfinder Dam | 108,000 | 80,000 | 108,000 | 129,000 |
| Pathfinder to Guernsey | 199,000 | 135,000 | 199,000 | 247,000 |
| Guernsey to State Line | 68,000 | 66,000 | 68,000 | 81,000 |
| Upper Laramie | 60,000 | 55,000 | 60,000 | 61,000 |
| Lower Laramie | 85,000 | 74,000 | 85,000 | 121,000 |
| Horse Creek | 57,000 | 57,000 | 57,000 | 66,000 |
| South Platte | 77,000 | 78,000 | 77,000 | 84,000 |
| **Total Basin Head of Livestock** | **656,000** | **545,000** | **656,000** | **791,000** |
| **Note:** Totals may not add due to rounding.<br>Source: Census of Agriculture for Wyoming (USDA, 2014).<br>Projections made by Harvey Economics 2015. | | | | |

### Tourism and Recreation - Economic Base Scenario Assumptions

The tourism and recreation sector does not play a large role within the economy of the Platte River Basin, but it is important to note the extent to which it contributes to sales, income and employment in several of the Basin's important economic sectors, including retail trade and accommodations and food services. As tourism and recreation contribute to providing jobs and income for the region, the effects on economic and population projections are captured in the municipal and rural domestic projections discussed later in this section. More importantly, tourism and recreation create notable consumptive and non-consumptive demands on water in the basin for golfing, alpine skiing, angling, boating, swimming, waterskiing and enjoyment of water amenities such as creeks, rivers, reservoirs and the scenery and habitats that accompany them.[4]

**HE specifically examined two recreational sectors, alpine skiing and golfing. These two sectors consumptively use water across the subbasins, and growth assumptions are important for water demand projections.[5]**

**Golf.** Three new golf courses have been developed in the Basin since the 2006 Basin Plan. These include a private course in the Saratoga area, a municipal course in Pine Bluffs and one additional private course in the Casper area; the Casper course is located on the site of

[4] Volume 2, Section 4 also provides a detailed discussion of water use in these sectors.
[5] In a change from the 2006 Basin Plan, the water demands associated with these two recreational activities are now included with the municipal and rural domestic projections and are not presented separately for individual analysis and evaluation in Section 4.3.


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the former Amoco Refinery. The water demands associated with these new courses are included in the Basin's 2015 water demand calculations. Additional golf-related water demands under the High, Low and Mid Scenarios are described below.

The demand for golfing and additional golf courses will be largely driven by the employment and population growth projected for the Basin over the next 30 years. The High Scenario includes an increase of about 180,000 people and over 100,000 jobs in the Basin by 2045, while the Low and Mid Scenarios assume more modest growth rates.[6] The projected development of new golf courses and golf course expansions is partially based on estimates of the number of holes available in the Basin on a per capita basis, as well as the location of projected population growth.

Under the High Scenario, HE assumes that any planned or proposed courses or expansions in each subbasin will be built and irrigated at similar acreage and irrigation rates as other courses in that subbasin. In the Above Pathfinder Dam subbasin, a new 18-hole course will begin operation in Rawlins with 95 irrigated acres using surface water from a raw water pipeline (Florquist, 2005).[7] In the Pathfinder to Guernsey subbasin, where a large portion of the additional projected population will reside, HE projects the development of two new 18 hole golf courses (190 new irrigated acres) and the expansion of both the Trail Ruts golf course in Guernsey and the Glenrock Golf Course. Each of those courses will expand from 9 to 18 holes over the next 30 years, adding about 80 new irrigated acres on groundwater. No new courses or expansions are anticipated in the Guernsey to State Line subbasin. The Laramie County Club course in the Upper Laramie subbasin will expand from 9 to 18 holes, adding about 30 new irrigated acres. In the Lower Laramie subbasin, HE projects that the Wheatland Golf Club will expand from 9 to 18 holes, adding 95 irrigated acres on surface water. There are no courses in the Horse Creek subbasin. In the South Platte subbasin, HE projects that the Prairie View Golf Course will expand from 9 to 18 holes, adding 70 new irrigated acres on surface water. The Leaning Rock Golf Course in Pine Bluffs would also expand from 9 to 18 holes, adding an additional 30 irrigated acres. HE also projects that the Cheyenne area will add two new golf course communities with 18 holes each and a total of 300 new irrigated acres on surface water (Ashby, Matsen and Mason, 2005).[8] Altogether, the High Scenario includes five new courses and six expansions throughout the Basin. The demand for those facilities will be supported by population growth and strong economic activity in several sectors, including mining, oil and gas production and power generation. The jobs in those sectors are typically relatively high paying and will generate additional employment in services and other sectors, as well as provide employees with a certain amount of disposable income. Under this scenario, HE assumes that regional tourism activity is strong and that the demand for recreational amenities is high.

In the Low Scenario, HE assumed that no new courses or expansions would be built in any of the subbasins and that all current operations would continue as they do currently. Population and employment growth would be slower and additional Basin residents would use existing golf amenities to the extent desired. Under this scenario, demographic characteristics may result in less interest in golf, as compared to other leisure activities, and economic conditions may leave less money available for golfing activity. Under the Low Scenario, activity in the mining, oil and gas and power generation sectors is expected to remain relatively constant and employment in those sectors is assumed to remain relatively

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[6] Population and employment projections for the Basin are presented in a subsequent section of this volume.

[7] This golf course has yet to be developed and was included in the future water demand projections at the time of the 2006 Basin Plan.

[8] At the time of the 2006 Basin Plan, interviews suggested that two new courses would be developed in the Cheyenne area in the future. Since then, one course was developed in Pine Bluffs, relieving some of the demand closer to Cheyenne.

steady. Overall, employment and population growth would be less than half of that projected for the High Scenario. That level of growth, in combination with relatively stagnant economic conditions would not generate the demand for new courses or expansions.

The Mid Scenario includes the development of three new golf courses and the expansion of four existing courses. One new 18 hole course would be built in Rawlins, adding about 95 irrigated acres in the Above Pathfinder Dam subbasin. In the Pathfinder to Guernsey subbasin, one new 18 hole course would be developed, adding about 95 irrigated acres, and the Trail Ruts golf course in Guernsey would expand from 9 to 18 holes, for an additional 30 irrigated acres. The Wheatland Golf Club in the Lower Laramie subbasin would undergo expansion from 9 to 18 holes, adding 95 new acres. In the South Platte subbasin, the Prairie View and Leaning Rock golf courses would each be expanded from 9 to 18 holes, for a total of about 100 new irrigated acres. Additionally, one new 18 hole course would be developed in the Cheyenne area, for an additional 150 irrigated acres. Both the Above Pathfinder Dam subbasin and the Pathfinder to Guernsey subbasin will experience growth in the mining and oil and gas sectors under the Mid Scenario, which will add employment, attract new people to the area and generate demands for additional recreational facilities. Considerable growth will also occur in the South Platte subbasin.

**Skiing.** There are two alpine ski areas that consumptively use water to make snow in the Platte River Basin. Both the Hogadon Basin near Casper (Pathfinder to Guernsey subbasin) and the Snowy Range ski area near Laramie (Upper Laramie subbasin) have surface water rights for snowmaking. Both of these ski areas cater to a local customer base and while the population of the Basin is expected to increase under all scenarios, there are no known plans or proposals for expansion of either facility. The Snowy Range ski area is located on U.S. Forest Service land and any expansion would likely require a lengthy environmental analysis. Therefore, HE assumes that these two ski areas will maintain their current demands for water under all future scenarios. Additionally, no new ski areas are expected to be developed in the Basin.

**Non-consumptive Recreation and Environmental Demands.** In large part, the Basin’s environmental and recreational water demands are non-consumptive; the consumptive uses of golf courses and ski areas comprise a very small portion of total recreational use in the Basin. Non-consumptive environmental and recreational uses are detailed in Volume 2, Section 4 that was developed as part of this Basin Plan update. That section focuses specifically on the environmental and recreational needs within the Platte River Basin and each of the subbasins. A brief overview of the types of non-consumptive recreational and environmental water uses available in the Basin is provided below.

Key recreational water uses in the Basin include fishing, boating and whitewater rafting. Much of this activity takes place on or near the North Platte River, its tributaries and associated reservoirs. There are numerous blue, red and yellow ribbon trout streams in the Basin, which provide excellent opportunities for anglers. In addition, Forest Service lands and mountainous areas provide extensive recreational options for outdoor enthusiasts. Boating occurs primarily on reservoirs. Camping is also a popular activity in the Basin, and although it is not directly related to water use, many of the camping locations are located near streams and reservoirs and their use may be directly tied to water levels.

Many of the environmental water uses in the Basin are associated with maintaining or enhancing crucial stream corridors and other areas designated as aquatic enhancement areas. This designation is determined by Wyoming Game and Fish and for each area critical issues and potential remediation activities are established. Although these designations do not establish specific protection for these areas, they are recognized and efforts are made to improve the health of these important habitats, as possible. There are 13 instream flow rights in the Basin. These critical stream segments are protected but are governed by their priority date, many of which are relatively recent. There are also two important wetlands areas in the Basin, Laramie Plains Wetlands Complex and the Goshen Hole Wetlands Complex. Waterfowl hunting and viewing also benefits from these important environmental areas.

Although there are no specific factors that drive future non-consumptive recreational or environmental demands, the overall economic conditions in the Basin under the High, Low and Mid Scenarios will affect those uses. An examination of the future trends for this sector of water use is included in Section 4.3 detailing future water demand projections for the Basin.

**Power Generation - Economic Base Scenario Assumptions**

Since the 2006 Basin Plan, groundwater use for power generation has increased in the Lower Laramie and South Platte subbasins. In the Lower Laramie subbasin, the Basin Electric Power Cooperative added one new well with a permitted water right of 950 gpm (~1,530 acre-feet) for use at the Laramie River Station, which is a steam power electric generation plant. The water is used for cooling water, process water and fire protection (Industrial Use, Volume 2, 2016). In the South Platte subbasin, the Generation Development Company, LLC was issued a permit for 400 gpm (~650 acre-feet) for use at the Cheyenne Prairie Generating Station, a natural gas fired plant completed in 2014. That water is used as an alternate supply for make-up water for the cooling tower (Industrial Use, Volume 2, 2016). The remaining subbasins either do not have power generation facilities (Above Pathfinder Dam, Guernsey to State Line, Upper Laramie and Horse Creek) or their water demands for power generation have remained constant (Pathfinder to Guernsey).

The Platte Basin is also home to a number of existing or proposed wind energy projects. Wind projects require little to no water; therefore, no water use associated with those projects is included in the Basin’s water demand projections.

The High, Low and Mid Scenarios each assume that water use at the Cheyenne Prairie Generating Station will increase by about 50% by 2045, based on estimates provided by Generating Station staff to the City of Cheyenne Board of Public Utilities (Cheyenne BOPU, 2013).

HE’s High Scenario also assumes the construction of one new natural gas plant which was in the planning stages at the time of the 2006 Basin Plan, but which is not yet in operation. That natural gas fired plant will be located between Glenrock and Douglas in the Pathfinder to Guernsey subbasin and will be sized for a capacity of 1,000 MW of power (Schroeder, 2005). That plant will use about 10,000 acre-feet of water consumptively each year. The Basin’s projected population increases, along with potential regional population growth given the assumed strong economic conditions under the High Scenario, will support the development of a new power plant. Additionally, activity in the industrial sector, the largest consumer of electricity in Wyoming (EIA, 2016), is expected to increase under the High Scenario, further generating demand for power. Expansion of various industrial sector activities, including uranium mining, oil and gas exploration and production and road construction and maintenance, will require additional source of power.

The Low and Mid Scenarios assume that the plant described above is not built and that power demands are met with existing facilities. Population and employment growth under these scenarios is more modest and industrial activity in the Basin either remains relatively steady (Low Scenario) or increases moderately (Mid Scenario). Slower economic growth will also slow the demand for additional power or power generation sources, as evidenced by the combination of slower economic growth and reduced electric demands at the national level in recent years (Godby 2015).

All three scenarios assume that water use at the Dave Johnston power plant in the Pathfinder to Guernsey subbasin and at the Laramie River Station remains constant in the future. Across the U.S. and in Wyoming, many coal fired plants are being converted to natural gas or are being decommissioned (Dixon, 2014). As an example, one of the purposes of the construction of the Cheyenne Prairie Generating Station was to replace the power generated by four coal fired units, which have since been decommissioned (Black Hills, 2016). The use of coal to generate power is facing increasing challenges, including EPA regulations for air quality, the low price of natural gas and rising costs for coal production (Godby, 2015; Wyoming Mining Association, 2016). Therefore, future expansion of the Basin's existing coal fired plants, or the development of new coal fired plants within the Basin, seems unlikely.

**Mining and Mine Reclamation - Economic Base Scenario Assumptions**

Water use for mining and mine reclamation occurs only in the Above Pathfinder Dam subbasin and the Pathfinder to Guernsey subbasin; none of the other subbasins include water use for mining purposes. Since the development of the 2006 Basin Plan, water use for uranium recovery and processing operations has greatly increased in the Pathfinder to Guernsey subbasin. The largest uranium mining company in that area (Cameco Resources) has four operating plants and mines uranium via the in-situ recovery process. Each of those plants can use up to 4,200 gpm (~6,800 acre-feet) of water, or a total of as much as 16,800 gpm (~27,100 acre-feet per year), although the company has recently acquired rights to more than double that amount (34,900 gpm or about 56,300 acre-feet). Four other, smaller companies have obtained permits for a combined 670 gpm (~1,100 acre-feet) related to uranium operations in that subbasin. In the Above Pathfinder Dam subbasin, the Kennecott Uranium Company has new rights to 150 gpm (~240 acre-feet) for uranium operations. There are currently no coal mines in the Basin and all other mining activity is related to reclamation.

Four additional uranium projects are in the permitting, proposed or exploratory phase in the Basin (Wyoming State Geological Survey, 2015). Three are located in the Above Pathfinder Dam subbasin (Sheep Mountain, Shirley Basin and Bootheel/Buck Point projects) and one is located in the Pathfinder to Guernsey subbasin (Ludeman project). Energy Fuels Wyoming, Inc. is the owner of the Sheep Mountain project. That project has been in the permitting phase since 2010 and the company anticipates that the project will start up in late 2016/ early 2017 (Industrial Use, Volume 2, 2016). Energy Fuels has permits totaling 2,000 gpm (~3,300 acre-feet) for that project.

In terms of future coal production, Arch of Wyoming (Arch Coal) has acquired water rights for 2,300 gpm (~3,700 acre-feet) for mine dewatering and dust suppression for coal mining at the Saddleback Hills Mine near Elk Mountain in the Above Pathfinder Dam subbasin (Industrial Use, Volume 2, 2016). That mine has yet to be developed due to lack of market demand. The future demand for coal from this mine may be more or less dependent on the development of the coal conversion facility described for the oil and gas sector later in this section. The future of coal is unclear due, in part, to proposed environmental regulations, future natural gas prices, national demand for coal and electricity and other factors. Several sources indicate zero to negative growth in the coal industry in the future (Godby, 2015).

**High Scenario.** According to the Wyoming State Geological Survey, "U.S. uranium reserves are strongly dependent on price" and their reports state that "many experts agree that a gap between worldwide demand and supply of yellowcake may apply upward pressure to prices in the future". Based on recent uranium activity in the Basin, along with the positive outlook for uranium from the Geological Survey, under the High Scenario, HE assumes high uranium prices and projects that all four proposed uranium projects will be permitted and will begin operations within the 30 year time frame of these projections. Each of those projects is assumed to require the same amount of water as the Sheep Mountain project (2,000 gpm). Additionally, we assume that Cameco Resources will expand their operations and perhaps build an additional plant in the Pathfinder to Guernsey subbasin, requiring an additional 4,200 gpm. Under this scenario, HE also assumes that the Saddleback Hills Mine will begin coal mining operations; those operations would mainly serve the production needs of the new coal gasification plant, which is projected to be developed under the High Scenario.

**Low Scenario.** Existing uranium operations would continue to operate with no additional activity in the Basin. The Saddleback Hills Mine would not be developed and no new coal production would take place in the Basin. Reclamation water use would be minimal.

**Mid Scenario.** The Sheep Mountain uranium project would be developed in the Above Pathfinder Dam subbasin and an expansion of activities at the Cameco Resources facilities would occur in the Pathfinder to Guernsey subbasin in response to small to moderate increases in uranium prices. Similar to the Low Scenario, the Saddleback Hills Mine would not be developed and no new coal production would take place in the Basin in the Mid Scenario.

#### Oil Refining, Oil and Gas Exploration and Production, Reclamation - Economic Base Scenario Assumptions

Since 2005, oil and gas prices have experienced highs and lows, affecting annual production levels for those resources, as well as associated water demands. Since the previous Basin Plan, water demands related to oil refining; oil and gas exploration and production; and reclamation have increased in all subbasins, with the exception of the Upper Laramie, in which this type of water use has remained constant at less than 100 acre-feet. Basin wide, water use in this industrial sector increased by almost 18,000 acre-feet, or over 50%, in the last 10 years.[9]

The Pathfinder to Guernsey subbasin remains the largest consumer of this type of water at about 25,000 acre-feet per year, an increase of about 39% since 2005. New water use in this subbasin is related to oil and gas exploration and reclamation. The South Platte subbasin experienced the largest increase in oil and gas related water demands, with over 8,400 acre-feet of additional water permits. In 2005, the Guernsey to State Line and Lower Laramie subbasins had no permits related to oil and gas activities; each of these subbasins now includes about 800 acre-feet of permitted water use in this sector. Other subbasins experienced small increases in permitted water demands, with the exception of Upper Laramie, as noted above.

Individual Basin counties have experienced unique trends in oil and gas production, but for all Basin counties combined, 2015 saw record high oil production as well as an up-tick in gas production (WOGCC, 2016). Oil production in the Basin increased by an average of about 20% per year over the last four years, reaching over 34.5 million barrels in 2015, about 40% of total statewide oil production. Although 2015 gas production was about 15%

[9] This increase accounts for all new permitted water use and may not reflect actual water use by individual users. Within Laramie County individual water users reports of water used for oil and gas fracing is significantly less than permitted quantities.

lower than in 2005, both 2014 and 2015 saw small increases in overall gas production in the Basin.

**The oil and gas industry experiences cyclical boom and bust periods, which are determined by a myriad of factors, including weather patterns, national and international demands, governmental regulations and other types of energy production.** The High, Low and Mid Scenarios account for differences in each of these factors. Crude oil prices and natural gas prices have varied over time, but have seen dramatic declines since 2014. Current low prices for those commodities have put pressure on oil and gas production across Wyoming.

**Under the High Scenario, HE projects that oil and gas prices will increase, encouraging additional production and exploration.** Under that scenario, HE projects that oil and gas prices will increase at a slightly faster rate than the modest amounts currently projected by the EIA (EIA, 2015). Several potential large oil or oil and gas projects or other developments proposed on BLM and other properties are currently in the midst of various NEPA analyses (BLM, 2016). Portions of some of those projects may be located within the Basin (Converse County Oil and Gas Project), but even projects in close proximity to Basin boundaries (i.e. Moneta Divide Natural Gas and Oil Development Project in Natrona and Fremont Counties; Continental Divide-Creston Natural Gas Project in Carbon and Sweetwater Counties; Greater Crossbow Oil and Gas Exploration and Development Project in Campbell and Converse Counties) have the potential to drive industry activity and support businesses within the Basin. In fact, the scale of many of those proposed projects is quite large, including the development of several thousand wells. Under the High Scenario, HE projects that these projects will be approved and will come online within the next 10 to 20 years, given steadily increasing oil and gas prices and increasing demands.

In addition to the oil and gas projects discussed above, a new coal conversion facility would be constructed in the Above Pathfinder Dam subbasin under the High Scenario.[10] This plant will produce about 100 MW of electricity for internal use and about 9,000 barrels of gasoline per day. The plant will consumptively use roughly 500 acre-feet of water each year (Industrial Use, Volume 2, 2016 and Gathmann, 2016). **Given the recent trends in oil and gas production in the Basin, the potential for increased commodity prices and the potential for the approval and development of many additional oil and gas projects in the region, HE projects that water demands for this sector will increase by 20% by 2045.**

**The Low Scenario reflects continued low commodity prices and continued pressure on profit margins for companies and production in the Basin.** This scenario assumes that even if proposed oil and gas projects are approved by the BLM, prices will remain low enough that development and production activities are postponed by the proponent companies indefinitely. The oversupply of oil and natural gas, as compared to demand will continue nationally and internationally under the Low Scenario. This will discourage additional exploration activity. However, HE also assumes that prices under the Low Scenario are near current lows and that they will not continue to decline in such a way as to significantly reduce current production levels in the Basin. **Therefore, under the Low Scenario, water demands for this sector will remain stable over the projection**

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[10] In the 2006 Basin Plan, this proposed facility was described as producing 300 to 500 MW of electricity and more than 9 million barrels of diesel fuel per day; water use estimates at that time were on the range of 15,000 to 20,000 acre-feet per year. Since then, DKRW Energy has greatly scaled back the size of the facility and decided to use a different process for converting methane to gasoline. This new process uses much less water than the original proposed process; in fact, the new process actually creates water, which is then recirculated and used within the facility.

**period, at current levels. In essence, new wells will replace existing wells as those play out.**

**The Mid Scenario assumes that gas prices rise modestly over time, as projected by the EIA at the national level, and that national and global demand for oil and gas also increases steadily over time (EIA, 2015).** Additional oil and gas exploration and production will occur within and outside the Basin, encouraging the development of additional oil and gas support services as well. Some of the oil and gas projects under review by the BLM will become profitable due to the increasing prices, but others will be put on hold throughout the 30-year projection period. **Under the Mid Scenario, water demands for this sector will increase by 10%.**

**Aggregates, Cement and Concrete - Economic Base Scenario Assumptions**

Water use aggregate, cement and concrete production increased by about 23% between 2005 and 2015. Water use for those purposes increased by varying amounts in all subbasins, with the exception of the Guernsey to State Line subbasin, in which no water is used for this sector, and the Horse Creek subbasin, in which this type of water use remained constant. The Pathfinder to Guernsey subbasin experienced the largest increase in water use for aggregate, cement and gravel production, with an additional 1,500 gpm (~2,400 acre-feet) of water use permitted to two separate companies.

According to the USGS, "natural aggregates are a major basic raw material used by construction, agriculture and industries employing complex chemical and metallurgical processes" (USGS, 1999). Products made with aggregates include asphalt, concrete, bricks, plastics, glass, paint, fertilizers and other items. Historically, national production of these materials has increased at a relatively slow, but steady annual rate. However, more recently, production has grown at slightly higher rates for all aggregate products. In 2015, sand and gravel production increased by 2%, cement production by 3.2% and crushed stone by 7% (Krehbiel, 2015). According to aggregate industry reports, "pricing data shows cement, ready-mix concrete, sand and gravel and crushed stone prices increasing, while asphalt prices plateaued and have begun to decline as a result of lower oil prices" (Krehbiel, 2015). However, national demand for asphalt is expected to increase as a result of a recently approved $305 billion highway and transit bill (Fixing America's Surface Transportation (FAST) act). The near-term outlook for aggregates and cement is for continued increases in annual growth (Kuhar and Smith, 2016).

Future demands for these products will be driven by activity in the transportation, infrastructure and construction (residential and non-residential) sectors (Kuhar, 2014; Kuhar and Smith, 2015). The demand for materials and supplies to develop those facilities will ultimately drive the demand for aggregates and other materials and therefore, the demand for related water supplies. The demand for aggregates, cement and gravel produced within the Basin is likely to come from both within and outside the Basin.

As described previously for other industrial sectors, the **High Scenario includes the expansion of the agricultural sector, development of new uranium projects, a large power plant, a coal conversion facility, and oil and gas development.** Additionally, as described later in this section, the High Scenario projects strong population growth within the Basin. Overall, under the High Scenario, there is a great amount of activity that will occur in the Basin, all of which supports increased demand for aggregates and aggregate products. The amount of industrial and residential construction that would occur under the High Scenario will drive up the demand in this sector. **HE forecasts a 20% increase in aggregate production related water demands over the 30 year projection period under the High Scenario.**

**The Low Scenario assumes no changes in current water demands for the aggregate sector.** Under this scenario, economic activity within the Basin remains relatively unchanged from current conditions. None of the agricultural activity, uranium projects or other facility developments would occur and the oil and gas industry would remain relatively stable. **Basin population is expected to grow relatively slowly under the Low Scenario and construction demands related to that growth is anticipated to be met at current production levels.**

**Under the Mid Scenario, the demand for aggregates is also driven by increased agricultural and industrial activity, as well as by Basin wide population growth; however, growth in those sectors is somewhat tempered, as compared to the High Scenario.** The Mid Scenario includes modest population growth and increased demand for residential construction, as well as some new uranium and oil and gas development, which will fuel industrial sector demands for aggregates. Activity under the Mid Scenario will not reach the levels anticipated for the High Scenario. **HE projects a 10% increase in aggregate production related water demands for this Scenario.**

**Miscellaneous Industry, including Road Construction - Economic Base Scenario Assumptions**

New miscellaneous water use in the Basin since the preparation of the 2006 Basin Plan generally includes water for certain agricultural purposes, such as mixing of liquid fertilizers and pesticides; some irrigation; dust suppression; equipment washing; stock watering and other, unique uses. The largest use of new miscellaneous water in the Basin is for stock watering. Basin wide, water use for miscellaneous purposes, other than for road construction, increased by about 13% between 2005 and 2015, based on the additional permits issued within that time frame.

Road construction is also included in the miscellaneous category. Water use for road and bridge construction and maintenance only occurs when those activities are in progress. These types of construction projects are generally short-term and local in nature, lasting only several years or less over a small area. Therefore, water use in this sector may vary widely from year to year and from subbasin to subbasin. Between 2013 and 2014, WYDOT was issued three permits totaling 350 gpm (~600 acre-feet) related to the reconstruction of several miles of I-25 and Wyoming 319 in the Pathfinder to Guernsey subbasin. Only two other permits were issued for road construction projects between 2005 and 2015, each for 100 gpm (less than 200 acre-feet) and each in different subbasins.

**Major changes in miscellaneous industrial water use occurred, or will occur, in the Guernsey to State Line subbasin. The Wyoming Ethanol facility in Torrington, which had been in operation since 1995, closed in the fall of 2015. That facility's water use is included in the 2015 water use data for the subbasin, but does not play a part in any future projections. In addition, the Western Sugar Cooperative plans to close its Torrington facility within the next year or two (by 2017 at the latest), eliminating their water use from future projections as well. HE assumes that the Wyoming Ethanol facility and the Western Sugar facility in Torrington will re-open at present capacities under the High Scenario but will remain closed under the Mid and Low scenarios.**

**The High Scenario includes the development of additional uranium projects, a new power plant, one coal mine and oil and gas development.** Together, these activities will stimulate the economy, resulting in healthy growth of all industries. That growth is likely to create additional, miscellaneous water demands from various sources. For example, HE projects that the Dyno Nobel ammonium nitrate plant in the South Platte subbasin will add a new production unit and increase water use by 10%, as compared to current levels, under the High Scenario. Other miscellaneous water use by individuals or smaller entities (non-road construction use) will also increase by a total of 10% overall for the Basin. The development activity and population growth expected to occur under the High Scenario is more than likely to result in the need for road construction and maintenance, as traffic volumes would likely increase as well. Additionally, the strong economy will allow the Wyoming Department of Transportation (WYDOT) to move forward with a number of projects that may have been delayed due to lack of funding (WYDOT 2013 and 2015); the same situation may be true at the county or municipal levels. Therefore, HE projected use of 2,000 acre-feet of water per year for road construction and maintenance activities under the High Scenario.

**Under the Low and Mid Scenarios, miscellaneous water use (non-road construction) is expected to hold steady at current levels, other than the loss of Wyoming Ethanol and Western Sugar. The Low Scenario includes water use of 500 acre-feet per year for road and bridge construction maintenance, essentially holding that type of use constant, as compared to 2015.** That level of use reflects the relatively slow economic conditions and growth expected under the Low Scenario.

**The Mid Scenario assumes 1,000 acre-feet of water per year will be required for road and bridge construction and maintenance activities.** That level of use reflects the more moderate economic conditions and growth expected under the Mid Scenario, including some new uranium and oil and gas projects.

### 4.3.4 Summary of Economic and Demographic Projections

The preceding evaluations and assumptions were incorporated into a model of Platte River Basin employment and population to develop aggregate estimates of total residents and total jobs in 2045 under each of the three planning scenarios. The estimates of future population drive the projections of future water demands for the municipal and rural domestic sector.

#### Overview of Projection Technique

The approach used to project future employment and population as part of the Basin Plan update remains generally the same as for the 2006 Basin Plan. HE estimated current jobs and population in the Basin (2015) using data from the State of Wyoming's Economic Analysis Division, the Bureau of Labor Statistics and the Bureau of Economic Analysis and then made projections for a period of 30 years, through the year 2045. Employment projections begin with forecasts of the Basin's basic economic sectors, which are those sectors that drive the economy, including:

- Natural resources and mining;
- Manufacturing;
- Tourism portion of retail trade;
- Agriculture; and
- Portions of other sectors that generate economic resources from outside the Basin.

HE applied an employment multiplier of 1.4 to the forecasts of basic jobs to obtain the total number of jobs available to people working in the region (Minnesota IMPLAN Group, Inc., 2004).[11] HE then proceeded to apply the following Basin specific factors to the projections of total jobs to develop estimates of Basin population under each scenario.

- Net in-commuters: This step is necessary because, on net, a sizable number of workers commute into the Basin from other locations. These in-commuters' jobs do not actually contribute to population levels inside the Basin itself and must be removed from the total to forecast population. HE assumed that the number of net in-commuters would remain constant over the projection period.
- Multiple job holding rate: This factor accounts for the fact that the total number of jobs is greater than the number of employed persons.
- Unemployment rate: The unemployment rate incorporates the idea that there are more people included in the Basin's labor force than is reflected in the employment data. There is an additional group of people looking for work that is not included in the jobs data.
- Labor force participation rate: This factor accounts for the portion of the population over the age of 16 that is not included in the labor force, i.e. stay at home parents, retirees. HE assumed average participation rates would decrease by about 5% over the projection period, reflecting the aging of basin population.
- Percentage of the population aged 16 and older: This final factor was utilized to project the total future population in the Basin.

### Economic and Demographic Projections

The final product of this analysis is projection of population in the Basin in 2045 under the High, Low and Mid Scenarios.

**High Scenario.** HE projected High Scenario employment in the Basin through 2045 based on the information described for each sector as summarized in **Table 4.12**.

**Table 4.12: Projected Economic Sector Changes, Platte River Basin, High Scenario**

| Economic Sector | Sector Prospects | Quantitative Changes |
|---|---|---|
| Agriculture | Growth in irrigated acres, livestock with high demand | Irrigated acres up 100,000<br>Livestock up 135,000 |
| Recreation | Five new golf courses and six expansions | 890 new irrigated acres |
| Power generation | One new natural gas plant; increased water demands at the Cheyenne Prairie Generating Station | 1,000 MW, 300 jobs |
| Mining | Five new uranium projects, one new coal conversion facility, one new coal mine | Additional employment and production |
| Oil and gas production and exploration | Commodity prices recover, production and exploration increases | Employment increasing |
| Other industries | Production generally increasing | Employment increasing |
| Source: Harvey Economics, 2016. | | |

[11] The employment multiplier indicates the total number of jobs created by one job in a basic sector. For example, an employment multiplier of 1.4 means that each basic job creates roughly an additional 0.4 local service jobs, such as additional retail and other services, for a total of 1.4 jobs.

With these inputs and assumptions, HE began with 2015 employment numbers and projected basic employment and population through 2045 according to the steps outlined above. The results of this analysis for the High Scenario are presented in **Table 4.13**.

**Table 4.13: Projected Basic Employment, Total Employment and Population by Subbasin, 2015 and 2045, High Scenario**

| | Basic Employment | | Total Employment | | Population | |
|---|---|---|---|---|---|---|
| | 2015 | 2045 | 2015 | 2045 | 2015 | 2045 |
| **Subbasin** | | | | | | |
| Above Pathfinder Dam | 7,800 | 9,700 | 10,900 | 13,600 | 17,000 | 22,000 |
| Pathfinder to Guernsey | 44,800 | 82,100 | 62,700 | 115,000 | 88,000 | 171,000 |
| Guernsey to State Line | 4,200 | 5,100 | 5,900 | 7,100 | 11,000 | 14,000 |
| Upper Laramie | 14,700 | 17,500 | 20,600 | 24,500 | 36,000 | 45,000 |
| Lower Laramie | 3,800 | 4,700 | 5,300 | 6,600 | 8,000 | 11,000 |
| Horse Creek | 1,200 | 1,700 | 1,600 | 2,300 | 3,000 | 5,000 |
| South Platte | 46,900 | 79,900 | 65,600 | 111,900 | 95,000 | 172,000 |
| **Total Basin** | **123,400** | **200,700** | **172,600** | **281,000** | **258,000** | **440,000** |
| Source: Harvey Economics, 2016. | | | | | | |

**HE projects that Basin employment under the High Scenario will increase by roughly 63%, from 172,600 jobs at present to about 281,000 by 2045.** This increase would be primarily driven by growth in the minerals and energy sector, which would create support service and related employment, and by growth in services to accommodate an aging population, including healthcare and social services. Under the High Scenario, the Basin's population is projected to increase by over 70%, to about 440,000 residents by 2045.

**Low Scenario.** The slower employment growth projected for the Low Scenario is supported by the Low Scenario assumptions outlined in the earlier discussions of this volume for each economic sector, as summarized in **Table 4.14**. Thus, these projections represent a reliable lower bound for planning purposes in this study.

**Table 4.14: Projected Economic Sector Changes, Platte River Basin, Low Scenario**

| Economic Sector | Sector Prospects | Quantitative Changes |
|---|---|---|
| Agriculture | Decline in irrigated acres and livestock with weak demand, urban development, aging ranchers | Irrigated acres down 96,000, livestock down 111,000 |
| Recreation | No new golf courses or expansions | Steady irrigated acres |
| Power generation | No new plants or expansions; increased water demands at the existing Cheyenne Prairie Generating Station | Steady employment |
| Mining | Current uranium mining operations continue | Steady water demands and employment |
| Oil and gas production and exploration | Oil and gas prices remain at low levels; production levels relatively steady | Water demands and employment relatively steady |
| Other industries | Production generally steady to decreasing | Employment flat to decreasing |
| Source: Harvey Economics, 2016. | | |

HE proceeded through the same forecasting approach, using the assumptions outlined in 4.12. The results of this analysis are presented in **Table 4.15**.

**Table 4.15: Projected Basic Employment, Total Employment and Population by Subbasin, 2015 and 2045, Low Scenario**

| | Basic Employment | | Total Employment | | Population | |
|---|---|---|---|---|---|---|
| | 2015 | 2045 | 2015 | 2045 | 2015 | 2045 |
| **Subbasin** | | | | | | |
| Above Pathfinder Dam | 7,800 | 8,200 | 10,900 | 11,500 | 17,000 | 19,00 |
| Pathfinder to Guernsey | 44,800 | 52,200 | 62,700 | 73,100 | 88,000 | 109,000 |
| Guernsey to State Line | 4,200 | 4,400 | 5,900 | 6,200 | 11,000 | 12,000 |
| Upper Laramie | 14,700 | 15,400 | 20,600 | 21,500 | 36,000 | 40,000 |
| Lower Laramie | 3,800 | 4,000 | 5,300 | 5,600 | 8,000 | 9,000 |
| Horse Creek | 1,200 | 1,300 | 1,600 | 1,800 | 3,000 | 3,000 |
| South Platte | 46,900 | 53,600 | 65,600 | 75,100 | 95,000 | 115,000 |
| **Total Basin** | **123,400** | **139,100** | **172,600** | **194,800** | **258,000** | **307,000** |
| Source: Harvey Economics, 2016. | | | | | | |

Under the **Low Scenario**, Basin wide jobs are projected to increase by less than a half of one percent per year, rising by about 22,200 jobs over the 30-year projection period. Under the Low Scenario, population within the Basin is projected to experience growth of about 0.6% annually and total growth of about 19% over the next 30 years; the Basin's population is projected to reach about 307,000 residents by 2045 under the Low Scenario. Both employment and population under the Low Scenario would be a fraction of that experienced under the High Scenario.

**Mid Scenario.** Under the Mid Scenario, employment and population projections are based on the Mid Scenario assumptions discussed previously in this section for each economic sector, summarized in **Table 4.16**.

**Table 4.16: Projected Economic Sector Changes, Platte River Basin, Mid Scenario**

| Economic Sector | Sector Prospects | Quantitative Changes |
|---|---|---|
| Agriculture | No change in irrigated acreage, stable livestock inventory and demand | Irrigated acres down by 49,000, livestock remains at current levels |
| Recreation | Three new golf courses, four expansions | 565 new irrigated acres |
| Power generation | One new natural gas plant | 1,000 new MW, 300 jobs |
| Mining | Two new uranium projects | Employment increases slightly |
| Oil and gas production and exploration | Oil and gas prices rise modestly over time, strong global demand | Employment relatively steady, small increases |
| Other industries | Production generally steady, small expansions | Employment flat to increasing |
| Source: Harvey Economics, 2016. | | |

HE proceeded through the same steps of forecasting from basic employment through total employment to population for the Basin under the Mid Scenario. The results of this analysis are presented in **Table 4.17**.

**Table 4.17: Projected Basic Employment, Total Employment and Population by Subbasin, 2015 and 2045, Mid Scenario**

| | Basic Employment | | Total Employment | | Population | |
|---|---|---|---|---|---|---|
| | 2015 | 2045 | 2015 | 2045 | 2015 | 2045 |
| **Subbasin** | | | | | | |
| Above Pathfinder Dam | 7,800 | 8,700 | 10,900 | 12,200 | 17,000 | 20,000 |
| Pathfinder to Guernsey | 44,800 | 60,700 | 62,700 | 85,000 | 88,000 | 126,000 |
| Guernsey to State Line | 4,200 | 4,600 | 5,900 | 6,500 | 11,000 | 13,000 |
| Upper Laramie | 14,700 | 16,100 | 20,600 | 22,500 | 36,000 | 42,000 |
| Lower Laramie | 3,800 | 4,200 | 5,300 | 5,900 | 8,000 | 10,000 |
| Horse Creek | 1,200 | 1,400 | 1,600 | 2,000 | 3,000 | 4,000 |
| South Platte | 46,900 | 61,300 | 65,600 | 85,800 | 95,000 | 132,000 |
| **Total Basin** | **123,400** | **157,000** | **172,600** | **219,900** | **258,000** | **347,000** |
| Source: Harvey Economics, 2016. | | | | | | |

**Under the Mid Scenario, aggregate jobs are projected to increase by roughly 47,300 over the course of the projection period.** Population within the Basin would experience steady growth of about 1% per year over the next 30 years, gaining about 89,000 additional people to reach a total of about 347,000 residents.

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## 4.4 UPDATED DEMAND PROJECTIONS

***"No one can forecast the economy with certainty."***
- Jamie Dimon

### 4.4.1 Introduction

The information presented in Section 4.4 is the third in a series related to water demands authored by HE for the purpose of updating the 2006 Platte Basin Plan. An overview of the current conditions in key economic and water use sectors was provided in the previous sections (Section 4.1 through Section 4.13) of Volume 4 that present economic and demographic projections upon which the updated Basin water demand projections are based. The water demand projections included here are largely based on HE's estimates and projections, which also incorporate information gathered from publicly available secondary sources.

Section 4.4 provides future water demand projections for the Platte River Basin under three alternative scenarios. Water use factors for four key water use sectors (agriculture, municipal/domestic, industrial and recreation) are addressed and water use projections for those sectors are described. This section includes the following:

- Estimation of existing water use relationships (or water use factors) for each of the major economic and demographic water consuming sectors provided in the second section;
- A discussion of changes in baseline, or current, water demands as compared to the year 2005 water demands included in the 2006 Platte River Basin Water Plan (Basin Plan);
- Basin wide water use projections (both future diversions and consumptive use) for each of the key water using economic sectors — agricultural, municipal and rural domestic, industrial and recreational[12] — under three scenarios;
- Water use projections for the Basin presented on a monthly basis; and
- Water use projections (diversions and consumptive use) for each of the seven subbasins of the Platte River Basin, by sector, under each of the three scenarios (**Appendix 4-A**).

### 4.4.2 Projected Water Use Factors for Economic Sectors

This section of the Platte Basin Plan Update describes the development of the estimated water use relationships for each of the key water using sectors — agricultural, municipal and rural domestic, industrial and recreational — within the Basin. Separate estimates of total diversions and consumptive use were calculated for each sector. A summary of all water use factors for all sectors is presented in **Table 4.18.**

[12] Although current and future ski area and golf course demands are estimated and projected independently from municipal/rural domestic demands, they are grouped together for purposes of presentation in this Platte Basin Plan Update.

**Table 4.18: Water Demand Factors by Economic Sector, Annual Consumptive Use and Annual Diversions**

| Average Demand by Economic Sector | Units | Diversions | | Consumptive Use | |
|---|---|---|---|---|---|
| | | Normal | Max | Normal | Max |
| **Agriculture** | | | | | |
| *Irrigation* | | | | | |
| Alfalfa | AF/acre | 2.6 | 3.8 | 1.1 | 1.6 |
| Other hay | AF/acre | 2.5 | 3.9 | 1.1 | 1.6 |
| Irrigated pasture | AF/acre | 1.7 | 3.0 | 0.7 | 1.3 |
| Corn | AF/acre | 3.3 | 4.2 | 1.4 | 1.8 |
| Sugar beets | AF/acre | 3.6 | 4.6 | 1.6 | 1.9 |
| Dry beans | AF/acre | 2.4 | 3.3 | 1.1 | 1.4 |
| Oats | AF/acre | 2.6 | 3.3 | 1.1 | 1.4 |
| Barley | AF/acre | 2.8 | 3.6 | 1.2 | 1.5 |
| Winter wheat | AF/acre | 2.2 | 3.1 | 0.9 | 1.3 |
| Spring wheat | AF/acre | 2.0 | 2.8 | 0.9 | 1.2 |
| *Livestock* | | | | | |
| Cattle | AF/head | 0.010 | 0.010 | 0.010 | 0.010 |
| Sheep | AF/head | 0.004 | 0.004 | 0.004 | 0.004 |
| **Municipal/Rural Domestic** | | | | | |
| *Basin average* | Gal/cap/day | 202 | 303 | 101 | 152 |
| **Industrial** | | | | | |
| *Individual to sectors and entities* | | | | | |
| **Recreational Facilities** | | | | | |
| *Alpine skiing (snowmaking)* | AF/facility | 22 | 37 | 5 | 9 |
| *Golf courses (irrigation)* | AF/AC | 4.7 | 5.2 | 2.4 | 2.7 |
| Source: Harvey Economics, 2016. | | | | | |

### Agricultural Sector

The agricultural sector consists of two primary areas of water use: irrigated crop production and livestock sustenance. As discussed earlier, the majority of the irrigated acreage within the Basin is alfalfa, other hay, and irrigated pasture, although producers grow a variety of other crops in the Basin, including corn, wheat, barley, sugar beets and dry beans.

For the 2006 Basin Plan, the study team developed crop-specific information on annual consumptive irrigation requirements (CIR) for each subbasin for the period 1972 through 2001 (TriHydro Corporation, 2005). HE determined that these CIRs are still applicable in 2015 and applied the CIR data from the years of maximum and average consumptive use to represent the maximum and normal consumptive use demands that irrigated agricultural acreage would place on the Platte River Basin under the High, Low and Mid Scenarios of economic development. CIR data for different crops in different subbasins ranged from 10 to 25 acre-inches per acre in the maximum water use year and from 6 to 21 acre-inches per acre in a normal water use year.[13] These ranges are comparable to those found in other Wyoming Basin planning studies. Estimated application efficiency depends on the relative proportion of acreage using gravity or sprinkler irrigation systems and using groundwater versus surface water. The study team assumed on farm application efficiencies of 50% for flooded acreage and 70% for sprinkler-irrigated acreage (Venn, 2005), and proportions of usage of each system were based on an assumption of flood irrigation used for alfalfa, hay

[13] Because "wet," "dry," and "normal" years were defined using annual stream flows while calculated consumptive irrigation requirements are a function of precipitation and temperature, some data anomalies occurred within the consumptive irrigation requirement averages. The study team felt that this was the best approach to establish a representative range of consumptive irrigation requirement estimates for each county within the Basin.

and pasture and pivots used for all other crops. Proportions of groundwater versus surface water were based upon the study team's records of water rights and irrigation mapping (Trihydro, 2005). The study team assumed that groundwater incurs no conveyance losses, while conveyance losses for surface water supplies varied by subbasin and the irrigation districts involved (WWDC 2015).

Combining on-farm irrigation efficiencies with conveyance losses, the net weighted average irrigation efficiency estimates ranged from roughly 25% for acreage in the Horse Creek subbasin to 55% in the South Platte subbasin. Diversions in a normal demand year average about 3.9 acre-feet per acre of hay and 2.3 acre-feet per acre of grain across the Basin as a whole. Corresponding diversions during a high demand year are 4.4 and 2.5 acre-feet per acre, respectively. Note that these diversion estimates are unconstrained, assuming no supply limitations within the subbasins. These diversion rates are roughly comparable with other Wyoming basin planning studies.

Livestock water use factors in the Basin, both diversion and consumptive use, are estimated at .01 acre-feet per cattle head per year and.004 acre-feet per sheep head per year (Broyles, 2005).

#### Municipal and Rural Domestic Sector

Based on data from the WWDC's 2013 *State of Wyoming Public Water System Survey Report*, as summarized in Lidstone, 2015, HE calculated a municipal and rural domestic diversion water use factor for each subbasin in the Basin. Those factors ranged from 168 gallons per capita per day (gpcd) in the Horse Creek subbasin up to 264 gpcd in the Guernsey to State Line subbasin; the Basin wide average was 202 gpcd in a normal water demand year. The difference between municipal diversions and effluent discharge is assumed to be 50%, based on interviews and previous basin studies. Therefore, the municipal and rural domestic consumptive use within each subbasin is calculated as 50% of the diversion factor. The maximum demand factors were calculated in the same way, assuming Basin municipal users' unconstrained peak year would be 50% higher than a normal year. This factor is similar to other basin plan assumptions in Wyoming.

Based on the inventory of municipal and rural domestic water use, HE assumed that roughly 75% of water use in this sector employs surface water, and 25% of use employs groundwater.

#### Industrial Sector

Although only a fraction of agricultural water use, industrial water use in the Basin is substantial. Major sectors include power generation; uranium mining; oil and natural gas production; aggregates and gravel; and miscellaneous industries such as road and bridge maintenance and stock watering. Industrial water use in the Basin is specific to individual users, projects and facility operations; therefore no one industrial water use factor could be developed for use in projecting future industrial water demands. Future water demands for various industrial sectors were based on sector specific assumptions under the High, Low and Mid Scenarios. Those assumptions are summarized below:

**Power Generation.** Under the High Scenario, HE projects that power generation water use will increase due to increased demand from the existing Cheyenne Prairie Generating Station and the addition of one new natural gas power plant in the Pathfinder to Guernsey subbasin that will consumptively use 10,000 acre-feet of water each year. Water demands from other existing power generation facilities will remain constant.

Under the Low and Mid Scenarios, HE projects that total power generation water use will remain relatively constant, as no new plants would be constructed. Increased water demands at the existing Cheyenne Prairie Generating Station would be small and other existing power generation water use would remain constant.

**Mining and Mine Reclamation.** Under the High Scenario, HE projects that four currently proposed uranium projects will be permitted and will begin operations within the 30 year time frame of these projections (three in the Above Pathfinder Dam subbasin and one in the Pathfinder to Guernsey subbasin). Each of those projects is assumed to require about 3,200 acre-feet of water per year. Additionally, we forecast the expansion of an existing uranium mining operation in the Pathfinder to Guernsey subbasin, requiring about 6,700 acre-feet of water per year. The High Scenario also includes the development of one coal gasification plant in the Above Pathfinder Dam subbasin that will consumptively use about 500 acre-feet of water each year and the commencement of coal mining operations at the Saddleback Hills Mine in that same subbasin to support the plant. Coal mining operations will require up to 3,700 acre-feet per year.

Under the Low Scenario, existing uranium mining operations would continue, but there would be no additional mining activity in the Basin. The Saddleback Hills Mine would not be developed and no coal production would take place in the Basin.

Under the Mid Scenario, one new uranium project would be developed in the Above Pathfinder Dam subbasin (3,200 acre-feet per year), as would the expansion of existing uranium mining operations in the Pathfinder to Guernsey subbasin (6,700 acre-feet per year). Similar to the Low Scenario, the Saddleback Hills Mine would not be developed and no new coal production would take place in the Basin in the Mid Scenario.

**Oil Refining, Oil and Gas Exploration, Production and Reclamation.** Under the High Scenario, HE projects that oil and gas prices will increase and will encourage additional production and exploration. Under this scenario, water demands for this sector will increase by 20% by 2045.

The Low Scenario reflects continued low commodity prices and continued pressure on profit margins for companies and production in the Basin. Under the Low Scenario, water demands for this sector will remain constant at 2015 levels.

The Mid Scenario assumes that gas prices rise modestly and that global demand for oil and gas continues steadily. Under the Mid Scenario, water demands for this sector will increase by 10%.

**Aggregates, Cement and Gravel.** Under the High Scenario, which includes uranium, coal and oil and gas development, HE forecasts a 20% increase in aggregate production related water demands over the 30-year projection period. The Low Scenario assumes no changes in current water demands and the Mid Scenario reflects a 10% increase in water demands.

**Miscellaneous Industry (including road construction).** Under the High Scenario, HE projects that both the Wyoming Ethanol facility and the Western Sugar facility in Torrington would re-open at some point within the 30-year projection period. Additionally, the Dyno Nobel ammonium nitrate plant in the South Platte subbasin will add a new production unit and increase water use by 10%, as compared to current levels. As described previously, the High Scenario includes the development of additional mining and power generation projects, as well as oil and gas development. Together, these activities are likely to result in the need for road construction and maintenance; HE projected 2,000 acre-feet per year of use for those activities under the High Scenario. Other miscellaneous water use by individuals or smaller entities will also increase by a total of 10% overall throughout the Basin.

The Low Scenario includes water use of 500 acre-feet per year for road and bridge construction and the Mid Scenario assumes 1,000 acre-feet per year for that activity. HE assumes that the Wyoming Ethanol facility and the Western Sugar facility in Torrington will remain closed under both the Low and Mid Scenarios. Other miscellaneous water use is expected to hold steady at current levels under both the Low and Mid Scenarios.

#### Consumptive Recreational Use

The majority of recreational water use (boating, fishing, etc.) in the Basin is non-consumptive. Two consumptive recreational water uses include snowmaking at alpine ski areas and golf course irrigation. The assumptions used to project water demands for those recreational uses are described below. The demands themselves are included with municipal/rural domestic demands later in this volume.

**Skiing.** HE projects that the two ski areas in the Basin (one each in the Pathfinder to Guernsey and Upper Laramie subbasins) will maintain their current demands for water under all future scenarios. No new ski areas are expected to be developed in the Basin under any of the scenarios.

**Golf.** Under the High Scenario, HE projected the development of five new 18 hole golf courses and the expansion of six existing courses, from 9 holes to 18 holes each. One new course would be built in the Above Pathfinder Dam subbasin and two new courses would be developed in each of the Pathfinder to Guernsey and the South Platte subbasins. Golf course expansions would occur in the Pathfinder to Guernsey (two courses), Upper Laramie (one course), Lower Laramie (one course) and South Platte (two courses) subbasins. The demand for additional golfing amenities is supported by the projected population growth as well as increased economic activity. About 900 new irrigated acres would be added under the High Scenario.

In the Low Scenario, HE assumed that no new courses or expansions would be built in any of the subbasins and that all current operations would continue. The Mid Scenario incorporates the development of three new 18 hole courses: one each in the Above Pathfinder Dam, Pathfinder to Guernsey and South Platte subbasins. Additionally, four existing courses would be expanded under the Mid Scenario: one each in the Pathfinder to Guernsey and Lower Laramie subbasins and two in the South Platte subbasin. About 570 new irrigated acres would be added under the Mid Scenario.

The consumptive use irrigation estimates derived for the 2006 Basin Plan were assumed to have remained constant over time and were also applied to all new or expanded courses in the High and Mid Scenarios.

### 4.4.3 Current Annual Water Demands, as Compared to the 2006 Basin Plan

The 2006 Basin Plan included water demands current to that time; those demands reflected water use in the year 2005. Since that time, there have been some major changes in water use in all sectors. Current water demands in 2015 look very different from those of 2005. Therefore, a brief discussion of the changes that have taken place in the Basin in the interim, with regards to water demands, provides some context for examining the projections included in this Basin Plan update. These changes can be summarized as follows:

- Total water diversions in the Basin decreased from about 1,721,040 acre-feet in 2005 to about 1,513,200 acre-feet in 2015, a drop of about 208,000 acre-feet, or about 12%. That net decrease is made up of changes in individual sectors.

- Agricultural operations and activities use the largest amount of water in the Basin. Between 2005 and 2015, the number of irrigated acres in the Basin decreased by about 14%. Number of cattle declined slightly, but generally remained relatively constant; sheep declined by a considerable amount. As a result, water diversions for agricultural use in the Basin decreased from about 1,559,300 acre-feet to about 1,295,800, given normal year conditions. That change amounts to a drop of about 263,500 acre-feet, or about 17%.
- Industrial water use throughout the Basin increased by about 53,000 acre-feet, or about 50%. That increase is mainly due to increased water demands for oil and gas production (17,700 acre-feet) and uranium mining (28,300 acre-feet). Other industrial sectors changed by smaller amounts.
- Municipal and rural domestic demands, including consumptive recreation, increased by about 5,800 acre-feet, or about 12%. Municipal demands increased in five of the seven basins due to population and employment increases, but decreased slightly in the Guernsey to State Line subbasin and the Upper Laramie subbasin due to reductions in per capita water use in those subbasins.

### 4.4.4 Projected Annual Water Demands by Scenario

This section presents current and projected annual water demands, both diversions and consumptive use, for the Basin under each of three separate scenarios: High, Low and Mid economic growth. The assumptions underlying the agricultural, municipal, industrial and recreational sectors for each scenario have been previously described in Section 4.2.

Water demands are derived by multiplying current or projected demographic or economic activity described in Section 4.2 by the water use factors presented in **Table 4.18** or by outright forecasts of individual water demands for various entities. Total water diversions and consumptive use are presented and discussed for each sector, relying on three pairs of tables, one pair for each scenario. Patterns of change from current to projected future use by sector do not vary from diversions to consumptive use within each scenario. At the bottom of each exhibit, these totals are aggregated into surface water and groundwater totals for the Basin.

#### High Scenario

Assuming normal water demand conditions, total Basin water diversion requirements are projected to increase by about 25% between 2015 and 2045 under the High Scenario; that amounts to an increase of about 377,000 acre-feet. In a high demand year, the increase is also projected to be around 25%, or about 510,600 acre-feet.

Under the High Scenario, total agricultural water demand grows by an estimated 22% over the projection period. Agriculture continues to comprise the vast majority of total water demand under the High Scenario; agriculture accounts for 84% of total water diverted and roughly 72% of total consumptive use in normal demand year 2045. Consumptive use is only 43% of total diversions for irrigated agricultural production within the Basin, reflecting low efficiencies and reuse of return flows. The vast majority of agricultural water demand remains in irrigated crop production, with less than 1% of total projected agricultural diversions and consumptive use going to direct livestock sustenance.

Under the High Scenario, while municipal water demand in the Basin increases by 70% over the 30-year projection period, it remains a relatively small sector, accounting for only 4% of total water diversions and 4% of total consumptive use in a normal demand year 2045.

Water demand within the industrial sector increases by about 34% over the projection period under the High Scenario for both consumptive use and diversions. Water demands in the industrial sector will account for a slightly greater percentage of total water use in 2045, as compared to 2015, but will remain only a small portion of the Basin's water demands, as compared to agriculture. Industrial demands will account for 22% of total consumptive use and 11% of total diversions under the High Scenario in a normal year 2045.

The share of aggregate water demand met by groundwater resources versus surface water within the Basin is projected to decrease slightly under the High Scenario.

About 82% percent of water diversions will continue to come from surface water by 2045, a decrease of about 2% over the projection period.

**Tables 4.19 and 4.20** provide estimates of current and projected annual diversions and consumptive use under the High Scenario.

**Table 4.19: Current and Projected Annual Platte River Basin Water Demand Annual Diversions in Acre-Feet per Year, High Scenario**

| **Economic Sector** | **Current (2015)** | | **Project (2045)** | |
|---|---|---|---|---|
| | **Normal** | **Max** | **Normal** | **Max** |
| **Agricultural** | | | | |
| *Irrigation* | | | | |
| Alfalfa | 316,000 | 435,000 | 403,000 | 550,000 |
| Other hay | 434,000 | 635,000 | 518,000 | 758,000 |
| Irrigated pasture | 258,000 | 412,000 | 307,000 | 493,000 |
| Corn | 125,000 | 159,000 | 152,000 | 192,000 |
| Sugar beets | 63,000 | 82,000 | 77,000 | 100,000 |
| Dry beans | 39,000 | 54,000 | 47,000 | 64,000 |
| Oats | 16,000 | 19,000 | 21,000 | 24,000 |
| Barley | 23,000 | 28,000 | 28,000 | 36,000 |
| Winter wheat | 14,000 | 19,000 | 16,000 | 21,000 |
| Spring wheat | 2,000 | 2,000 | 2,000 | 2,000 |
| *Subtotal* | *1,290,000* | *1,845,000* | *1,571,000* | *2,240,000* |
| *Livestock* | 5,800 | 5,800 | 6,900 | 6,900 |
| **Municipal/Rural Domestic** | 60,100 | 87,800 | 102,100 | 149,600 |
| **Industrial** | | | | |
| *Oil refining and production* | 51,300 | 51,300 | 61,600 | 61,600 |
| *Coal and uranium mining* | 28,600 | 28,600 | 52,000 | 52,000 |
| *Power generation* | 27,200 | 27,200 | 37,500 | 37,500 |
| *Miscellaneous and other* | 50,200 | 50,200 | 58,900 | 58,900 |
| **Total Water Usage** | 1,513,200 | 2,095,900 | 1,890,000 | 2,606,500 |
| Surface Water | 1,271,200 | 1,789,400 | 1,567,000 | 2,202,100 |
| Ground Water | 242,000 | 306,500 | 323,000 | 404,400 |
| **Share Water Usage** | | | | |
| Surface Water | 84% | 85% | 83% | 84% |
| Ground Water | 16% | 15% | 17% | 16% |

**Notes:**
1. Municipal/Rural Domestic demands include water demands for ski areas and golf courses.
2. All irrigation water demands are rounded to the nearest thousand acre-feet.

Source: Harvey Economics, 2016.

**Table 4.20: Current and Projected Annual Platte River Water Demand Consumptive Use in Acre-Feet per Year, High Scenario**

| Economic Sector | Current (2015) | | Project (2045) | |
|---|---|---|---|---|
| | Normal | Max | Normal | Max |
| **Agricultural** | | | | |
| *Irrigation* | | | | |
| Alfalfa | 136,000 | 186,000 | 172,000 | 232,000 |
| Other hay | 187,000 | 271,000 | 221,000 | 320,000 |
| Irrigated pasture | 111,000 | 176,000 | 131,000 | 208,000 |
| Corn | 54,000 | 68,000 | 65,000 | 81,000 |
| Sugar beets | 27,000 | 35,000 | 33,000 | 42,000 |
| Dry beans | 17,000 | 23,000 | 20,000 | 27,000 |
| Oats | 7,000 | 8,000 | 9,000 | 10,000 |
| Barley | 10,000 | 12,000 | 12,000 | 15,000 |
| Winter wheat | 6,000 | 8,000 | 7,000 | 9,000 |
| Spring wheat | 1,000 | 1,000 | 1,000 | 1,000 |
| *Subtotal* | *556,000* | *788,000* | *671,000* | *945,000* |
| *Livestock* | 5,800 | 5,800 | 6,900 | 6,900 |
| **Municipal/Rural Domestic** | 30,200 | 44,300 | 51,200 | 74,900 |
| **Industrial** | | | | |
| *Oil refining and production* | 51,300 | 51,300 | 61,600 | 61,600 |
| *Coal and uranium mining* | 28,600 | 28,600 | 52,000 | 52,000 |
| *Power generation* | 27,200 | 27,200 | 37,500 | 37,500 |
| *Miscellaneous and other* | 50,200 | 50,200 | 58,900 | 58,900 |
| **Total Water Usage** | 749,300 | 995,400 | 939,100 | 1,236,800 |
| Surface Water | 571,300 | 789,700 | 698,100 | 961,200 |
| Ground Water | 178,000 | 205,700 | 241,000 | 275,600 |
| **Share Water Usage** | | | | |
| Surface Water | 76% | 79% | 74% | 78% |
| Ground Water | 24% | 21% | 26% | 22% |

**Notes:**
1. Municipal/Rural Domestic demands include water demands for ski areas and golf courses.
2. All irrigation water demands are rounded to the nearest thousand acre-feet.

Source: Harvey Economics, 2016.

### Low Scenario

Total water diversion requirements under the Low Scenario in a normal demand year are projected to decline by about 19% from 2015 to 2045, or about 284,000 acre-feet. Maximum or drought year demand year diversion requirements are also projected to drop by about 18% over the same period. Consumptive use is expected to drop slightly less under the Low Scenario, by 16% in a normal demand year and by 15% in a high demand year.

Under the Low Scenario, total agricultural water demand declines considerably over the projection period – about 23%, in terms of diversions and about 22% in terms of consumptive use. Agriculture continues to comprise the vast majority of total water demand under the Low Scenario; agriculture is responsible for 81% of total water diverted and roughly 70% of total consumptive use in a normal demand year 2045. Consumptive use amounts to 44% of total diversions for irrigated agricultural production within the Basin, reflecting low efficiencies and reuse of return flows. The vast majority of agricultural water demand remains in irrigated crop production, with about one percent of total projected agricultural diversions and consumptive use going to direct livestock sustenance.

In the municipal sector, the 18% increase in both diversions and consumptive use is the direct result of the projected increases in Basin population levels, but it remains a small portion of overall Basin water demands.

Under the Low Scenario, industrial water demand remains relatively constant through 2045 as oil and gas production increases at a slow, but steady pace and uranium mining continues. This sector will represent a greater portion of overall water demands under the Low Scenario, as agricultural water use decreases.

Under the Low Scenario, the share of total groundwater diversions and consumptive use is expected to decrease slightly, by roughly 2%.

**Tables 4.21 and 4.22** present estimates of the current and projected annual water diversions and consumptive use estimates under the Low Scenario.

**Table 4.21: Current and Projected Annual Platte River Water Demand Annual Diversions in Acre-Feet per Year, Low Scenario**

| Economic Sector | Current (2015) | | Project (2045) | |
|---|---|---|---|---|
| | Normal | Max | Normal | Max |
| **Agricultural** | | | | |
| *Irrigation* | | | | |
| Alfalfa | 316,000 | 435,000 | 217,000 | 306,000 |
| Other hay | 434,000 | 635,000 | 359,000 | 529,000 |
| Irrigated pasture | 258,000 | 412,000 | 215,000 | 343,000 |
| Corn | 125,000 | 159,000 | 94,000 | 122,000 |
| Sugar beets | 63,000 | 82,000 | 48,000 | 62,000 |
| Dry beans | 39,000 | 54,000 | 30,000 | 39,000 |
| Oats | 16,000 | 19,000 | 9,000 | 12,000 |
| Barley | 23,000 | 28,000 | 16,000 | 21,000 |
| Winter wheat | 14,000 | 19,000 | 9,000 | 14,000 |
| Spring wheat | 2,000 | 2,000 | 0 | 2,000 |
| *Subtotal* | *1,290,000* | *1,845,000* | *997,000* | *1,450,000* |
| *Livestock* | 5,800 | 5,800 | 5,000 | 5,000 |
| **Municipal/Rural Domestic** | 60,100 | 87,800 | 71,000 | 103,900 |
| **Industrial** | | | | |
| *Oil refining and production* | 51,300 | 51,300 | 51,300 | 51,300 |
| *Coal and uranium mining* | 28,600 | 28,600 | 28,600 | 28,600 |
| *Power generation* | 27,200 | 27,200 | 27,500 | 27,500 |
| *Miscellaneous and other* | 50,200 | 50,200 | 49,300 | 49,300 |
| **Total Water Usage** | 1,513,200 | 2,095,900 | 1,229,700 | 1,715,600 |
| Surface Water | 1,271,200 | 1,789,400 | 1,008,600 | 1,439,800 |
| Ground Water | 242,000 | 306,500 | 221,100 | 275,800 |
| **Share Water Usage** | | | | |
| Surface Water | 84% | 85% | 82% | 84% |
| Ground Water | 16% | 15% | 18% | 16% |

**Notes:**

1. Municipal/Rural Domestic demands include water demands for ski areas and golf courses.
2. All irrigation water demands are rounded to the nearest thousand acre-feet.

Source: Harvey Economics, 2016.

**Table 4.22: Current and Projected Annual Platte River Water Demand Consumptive Use in Acre-Feet per Year, Low Scenario**

| Economic Sector | Current (2015) | | Project (2045) | |
|---|---|---|---|---|
| | Normal | Max | Normal | Max |
| **Agricultural** | | | | |
| *Irrigation* | | | | |
| Alfalfa | 136,000 | 186,000 | 95,000 | 133,000 |
| Other hay | 187,000 | 271,000 | 157,000 | 230,000 |
| Irrigated pasture | 111,000 | 176,000 | 94,000 | 149,000 |
| Corn | 54,000 | 68,000 | 41,000 | 53,000 |
| Sugar beets | 27,000 | 35,000 | 21,000 | 27,000 |
| Dry beans | 17,000 | 23,000 | 13,000 | 17,000 |
| Oats | 7,000 | 8,000 | 4,000 | 5,000 |
| Barley | 10,000 | 12,000 | 7,000 | 9,000 |
| Winter wheat | 6,000 | 8,000 | 4,000 | 6,000 |
| Spring wheat | 1,000 | 1,000 | 0 | 1,000 |
| *Subtotal* | *556,000* | *788,000* | *436,000* | *630,000* |
| *Livestock* | 5,800 | 5,800 | 5,000 | 5,000 |
| **Municipal/Rural Domestic** | 30,200 | 44,300 | 35,500 | 52,200 |
| **Industrial** | | | | |
| *Oil refining and production* | 51,300 | 51,300 | 51,300 | 51,300 |
| *Coal and uranium mining* | 28,600 | 28,600 | 28,600 | 28,600 |
| *Power generation* | 27,200 | 27,200 | 27,500 | 27,500 |
| *Miscellaneous and other* | 50,200 | 50,200 | 49,300 | 49,300 |
| **Total Water Usage** | 749,300 | 995,400 | 633,200 | 843,900 |
| Surface Water | 571,300 | 789,700 | 464,200 | 650,700 |
| Ground Water | 178,000 | 205,700 | 169,000 | 193,200 |
| **Share Water Usage** | | | | |
| Surface Water | 76% | 79% | 73% | 77% |
| Ground Water | 24% | 21% | 27% | 23% |

**Notes:**
1. Municipal/Rural Domestic demands include water demands for ski areas and golf courses.
2. All irrigation water demands are rounded to the nearest thousand acre-feet.

Source: Harvey Economics, 2016.

### Mid Scenario

In both normal and high demand years, total Basin water diversions are projected to decrease by about 7% between year 2015 to year 2045 under the Mid Scenario. Consumptive use is projected to decrease by about 4% in both normal and high demand years. The projected difference in aggregate diversions and aggregate consumptive use under normal water demand conditions amounts to roughly 104,300 acre-feet and 30,700 acre-feet, respectively.

Under the Mid Scenario, total agricultural water demand declines by about 11% over the projection period, measured in terms of diversions or consumptive use. Agriculture continues to comprise the vast majority of total water demand under the Mid Scenario; agriculture is responsible for 82% of total water diverted and roughly 70% of total consumptive use in a normal demand year 2045. Consumptive use is only 44% of total diversions for irrigated agricultural production within the Basin, reflecting low efficiencies and reuse of return flows. The vast majority of agricultural water demand remains in irrigated crop production, with less than 1% of total projected agricultural diversions and consumptive use going to direct livestock sustenance.

Under the Mid Scenario, while municipal water demand increases by 37% over the 30-year projection period, it remains a relatively small sector, accounting for only 4% of total water diversions and total consumptive use within the Basin in a normal demand year 2045.

Under the Mid Scenario, industrial water diversions and consumptive use in the Basin industrial sector are projected to increase by 11% from current levels. Industrial water use will become a larger portion of the overall Basin water demand, increasing to 12% of diversions and 24% of consumptive use in a normal demand year 2045.

Under the Mid Scenario, the share of total diversions and consumptive use from groundwater sources is projected to decrease slightly, by about 2% to 3%.

**Tables 4.23 and 4.24** present estimates of the current and projected annual diversions and consumptive use estimates under the Low Scenario.

**Table 4.23: Current and Projected Annual Platte River Water Demand Annual Diversions in Acre-Feet per Year, Mid Scenario**

| Economic Sector | Current (2015) | | Project (2045) | |
|---|---|---|---|---|
| | Normal | Max | Normal | Max |
| **Agricultural** | | | | |
| *Irrigation* | | | | |
| Alfalfa | 316,000 | 435,000 | 267,000 | 371,000 |
| Other hay | 434,000 | 635,000 | 396,000 | 580,000 |
| Irrigated pasture | 258,000 | 412,000 | 237,000 | 376,000 |
| Corn | 125,000 | 159,000 | 111,000 | 142,000 |
| Sugar beets | 63,000 | 82,000 | 55,000 | 72,000 |
| Dry beans | 39,000 | 54,000 | 35,000 | 46,000 |
| Oats | 16,000 | 19,000 | 12,000 | 16,000 |
| Barley | 23,000 | 28,000 | 21,000 | 26,000 |
| Winter wheat | 14,000 | 19,000 | 12,000 | 16,000 |
| Spring wheat | 2,000 | 2,000 | 0 | 2,000 |
| *Subtotal* | *1,290,000* | *1,845,000* | *1,146,000* | *1,647,000* |
| *Livestock* | 5,800 | 5,800 | 5,800 | 5,800 |
| **Municipal/Rural Domestic** | 60,100 | 87,800 | 82,400 | 119,800 |
| **Industrial** | | | | |
| *Oil refining and production* | 51,300 | 51,300 | 56,400 | 56,400 |
| *Coal and uranium mining* | 28,600 | 28,600 | 38,600 | 38,600 |
| *Power generation* | 27,200 | 27,200 | 27,500 | 27,500 |
| *Miscellaneous and other* | 50,200 | 50,200 | 52,200 | 52,200 |
| **Total Water Usage** | 1,513,200 | 2,095,900 | 1,408,900 | 1,947,300 |
| Surface Water | 1,271,200 | 1,789,400 | 1,156,600 | 1,633,900 |
| Ground Water | 242,000 | 306,500 | 252,300 | 313,400 |
| **Share Water Usage** | | | | |
| Surface Water | 84% | 85% | 82% | 84% |
| Ground Water | 16% | 15% | 18% | 16% |

**Notes:**
1. Municipal/Rural Domestic demands include water demands for ski areas and golf courses.
2. All irrigation water demands are rounded to the nearest thousand acre-feet.

Source: Harvey Economics, 2016.

**Table 4.24: Current and Projected Annual Platte River Water Demand Consumptive Use in Acre-Feet per Year, Mid Scenario**

| Economic Sector | Current (2015) | | Project (2045) | |
|---|---|---|---|---|
| | Normal | Max | Normal | Max |
| **Agricultural** | | | | |
| *Irrigation* | | | | |
| Alfalfa | 136,000 | 186,000 | 116,000 | 160,000 |
| Other hay | 187,000 | 271,000 | 172,000 | 250,000 |
| Irrigated pasture | 111,000 | 176,000 | 103,000 | 162,000 |
| Corn | 54,000 | 68,000 | 48,000 | 61,000 |
| Sugar beets | 27,000 | 35,000 | 24,000 | 31,000 |
| Dry beans | 17,000 | 23,000 | 15,000 | 20,000 |
| Oats | 7,000 | 8,000 | 5,000 | 7,000 |
| Barley | 10,000 | 12,000 | 9,000 | 11,000 |
| Winter wheat | 6,000 | 8,000 | 5,000 | 7,000 |
| Spring wheat | 1,000 | 1,000 | 0 | 1,000 |
| *Subtotal* | *556,000* | *788,000* | *497,000* | *710,000* |
| *Livestock* | 5,800 | 5,800 | 5,800 | 5,800 |
| **Municipal/Rural Domestic** | 30,200 | 44,300 | 41,100 | 60,100 |
| **Industrial** | | | | |
| *Oil refining and production* | 51,300 | 51,300 | 56,400 | 56,400 |
| *Coal and uranium mining* | 28,600 | 28,600 | 38,600 | 38,600 |
| *Power generation* | 27,200 | 27,200 | 27,500 | 27,500 |
| *Miscellaneous and other* | 50,200 | 50,200 | 52,200 | 52,200 |
| **Total Water Usage** | 749,300 | 995,400 | 718,600 | 950,600 |
| Surface Water | 571,300 | 789,700 | 526,600 | 731,800 |
| Ground Water | 178,000 | 205,700 | 192,000 | 218,800 |
| **Share Water Usage** | | | | |
| Surface Water | 76% | 79% | 73% | 77% |
| Ground Water | 24% | 21% | 27% | 23% |

**Notes:**

1. Municipal/Rural Domestic demands include water demands for ski areas and golf courses.
2. All irrigation water demands are rounded to the nearest thousand acre-feet.

Source: Harvey Economics, 2016.

### 4.4.5 Projected Monthly Demands by Scenario

Current and projected monthly water demands (both diversions and consumptive use) have been prepared for the Basin under the High, Low and Mid scenarios. Monthly water demands are derived by multiplying current and projected annual water demands for each sector by monthly shares of annual water use based upon the assumptions used in the 2006 Basin Plan. Total water diversions and consumptive use are presented and discussed for each consuming sector under each scenario.

An analysis of the temporal distribution of water demands throughout the year illustrates the seasonal nature of water demand within the Basin. Almost all sectors exhibit a significant difference in demand between the peak summer months and the off-peak winter months. Such distinct seasonal patterns in water demand are characteristic of regions with colder climates. The percentage of diversions and consumptive use occurring in each month over the course of a year are assumed to be the same under each scenario.

The distribution of irrigation water demand used in the 2006 Basin Plan was also used for this update. That distribution is based on aggregate CIR information developed at that time. Livestock water demand is assumed to be twice as high during the months of April through

September to reflect both the presence of the spring calf crop and the increased temperatures during those months.

Municipal and rural domestic use is distributed throughout the year with heavy use in the summer months of June through September and relatively lighter use in October through May. HE estimates that roughly 50% of total municipal and rural domestic use occurs throughout the summer months, with the remainder of water use spread equally throughout the rest of the year.

Industrial water demand in the Basin was assumed to be constant throughout the year, as most processes and production in the industries in the Basin are fairly stable across seasons. Recreational water demands were assumed to occur in different seasons. HE assumed that snowmaking would occur evenly throughout the months of December through March, while golf irrigation would occur from April through September, similar to agricultural irrigation.

### High Scenario

The aggregate temporal distribution of water demand within the Basin under the High Scenario is presented in **Table 4.25**. It is possible to divide the months into three categories of water use: the baseline or off-peak months of October through March; the peak months of June and July; and the shoulder months of April, May, August and September.

**Table 4.25: Current and Projected Monthly Platte River Basin Water Demand, Estimated Diversions and Consumptive Use in Acre-Feet per Month, High Scenario**

| | Current 2015 Demands | | | | 2045 High Scenario Demands | | | |
|---|---|---|---|---|---|---|---|---|
| | Normal | | Max | | Normal | | Max | |
| | Diversions | CU | Diversions | CU | Diversions | CU | Diversions | CU |
| January | 17,200 | 15,300 | 18,900 | 16,200 | 24,300 | 21,100 | 27,200 | 22,600 |
| February | 17,200 | 15,300 | 18,900 | 16,200 | 24,300 | 21,100 | 27,200 | 22,600 |
| March | 17,200 | 15,300 | 18,900 | 16,200 | 24,300 | 21,100 | 27,200 | 22,600 |
| April | 89,100 | 46,500 | 121,600 | 60,200 | 111,800 | 58,700 | 151,900 | 75,400 |
| May | 212,400 | 99,600 | 298,000 | 135,600 | 262,000 | 122,800 | 366,000 | 165,700 |
| June | 364,100 | 165,300 | 515,100 | 228,700 | 448,600 | 203,000 | 632,300 | 278,800 |
| July | 371,000 | 168,300 | 524,900 | 232,900 | 457,000 | 206,600 | 644,300 | 283,800 |
| August | 233,000 | 108,800 | 327,500 | 148,600 | 288,800 | 134,800 | 404,600 | 182,700 |
| September | 140,500 | 68,900 | 195,300 | 92,100 | 176,300 | 86,700 | 244,100 | 115,000 |
| October | 17,200 | 15,300 | 18,900 | 16,200 | 24,300 | 21,100 | 27,200 | 22,600 |
| November | 17,200 | 15,300 | 18,900 | 16,200 | 24,300 | 21,100 | 27,200 | 22,600 |
| December | 17,200 | 15,300 | 18,900 | 16,200 | 24,300 | 21,100 | 27,200 | 22,600 |
| **Total Annual Demand** | **1,513,300** | **749,200** | **2,095,800** | **995,300** | **1,890,300** | **939,200** | **2,606,400** | **1,237,000** |

**Note:** All water demands are rounded to the nearest hundred acre-feet.
Source: Harvey Economics, 2016.

Water demand growth occurs in both the peak and off-peak months of demand under the High Scenario. Percentage increases are greater in the non-irrigation months given a smaller starting point of use and given relatively higher growth in the municipal and rural domestic sector that makes up the vast majority of water use during the non-irrigation months.

### Low Scenario

The aggregate temporal distribution of water demand in the Basin under the Low Scenario is presented in **Table 4.26**.

**Table 4.26: Current and Projected Monthly Platte River Basin Water Demand, Estimated Diversions and Consumptive Use in Acre-Feet per Month, Low Scenario**

| | Current 2015 Demands | | | | 2045 Low Scenario Demands | | | |
|---|---|---|---|---|---|---|---|---|
| | Normal | | Max | | Normal | | Max | |
| | Diversions | CU | Diversions | CU | Diversions | CU | Diversions | CU |
| January | 17,200 | 15,300 | 18,900 | 16,200 | 17,800 | 15,600 | 19,800 | 16,600 |
| February | 17,200 | 15,300 | 18,900 | 16,200 | 17,800 | 15,600 | 19,800 | 16,600 |
| March | 17,200 | 15,300 | 18,900 | 16,200 | 17,800 | 15,600 | 19,800 | 16,600 |
| April | 89,100 | 46,500 | 121,600 | 60,200 | 73,400 | 40,000 | 100,600 | 51,800 |
| May | 212,400 | 99,600 | 298,000 | 135,600 | 168,700 | 81,700 | 239,200 | 112,100 |
| June | 364,100 | 165,300 | 515,100 | 228,700 | 287,500 | 133,900 | 412,000 | 187,600 |
| July | 371,000 | 168,300 | 524,900 | 232,900 | 292,800 | 136,300 | 419,700 | 190,900 |
| August | 233,000 | 108,800 | 327,500 | 148,600 | 186,100 | 89,600 | 264,600 | 123,500 |
| September | 140,500 | 68,900 | 195,300 | 92,100 | 114,700 | 58,400 | 160,700 | 78,400 |
| October | 17,200 | 15,300 | 18,900 | 16,200 | 17,800 | 15,600 | 19,800 | 16,600 |
| November | 17,200 | 15,300 | 18,900 | 16,200 | 17,800 | 15,600 | 19,800 | 16,600 |
| December | 17,200 | 15,300 | 18,900 | 16,200 | 17,800 | 15,600 | 19,800 | 16,600 |
| **Total Annual Demand** | **1,513,300** | **749,200** | **2,095,800** | **995,300** | **1,230,000** | **633,500** | **1,715,600** | **843,900** |

**Note:** All water demands are rounded to the nearest hundred acre-feet.
Source: Harvey Economics, 2016.

Under the Low Scenario, overall water demand for the Basin decreases considerably. Because those decreases are due to changes in the agricultural sector, the greatest reductions occur during the irrigation season. Industrial use, which is evenly distributed year-round, remains relatively constant, while municipal water demands increase over time.

### Mid Scenario

The aggregate temporal distribution of water demand in the Basin under the Mid Scenario is presented in **Table 4.27**. The temporal distribution of water demand under the Mid Scenario essentially splits the difference between the patterns exhibited under the other two scenarios.

**Table 4.27: Current and Projected Monthly Platte River Basin Water Demand, Estimated Diversions and Consumptive Use in Acre-Feet per Month, Mid Scenario**

| | Current 2015 Demands | | | | 2045 Mid Scenario Demands | | | |
|---|---|---|---|---|---|---|---|---|
| | Normal | | Max | | Normal | | Max | |
| | Diversions | CU | Diversions | CU | Diversions | CU | Diversions | CU |
| January | 17,200 | 15,300 | 18,900 | 16,200 | 20,000 | 17,400 | 22,400 | 18,600 |
| February | 17,200 | 15,300 | 18,900 | 16,200 | 20,000 | 17,400 | 22,400 | 18,600 |
| March | 17,200 | 15,300 | 18,900 | 16,200 | 20,000 | 17,400 | 22,400 | 18,600 |
| April | 89,100 | 46,500 | 121,600 | 60,200 | 83,900 | 45,300 | 114,100 | 58,400 |
| May | 212,400 | 99,600 | 298,000 | 135,600 | 193,500 | 92,900 | 271,500 | 126,200 |
| June | 364,100 | 165,300 | 515,100 | 228,700 | 330,100 | 152,400 | 467,900 | 211,400 |
| July | 371,000 | 168,300 | 524,900 | 232,900 | 336,200 | 155,100 | 476,700 | 215,200 |
| August | 233,000 | 108,800 | 327,500 | 148,600 | 213,600 | 101,900 | 300,500 | 139,200 |
| September | 140,500 | 68,900 | 195,300 | 92,100 | 131,500 | 66,300 | 182,400 | 88,400 |
| October | 17,200 | 15,300 | 18,900 | 16,200 | 20,000 | 17,400 | 22,400 | 18,600 |
| November | 17,200 | 15,300 | 18,900 | 16,200 | 20,000 | 17,400 | 22,400 | 18,600 |
| December | 17,200 | 15,300 | 18,900 | 16,200 | 20,000 | 17,400 | 22,400 | 18,600 |
| **Total Annual Demand** | **1,513,300** | **749,200** | **2,095,800** | **995,300** | **1,408,800** | **718,300** | **1,947,500** | **950,400** |

**Note:** All water demands are rounded to the nearest hundred acre-feet.
Source: Harvey Economics, 2016.

### 4.4.6 Projected Water Use in the Non-consumptive Environmental and Recreational Sectors

As described in Volume 2, Section 4 of this Basin Plan Update, activities in the environmental and non-consumptive recreational use sectors are highly dependent on traditional water uses.[14] Therefore, this analysis of future demands is a reflection of the interactions of traditional water uses and these non-consumptive uses. Ideally, the mapping of E&R water use in the Surface Water Profile would be translated into a number, expressed in acre feet, which would demonstrate how much of the Basin's water resources contribute to these important sectors; that information would then serve as a basis for the E&R demand projections. Unfortunately, flow data for the Basin is incomplete and thus such a calculation has not been possible. A qualitative discussion of HE's expectations for E&R water use under each of the scenarios is provided below.

#### High Scenario

Under these conditions, it is likely that recreational water use will be stable or will decline modestly. As agricultural activity increases, diversions will also increase, which will have a dual impact. Uses that have been classified as complementary or protected should continue to be available or even increase because these recreational uses rely upon senior downstream diverters, who would operate at maximum or near maximum levels. However, competing uses might be threatened as increasing diversions on over-appropriated stream segments would constrain or even eliminate those recreational uses, especially in dry years. The growing population under this scenario would create greater recreational demands, placing additional pressure on the remaining resources.

On the environmental side, a strong economy would tend to expand those water uses on the whole. Agricultural irrigation tends to improve and expand wetlands, a beneficial complementary relationship. As competition for water increases, in-stream flow applications might become more difficult, although increase in environmental protection interests might offset this. Development activity and increased governmental revenues are both likely to have the effect of increasing interest in environmental protection and remediation. Remedial activities for critical habitat areas have been established and include actions such as improved grazing management, river bank restoration, control of invasive species, obtaining conservation easements, and restoration of native populations, to name just a few. These activities require government expenditures that will be much more likely under the high scenario.

#### Low Scenario

As with the High Scenario, the Low Scenario will produce contradictory impacts but mostly positive effects on recreational water use. Less water will be diverted for agriculture, so competing uses will not threaten recreational uses, unless other non-agricultural uses step in (unlikely under the low scenario). However, the complementary uses might be threatened if senior water right diverters reduced dramatically or eliminated their use. As described previously, it is the existence of downstream diversions that support stream-based recreation. This is unlikely, given the value of such water diversions. Draw-down of reservoirs would also be reduced, increasing the attractiveness of recreation at those locations later in the season. Environmental water uses under the low scenario face a mixed outlook to negative outlook. Reductions in agricultural activities will naturally improve environmental conditions, such as adverse impacts from grazing. However, reductions in irrigation will also mean fewer wetlands. The extended period of relatively low energy

[14] HE's Recreation and Environmental Water Use discussion in Volume 2 of the Platte River Basin Update provides a detailed discussion of water use in these sectors.

production envisioned in this scenario will have a negative impact on State mineral revenues, so remediation will be less.

On the whole, there will be less pressure to divert water, which leaves it for in-stream recreational uses. Over-appropriated streams will feel less pressure and thus competing stream segments will likely be available in non-drought conditions. Population increases under this scenario, albeit modest, will take advantage of these improved conditions and activity levels should increase.

**Mid Scenario**

This scenario reflects conditions that assume modestly declining agriculture and modestly increasing industrial and domestic water use. It is likely that recreational opportunities will remain about the same. Protected and complementary locations will still be available. Those competing uses that are already subject to drought and over-appropriation will continue to be available only in wetter years.  A growing population will bring increase activity levels. Environmental conditions are also expected to improve at the margin. Wyoming Game and Fish will continue to identify remedial actions to improve habitat, but without large increases in funding, these improvements will be modest.

### 4.4.7 References

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Wyoming Water Development Commission (WWDC). 2015. *State of Wyoming 2015 Irrigation System Survey Report*.

# Appendix 4-A

Appendix 4-A provides the summary water demand projection exhibits for 2015 and 2045 for each subbasin of the Platte River Basin in Wyoming. Each subbasin has six tables in three pairs. Each pair matches consumptive use of water and water diversions for each of three economic growth scenarios described in the High, Low and Mid Scenarios. Water demands within each table are specified for normal/average demand years and for high/maximum demand years. HE developed all information for the economic and demographic scenarios and for water use throughout Volume 4 at the Basin and subbasin level to be able to generate exhibits 4-A-1 through 4-A-44. All of the irrigation diversions and consumptive use data included in these tables have been rounded to the nearest thousand acre-feet.

Exhibit 4-A-1: Above Pathfinder Dam Subbasin Current and Projected Annual Water Demand Annual Diversions in Acre-Feet per Year, High Scenario

| | Current (2015) | | Projected (2045) | |
|---|---|---|---|---|
| **Economic Sector** | **Normal** | **Max** | **Normal** | **Max** |
| **Agricultural** | | | | |
| *Irrigation* | | | | |
| Alfalfa | 20,000 | 27,000 | 25,000 | 34,000 |
| Other hay | 164,000 | 216,000 | 201,000 | 266,000 |
| Irrigated pasture | 94,000 | 132,000 | 116,000 | 162,000 |
| Corn | 0 | 0 | 0 | 0 |
| Sugar beets | 0 | 0 | 0 | 1,000 |
| Dry beans | 0 | 0 | 0 | 0 |
| Oats | 0 | 1,000 | 0 | 1,000 |
| Barley | 1,000 | 1,000 | 1,000 | 2,000 |
| Winter wheat | 0 | 0 | 0 | 0 |
| Spring wheat | 0 | 0 | 0 | 0 |
| *Subtotal* | 279,000 | 377,000 | 343,000 | 466,000 |
| *Livestock* | 1,000 | 1,000 | 1,200 | 1,200 |
| **Municipal/Rural Domestic** | 6,300 | 8,700 | 8,100 | 11,200 |
| **Industrial** | | | | |
| *Oil refining and production* | 15,500 | 15,500 | 18,600 | 18,600 |
| *Coal and uranium mining* | 300 | 300 | 13,700 | 13,700 |
| *Power generation* | 0 | 0 | 0 | 0 |
| *Miscellaneous and other* | 3,100 | 3,100 | 3,700 | 3,700 |
| **Total Water Usage** | 305,200 | 405,600 | 388,300 | 514,400 |
| Surface Water | 267,000 | 359,300 | 328,400 | 444,300 |
| Ground Water | 38,200 | 46,300 | 59,900 | 70,100 |
| Share Water Usage | | | | |
| Surface Water | 87% | 89% | 85% | 86% |
| Ground Water | 13% | 11% | 15% | 14% |

Source: Harvey Economics, 2016.

Exhibit 4-A-2: Above Pathfinder Dam Subbasin Current and Projected Annual Water Demand Annual Consumptive Use in Acre-Feet per Year, High Scenario

| | Current (2015) | | Projected (2045) | |
|---|---|---|---|---|
| **Economic Sector** | **Normal** | **Max** | **Normal** | **Max** |
| **Agricultural** | | | | |
| *Irrigation* | | | | |
| Alfalfa | 9,000 | 12,000 | 10,000 | 14,000 |
| Other hay | 71,000 | 92,000 | 86,000 | 112,000 |
| Irrigated pasture | 41,000 | 56,000 | 49,000 | 68,000 |
| Corn | 0 | 0 | 0 | 0 |
| Sugar beets | 0 | 0 | 0 | 0 |
| Dry beans | 0 | 0 | 0 | 0 |
| Oats | 0 | 0 | 0 | 0 |
| Barley | 0 | 1,000 | 1,000 | 1,000 |
| Winter wheat | 0 | 0 | 0 | 0 |
| Spring wheat | 0 | 0 | 0 | 0 |
| *Subtotal* | 121,000 | 161,000 | 146,000 | 195,000 |
| *Livestock* | 1,000 | 1,000 | 1,200 | 1,200 |
| **Municipal/Rural Domestic** | 3,100 | 4,400 | 4,000 | 5,500 |
| **Industrial** | | | | |
| *Oil refining and production* | 15,500 | 15,500 | 18,600 | 18,600 |
| *Coal and uranium mining* | 300 | 300 | 13,700 | 13,700 |
| *Power generation* | 0 | 0 | 0 | 0 |
| *Miscellaneous and other* | 3,100 | 3,100 | 3,700 | 3,700 |
| **Total Water Usage** | 144,000 | 185,300 | 187,200 | 237,700 |
| Surface Water | 118,800 | 155,400 | 143,500 | 188,300 |
| Ground Water | 25,200 | 29,900 | 43,700 | 49,400 |
| Share Water Usage | | | | |
| Surface Water | 83% | 84% | 77% | 79% |
| Ground Water | 18% | 16% | 23% | 21% |

Source: Harvey Economics, 2016.

Exhibit 4-A-3: Above Pathfinder Dam Subbasin Current and Projected Annual Water Demand Annual Diversions in Acre-Feet per Year, Low Scenario

| | Current (2015) | | Projected (2045) | |
|---|---|---|---|---|
| **Economic Sector** | **Normal** | **Max** | **Normal** | **Max** |
| **Agricultural** | | | | |
| *Irrigation* | | | | |
| Alfalfa | 20,000 | 27,000 | 14,000 | 19,000 |
| Other hay | 164,000 | 216,000 | 115,000 | 151,000 |
| Irrigated pasture | 94,000 | 132,000 | 66,000 | 92,000 |
| Corn | 0 | 0 | 0 | 0 |
| Sugar beets | 0 | 0 | 0 | 0 |
| Dry beans | 0 | 0 | 0 | 0 |
| Oats | 0 | 1,000 | 0 | 0 |
| Barley | 1,000 | 1,000 | 1,000 | 1,000 |
| Winter wheat | 0 | 0 | 0 | 0 |
| Spring wheat | 0 | 0 | 0 | 0 |
| *Subtotal* | 279,000 | 377,000 | 196,000 | 263,000 |
| *Livestock* | 1,000 | 1,000 | 800 | 800 |
| **Municipal/Rural Domestic** | 6,300 | 8,700 | 6,800 | 9,500 |
| **Industrial** | | | | |
| *Oil refining and production* | 15,500 | 15,500 | 15,500 | 15,500 |
| *Coal and uranium mining* | 300 | 300 | 300 | 300 |
| *Power generation* | 0 | 0 | 0 | 0 |
| *Miscellaneous and other* | 3,100 | 3,100 | 3,100 | 3,100 |
| **Total Water Usage** | 305,200 | 405,600 | 222,500 | 292,200 |
| Surface Water | 267,000 | 356,200 | 190,600 | 252,400 |
| Ground Water | 38,200 | 49,400 | 31,900 | 39,800 |
| Share Water Usage | | | | |
| Surface Water | 87% | 88% | 86% | 86% |
| Ground Water | 13% | 12% | 14% | 14% |

Source: Harvey Economics, 2016.

Exhibit 4-A-4: Above Pathfinder Dam Subbasin Current and Projected Annual Water Demand Annual Consumptive Use in Acre-Feet per Year, Low Scenario

| | Current (2015) | | Projected (2045) | |
|---|---|---|---|---|
| **Economic Sector** | **Normal** | **Max** | **Normal** | **Max** |
| **Agricultural** | | | | |
| *Irrigation* | | | | |
| Alfalfa | 9,000 | 12,000 | 6,000 | 8,000 |
| Other hay | 71,000 | 92,000 | 50,000 | 66,000 |
| Irrigated pasture | 41,000 | 56,000 | 29,000 | 40,000 |
| Corn | 0 | 0 | 0 | 0 |
| Sugar beets | 0 | 0 | 0 | 0 |
| Dry beans | 0 | 0 | 0 | 0 |
| Oats | 0 | 0 | 0 | 0 |
| Barley | 0 | 1,000 | 0 | 0 |
| Winter wheat | 0 | 0 | 0 | 0 |
| Spring wheat | 0 | 0 | 0 | 0 |
| *Subtotal* | 121,000 | 161,000 | 85,000 | 114,000 |
| *Livestock* | 1,000 | 1,000 | 800 | 800 |
| **Municipal/Rural Domestic** | 3,100 | 4,400 | 3,400 | 4,700 |
| **Industrial** | | | | |
| *Oil refining and production* | 15,500 | 15,500 | 15,500 | 15,500 |
| *Coal and uranium mining* | 300 | 300 | 300 | 300 |
| *Power generation* | 0 | 0 | 0 | 0 |
| *Miscellaneous and other* | 3,100 | 3,100 | 3,100 | 3,100 |
| **Total Water Usage** | 144,000 | 185,300 | 108,100 | 138,400 |
| Surface Water | 118,800 | 155,400 | 85,600 | 112,500 |
| Ground Water | 25,200 | 29,900 | 22,500 | 25,900 |
| Share Water Usage | | | | |
| Surface Water | 83% | 84% | 79% | 81% |
| Ground Water | 18% | 16% | 21% | 19% |

Source: Harvey Economics, 2016.

Exhibit 4-A-5: Above Pathfinder Dam Subbasin Current and Projected Annual Water Demand Annual Diversions in Acre-Feet per Year, Mid Scenario

| | Current (2015) | | Projected (2045) | |
|---|---|---|---|---|
| **Economic Sector** | **Normal** | **Max** | **Normal** | **Max** |
| **Agricultural** | | | | |
| *Irrigation* | | | | |
| Alfalfa | 20,000 | 27,000 | 17,000 | 23,000 |
| Other hay | 164,000 | 216,000 | 141,000 | 185,000 |
| Irrigated pasture | 94,000 | 132,000 | 81,000 | 113,000 |
| Corn | 0 | 0 | 0 | 0 |
| Sugar beets | 0 | 0 | 0 | 0 |
| Dry beans | 0 | 0 | 0 | 0 |
| Oats | 0 | 1,000 | 0 | 0 |
| Barley | 1,000 | 1,000 | 1,000 | 1,000 |
| Winter wheat | 0 | 0 | 0 | 0 |
| Spring wheat | 0 | 0 | 0 | 0 |
| *Subtotal* | 279,000 | 377,000 | 240,000 | 322,000 |
| *Livestock* | 1,000 | 1,000 | 1,000 | 1,000 |
| **Municipal/Rural Domestic** | 6,300 | 8,700 | 7,600 | 10,500 |
| **Industrial** | | | | |
| *Oil refining and production* | 15,500 | 15,500 | 17,100 | 17,100 |
| *Coal and uranium mining* | 300 | 300 | 3,500 | 3,500 |
| *Power generation* | 0 | 0 | 0 | 0 |
| *Miscellaneous and other* | 3,100 | 3,100 | 3,200 | 3,200 |
| **Total Water Usage** | 305,200 | 405,600 | 272,400 | 357,300 |
| Surface Water | 267,000 | 356,200 | 232,300 | 307,500 |
| Ground Water | 38,200 | 49,400 | 40,100 | 49,800 |
| Share Water Usage | | | | |
| Surface Water | 87% | 88% | 85% | 86% |
| Ground Water | 13% | 12% | 15% | 14% |

Source: Harvey Economics, 2016.

Exhibit 4-A-6: Above Pathfinder Dam Subbasin Current and Projected Annual Water Demand Annual Consumptive Use in Acre-Feet per Year, Mid Scenario

| | Current (2015) | | Projected (2045) | |
|---|---|---|---|---|
| **Economic Sector** | **Normal** | **Max** | **Normal** | **Max** |
| **Agricultural** | | | | |
| *Irrigation* | | | | |
| Alfalfa | 9,000 | 12,000 | 7,000 | 10,000 |
| Other hay | 71,000 | 92,000 | 61,000 | 80,000 |
| Irrigated pasture | 41,000 | 56,000 | 35,000 | 49,000 |
| Corn | 0 | 0 | 0 | 0 |
| Sugar beets | 0 | 0 | 0 | 0 |
| Dry beans | 0 | 0 | 0 | 0 |
| Oats | 0 | 0 | 0 | 0 |
| Barley | 0 | 1,000 | 0 | 0 |
| Winter wheat | 0 | 0 | 0 | 0 |
| Spring wheat | 0 | 0 | 0 | 0 |
| *Subtotal* | 121,000 | 161,000 | 103,000 | 139,000 |
| *Livestock* | 1,000 | 1,000 | 1,000 | 1,000 |
| **Municipal/Rural Domestic** | 3,100 | 4,400 | 3,800 | 5,100 |
| **Industrial** | | | | |
| *Oil refining and production* | 15,500 | 15,500 | 17,100 | 17,100 |
| *Coal and uranium mining* | 300 | 300 | 3,500 | 3,500 |
| *Power generation* | 0 | 0 | 0 | 0 |
| *Miscellaneous and other* | 3,100 | 3,100 | 3,200 | 3,200 |
| **Total Water Usage** | 144,000 | 185,300 | 131,600 | 168,900 |
| Surface Water | 118,800 | 155,400 | 103,000 | 136,000 |
| Ground Water | 25,200 | 29,900 | 28,600 | 32,900 |
| Share Water Usage | | | | |
| Surface Water | 83% | 84% | 78% | 81% |
| Ground Water | 18% | 16% | 22% | 19% |

Source: Harvey Economics, 2016.

Exhibit 4-A-7: Pathfinder to Guernsey Subbasin Current and Projected Annual Water Demand Annual Diversions in Acre-Feet per Year, High Scenario

| | Current (2015) | | Projected (2045) | |
|---|---|---|---|---|
| **Economic Sector** | **Normal** | **Max** | **Normal** | **Max** |
| **Agricultural** | | | | |
| *Irrigation* | | | | |
| Alfalfa | 98,000 | 119,000 | 137,000 | 167,000 |
| Other hay | 36,000 | 57,000 | 50,000 | 79,000 |
| Irrigated pasture | 24,000 | 43,000 | 33,000 | 60,000 |
| Corn | 4,000 | 4,000 | 5,000 | 6,000 |
| Sugar beets | 2,000 | 2,000 | 2,000 | 2,000 |
| Dry beans | 2,000 | 2,000 | 2,000 | 3,000 |
| Oats | 7,000 | 6,000 | 9,000 | 9,000 |
| Barley | 4,000 | 4,000 | 5,000 | 6,000 |
| Winter wheat | 0 | 1,000 | 1,000 | 1,000 |
| Spring wheat | 0 | 1,000 | 1,000 | 1,000 |
| *Subtotal* | 177,000 | 239,000 | 245,000 | 334,000 |
| *Livestock* | 1,500 | 1,500 | 1,800 | 1,800 |
| **Municipal/Rural Domestic** | 21,000 | 30,500 | 40,000 | 58,500 |
| **Industrial** | | | | |
| *Oil refining and production* | 25,000 | 25,000 | 30,000 | 30,000 |
| *Coal and uranium mining* | 28,300 | 28,300 | 38,300 | 38,300 |
| *Power generation* | 8,000 | 8,000 | 18,000 | 18,000 |
| *Miscellaneous and other* | 23,900 | 23,900 | 27,500 | 27,500 |
| **Total Water Usage** | 284,700 | 356,200 | 400,600 | 508,100 |
| Surface Water | 188,400 | 250,800 | 267,100 | 360,400 |
| Ground Water | 96,300 | 105,400 | 133,500 | 147,700 |
| Share Water Usage | | | | |
| Surface Water | 66% | 70% | 67% | 71% |
| Ground Water | 34% | 30% | 33% | 29% |

Source: Harvey Economics, 2016.

Exhibit 4-A-8: Pathfinder to Guernsey Subbasin Current and Projected Annual Water Demand Annual Consumptive Use in Acre-Feet per Year, High Scenario

| | Current (2015) | | Projected (2045) | |
|---|---|---|---|---|
| **Economic Sector** | **Normal** | **Max** | **Normal** | **Max** |
| **Agricultural** | | | | |
| *Irrigation* | | | | |
| Alfalfa | 42,000 | 51,000 | 58,000 | 71,000 |
| Other hay | 15,000 | 24,000 | 21,000 | 34,000 |
| Irrigated pasture | 10,000 | 18,000 | 14,000 | 25,000 |
| Corn | 2,000 | 2,000 | 2,000 | 3,000 |
| Sugar beets | 1,000 | 1,000 | 1,000 | 1,000 |
| Dry beans | 1,000 | 1,000 | 1,000 | 1,000 |
| Oats | 3,000 | 3,000 | 4,000 | 4,000 |
| Barley | 2,000 | 2,000 | 2,000 | 2,000 |
| Winter wheat | 0 | 0 | 0 | 1,000 |
| Spring wheat | 0 | 0 | 0 | 0 |
| *Subtotal* | 76,000 | 102,000 | 103,000 | 142,000 |
| *Livestock* | 1,500 | 1,500 | 1,800 | 1,800 |
| **Municipal/Rural Domestic** | 10,700 | 15,500 | 20,000 | 29,300 |
| **Industrial** | | | | |
| *Oil refining and production* | 25,000 | 25,000 | 30,000 | 30,000 |
| *Coal and uranium mining* | 28,300 | 28,300 | 38,300 | 38,300 |
| *Power generation* | 8,000 | 8,000 | 18,000 | 18,000 |
| *Miscellaneous and other* | 23,900 | 23,900 | 27,500 | 27,500 |
| **Total Water Usage** | 173,400 | 204,200 | 238,600 | 286,900 |
| Surface Water | 87,400 | 114,200 | 121,000 | 162,800 |
| Ground Water | 86,000 | 90,000 | 117,600 | 124,100 |
| Share Water Usage | | | | |
| Surface Water | 50% | 56% | 51% | 57% |
| Ground Water | 50% | 44% | 49% | 43% |

Source: Harvey Economics, 2016.

Exhibit 4-A-9: Pathfinder to Guernsey Subbasin Current and Projected Annual Water Demand Annual Diversions in Acre-Feet per Year, Low Scenario

| | Current (2015) | | Projected (2045) | |
|---|---|---|---|---|
| **Economic Sector** | **Normal** | **Max** | **Normal** | **Max** |
| **Agricultural** | | | | |
| *Irrigation* | | | | |
| Alfalfa | 98,000 | 119,000 | 55,000 | 67,000 |
| Other hay | 36,000 | 57,000 | 20,000 | 32,000 |
| Irrigated pasture | 24,000 | 43,000 | 13,000 | 24,000 |
| Corn | 4,000 | 4,000 | 2,000 | 2,000 |
| Sugar beets | 2,000 | 2,000 | 1,000 | 1,000 |
| Dry beans | 2,000 | 2,000 | 1,000 | 1,000 |
| Oats | 7,000 | 6,000 | 4,000 | 4,000 |
| Barley | 4,000 | 4,000 | 2,000 | 2,000 |
| Winter wheat | 0 | 1,000 | 0 | 1,000 |
| Spring wheat | 0 | 1,000 | 0 | 0 |
| *Subtotal* | 177,000 | 239,000 | 98,000 | 134,000 |
| *Livestock* | 1,500 | 1,500 | 1,100 | 1,100 |
| **Municipal/Rural Domestic** | 21,000 | 30,500 | 25,100 | 36,860 |
| **Industrial** | | | | |
| *Oil refining and production* | 25,000 | 25,000 | 25,000 | 25,000 |
| *Coal and uranium mining* | 28,300 | 28,300 | 28,300 | 28,300 |
| *Power generation* | 8,000 | 8,000 | 8,000 | 8,000 |
| *Miscellaneous and other* | 23,900 | 23,900 | 23,400 | 23,400 |
| **Total Water Usage** | 284,700 | 356,200 | 208,900 | 256,660 |
| Surface Water | 188,400 | 250,800 | 118,200 | 159,200 |
| Ground Water | 96,300 | 105,400 | 90,700 | 97,460 |
| Share Water Usage | | | | |
| Surface Water | 66% | 70% | 57% | 62% |
| Ground Water | 34% | 30% | 43% | 38% |

Source: Harvey Economics, 2016.

Exhibit 4-A-10: Pathfinder to Guernsey Subbasin Current and Projected Annual Water Demand Annual Consumptive Use in Acre-Feet per Year, Low Scenario

| | Current (2015) | | Projected (2045) | |
|---|---|---|---|---|
| **Economic Sector** | **Normal** | **Max** | **Normal** | **Max** |
| **Agricultural** | | | | |
| *Irrigation* | | | | |
| Alfalfa | 42,000 | 51,000 | 24,000 | 29,000 |
| Other hay | 15,000 | 24,000 | 9,000 | 14,000 |
| Irrigated pasture | 10,000 | 18,000 | 6,000 | 10,000 |
| Corn | 2,000 | 2,000 | 1,000 | 1,000 |
| Sugar beets | 1,000 | 1,000 | 0 | 0 |
| Dry beans | 1,000 | 1,000 | 0 | 1,000 |
| Oats | 3,000 | 3,000 | 2,000 | 2,000 |
| Barley | 2,000 | 2,000 | 1,000 | 1,000 |
| Winter wheat | 0 | 0 | 0 | 0 |
| Spring wheat | 0 | 0 | 0 | 0 |
| *Subtotal* | 76,000 | 102,000 | 43,000 | 58,000 |
| *Livestock* | 1,500 | 1,500 | 1,100 | 1,100 |
| **Municipal/Rural Domestic** | 10,700 | 15,500 | 12,630 | 18,490 |
| **Industrial** | | | | |
| *Oil refining and production* | 25,000 | 25,000 | 25,000 | 25,000 |
| *Coal and uranium mining* | 28,300 | 28,300 | 28,300 | 28,300 |
| *Power generation* | 8,000 | 8,000 | 8,000 | 8,000 |
| *Miscellaneous and other* | 23,900 | 23,900 | 23,400 | 23,400 |
| **Total Water Usage** | 173,400 | 204,200 | 141,430 | 162,290 |
| Surface Water | 87,400 | 114,200 | 58,100 | 75,900 |
| Ground Water | 86,000 | 90,000 | 83,330 | 86,390 |
| Share Water Usage | | | | |
| Surface Water | 50% | 56% | 41% | 47% |
| Ground Water | 50% | 44% | 59% | 53% |

Source: Harvey Economics, 2016.

Exhibit 4-A-11: Pathfinder to Guernsey Subbasin Current and Projected Annual Water Demand Annual Diversions in Acre-Feet per Year, Mid Scenario

| | Current (2015) | | Projected (2045) | |
|---|---|---|---|---|
| **Economic Sector** | **Normal** | **Max** | **Normal** | **Max** |
| **Agricultural** | | | | |
| *Irrigation* | | | | |
| Alfalfa | 98,000 | 119,000 | 77,000 | 93,000 |
| Other hay | 36,000 | 57,000 | 28,000 | 44,000 |
| Irrigated pasture | 24,000 | 43,000 | 19,000 | 33,000 |
| Corn | 4,000 | 4,000 | 3,000 | 3,000 |
| Sugar beets | 2,000 | 2,000 | 1,000 | 1,000 |
| Dry beans | 2,000 | 2,000 | 1,000 | 2,000 |
| Oats | 7,000 | 6,000 | 5,000 | 5,000 |
| Barley | 4,000 | 4,000 | 3,000 | 3,000 |
| Winter wheat | 0 | 1,000 | 0 | 1,000 |
| Spring wheat | 0 | 1,000 | 0 | 1,000 |
| *Subtotal* | 177,000 | 239,000 | 137,000 | 186,000 |
| *Livestock* | 1,500 | 1,500 | 1,500 | 1,500 |
| **Municipal/Rural Domestic** | 21,000 | 30,500 | 30,000 | 43,600 |
| **Industrial** | | | | |
| *Oil refining and production* | 25,000 | 25,000 | 27,500 | 27,500 |
| *Coal and uranium mining* | 28,300 | 28,300 | 35,100 | 35,100 |
| *Power generation* | 8,000 | 8,000 | 8,000 | 8,000 |
| *Miscellaneous and other* | 23,900 | 23,900 | 25,000 | 25,000 |
| **Total Water Usage** | 284,700 | 356,200 | 264,100 | 326,700 |
| Surface Water | 188,400 | 250,800 | 158,700 | 212,600 |
| Ground Water | 96,300 | 105,400 | 105,400 | 114,100 |
| Share Water Usage | | | | |
| Surface Water | 66% | 70% | 60% | 65% |
| Ground Water | 34% | 30% | 40% | 35% |

Source: Harvey Economics, 2016.

Exhibit 4-A-12: Pathfinder to Guernsey Subbasin Current and Projected Annual Water Demand Annual Consumptive Use in Acre-Feet per Year, Mid Scenario

| | Current (2015) | | Projected (2045) | |
|---|---|---|---|---|
| **Economic Sector** | **Normal** | **Max** | **Normal** | **Max** |
| **Agricultural** | | | | |
| *Irrigation* | | | | |
| Alfalfa | 42,000 | 51,000 | 33,000 | 40,000 |
| Other hay | 15,000 | 24,000 | 12,000 | 19,000 |
| Irrigated pasture | 10,000 | 18,000 | 8,000 | 14,000 |
| Corn | 2,000 | 2,000 | 1,000 | 1,000 |
| Sugar beets | 1,000 | 1,000 | 0 | 1,000 |
| Dry beans | 1,000 | 1,000 | 1,000 | 1,000 |
| Oats | 3,000 | 3,000 | 2,000 | 2,000 |
| Barley | 2,000 | 2,000 | 1,000 | 1,000 |
| Winter wheat | 0 | 0 | 0 | 0 |
| Spring wheat | 0 | 0 | 0 | 0 |
| *Subtotal* | 76,000 | 102,000 | 58,000 | 79,000 |
| *Livestock* | 1,500 | 1,500 | 1,500 | 1,500 |
| **Municipal/Rural Domestic** | 10,700 | 15,500 | 15,000 | 21,800 |
| **Industrial** | | | | |
| *Oil refining and production* | 25,000 | 25,000 | 27,500 | 27,500 |
| *Coal and uranium mining* | 28,300 | 28,300 | 35,100 | 35,100 |
| *Power generation* | 8,000 | 8,000 | 8,000 | 8,000 |
| *Miscellaneous and other* | 23,900 | 23,900 | 25,000 | 25,000 |
| **Total Water Usage** | 173,400 | 204,200 | 170,100 | 197,900 |
| Surface Water | 87,400 | 114,200 | 74,500 | 98,400 |
| Ground Water | 86,000 | 90,000 | 95,600 | 99,500 |
| Share Water Usage | | | | |
| Surface Water | 50% | 56% | 44% | 50% |
| Ground Water | 50% | 44% | 56% | 50% |

Source: Harvey Economics, 2016.



WENCK ASSOCIATES
Responsive partner. Exceptional outcomes.

Exhibit 4-A-13: Guernsey to State Line Subbasin Current and Projected Annual Water Demand Annual Diversions in Acre-Feet per Year, High Scenario

| | Current (2015) | | Projected (2045) | |
|---|---|---|---|---|
| **Economic Sector** | **Normal** | **Max** | **Normal** | **Max** |
| **Agricultural** | | | | |
| *Irrigation* | | | | |
| Alfalfa | 68,000 | 109,000 | 72,000 | 115,000 |
| Other hay | 25,000 | 28,000 | 26,000 | 30,000 |
| Irrigated pasture | 31,000 | 37,000 | 33,000 | 40,000 |
| Corn | 66,000 | 89,000 | 70,000 | 94,000 |
| Sugar beets | 33,000 | 44,000 | 35,000 | 47,000 |
| Dry beans | 17,000 | 25,000 | 18,000 | 26,000 |
| Oats | 2,000 | 3,000 | 2,000 | 3,000 |
| Barley | 5,000 | 7,000 | 5,000 | 8,000 |
| Winter wheat | 2,000 | 3,000 | 2,000 | 3,000 |
| Spring wheat | 0 | 0 | 0 | 0 |
| *Subtotal* | 249,000 | 345,000 | 263,000 | 366,000 |
| *Livestock* | 700 | 700 | 800 | 800 |
| **Municipal/Rural Domestic** | 3,600 | 5,300 | 4,700 | 6,900 |
| **Industrial** | | | | |
| *Oil refining and production* | 800 | 800 | 1,000 | 1,000 |
| *Coal and uranium mining* | 0 | 0 | 0 | 0 |
| *Power generation* | 0 | 0 | 0 | 0 |
| *Miscellaneous and other* | 3,400 | 3,400 | 4,000 | 4,000 |
| **Total Water Usage** | 257,500 | 355,200 | 273,500 | 378,700 |
| Surface Water | 233,200 | 320,400 | 247,400 | 341,200 |
| Ground Water | 24,300 | 34,800 | 26,100 | 37,500 |
| Share Water Usage | | | | |
| Surface Water | 91% | 90% | 90% | 90% |
| Ground Water | 9% | 10% | 10% | 10% |

Source: Harvey Economics, 2016.

Exhibit 4-A-14: Guernsey to State Line Subbasin Current and Projected Annual Water Demand Annual Consumptive Use in Acre-Feet per Year, High Scenario

| | Current (2015) | | Projected (2045) | |
|---|---|---|---|---|
| **Economic Sector** | **Normal** | **Max** | **Normal** | **Max** |
| **Agricultural** | | | | |
| *Irrigation* | | | | |
| Alfalfa | 29,000 | 46,000 | 31,000 | 49,000 |
| Other hay | 11,000 | 12,000 | 11,000 | 13,000 |
| Irrigated pasture | 13,000 | 16,000 | 14,000 | 17,000 |
| Corn | 29,000 | 38,000 | 30,000 | 40,000 |
| Sugar beets | 14,000 | 19,000 | 15,000 | 20,000 |
| Dry beans | 7,000 | 11,000 | 8,000 | 11,000 |
| Oats | 1,000 | 1,000 | 1,000 | 1,000 |
| Barley | 2,000 | 3,000 | 2,000 | 3,000 |
| Winter wheat | 1,000 | 1,000 | 1,000 | 1,000 |
| Spring wheat | 0 | 0 | 0 | 0 |
| *Subtotal* | 107,000 | 147,000 | 113,000 | 155,000 |
| *Livestock* | 700 | 700 | 800 | 800 |
| **Municipal/Rural Domestic** | 1,800 | 2,700 | 2,500 | 3,600 |
| **Industrial** | | | | |
| *Oil refining and production* | 800 | 800 | 1,000 | 1,000 |
| *Coal and uranium mining* | 0 | 0 | 0 | 0 |
| *Power generation* | 0 | 0 | 0 | 0 |
| *Miscellaneous and other* | 3,400 | 3,400 | 4,000 | 4,000 |
| **Total Water Usage** | 113,700 | 154,600 | 121,300 | 164,400 |
| Surface Water | 100,800 | 137,200 | 107,300 | 145,600 |
| Ground Water | 12,900 | 17,400 | 14,000 | 18,800 |
| Share Water Usage | | | | |
| Surface Water | 89% | 89% | 88% | 89% |
| Ground Water | 11% | 11% | 12% | 11% |

Source: Harvey Economics, 2016.

Exhibit 4-A-15: Guernsey to State Line Subbasin Current and Projected Annual Water Demand Annual Diversions in Acre-Feet per Year, Low Scenario

| | Current (2015) | | Projected (2045) | |
|---|---|---|---|---|
| **Economic Sector** | **Normal** | **Max** | **Normal** | **Max** |
| **Agricultural** | | | | |
| *Irrigation* | | | | |
| Alfalfa | 68,000 | 109,000 | 62,000 | 98,000 |
| Other hay | 25,000 | 28,000 | 22,000 | 25,000 |
| Irrigated pasture | 31,000 | 37,000 | 28,000 | 34,000 |
| Corn | 66,000 | 89,000 | 60,000 | 80,000 |
| Sugar beets | 33,000 | 44,000 | 30,000 | 40,000 |
| Dry beans | 17,000 | 25,000 | 15,000 | 22,000 |
| Oats | 2,000 | 3,000 | 2,000 | 2,000 |
| Barley | 5,000 | 7,000 | 5,000 | 7,000 |
| Winter wheat | 2,000 | 3,000 | 2,000 | 3,000 |
| Spring wheat | 0 | 0 | 0 | 0 |
| *Subtotal* | 249,000 | 345,000 | 226,000 | 311,000 |
| *Livestock* | 700 | 700 | 700 | 700 |
| **Municipal/Rural Domestic** | 3,600 | 5,300 | 3,900 | 5,700 |
| **Industrial** | | | | |
| *Oil refining and production* | 800 | 800 | 800 | 800 |
| *Coal and uranium mining* | 0 | 0 | 0 | 0 |
| *Power generation* | 0 | 0 | 0 | 0 |
| *Miscellaneous and other* | 3,400 | 3,400 | 2,600 | 2,600 |
| **Total Water Usage** | 257,500 | 355,200 | 234,000 | 320,800 |
| Surface Water | 233,200 | 320,400 | 212,300 | 289,600 |
| Ground Water | 24,300 | 34,800 | 21,700 | 31,200 |
| Share Water Usage | | | | |
| Surface Water | 91% | 90% | 91% | 90% |
| Ground Water | 9% | 10% | 9% | 10% |

Source: Harvey Economics, 2016.

Exhibit 4-A-16: Guernsey to State Line Subbasin Current and Projected Annual Water Demand Annual Consumptive Use in Acre-Feet per Year, Low Scenario

| | Current (2015) | | Projected (2045) | |
|---|---|---|---|---|
| **Economic Sector** | **Normal** | **Max** | **Normal** | **Max** |
| **Agricultural** | | | | |
| *Irrigation* | | | | |
| Alfalfa | 29,000 | 46,000 | 27,000 | 43,000 |
| Other hay | 11,000 | 12,000 | 10,000 | 11,000 |
| Irrigated pasture | 13,000 | 16,000 | 12,000 | 15,000 |
| Corn | 29,000 | 38,000 | 26,000 | 35,000 |
| Sugar beets | 14,000 | 19,000 | 13,000 | 17,000 |
| Dry beans | 7,000 | 11,000 | 7,000 | 10,000 |
| Oats | 1,000 | 1,000 | 1,000 | 1,000 |
| Barley | 2,000 | 3,000 | 2,000 | 3,000 |
| Winter wheat | 1,000 | 1,000 | 1,000 | 1,000 |
| Spring wheat | 0 | 0 | 0 | 0 |
| *Subtotal* | 107,000 | 147,000 | 99,000 | 136,000 |
| *Livestock* | 700 | 700 | 700 | 700 |
| **Municipal/Rural Domestic** | 1,800 | 2,700 | 2,000 | 3,000 |
| **Industrial** | | | | |
| *Oil refining and production* | 800 | 800 | 800 | 800 |
| *Coal and uranium mining* | 0 | 0 | 0 | 0 |
| *Power generation* | 0 | 0 | 0 | 0 |
| *Miscellaneous and other* | 3,400 | 3,400 | 2,600 | 2,600 |
| **Total Water Usage** | 113,700 | 154,600 | 105,100 | 143,100 |
| Surface Water | 100,800 | 137,200 | 93,700 | 127,500 |
| Ground Water | 12,900 | 17,400 | 11,400 | 15,600 |
| Share Water Usage | | | | |
| Surface Water | 89% | 89% | 89% | 89% |
| Ground Water | 11% | 11% | 11% | 11% |

Source: Harvey Economics, 2016.

Exhibit 4-A-17: Guernsey to State Line Subbasin Current and Projected Annual Water Demand Annual Diversions in Acre-Feet per Year, Mid Scenario

| | Current (2015) | | Projected (2045) | |
|---|---|---|---|---|
| **Economic Sector** | **Normal** | **Max** | **Normal** | **Max** |
| **Agricultural** | | | | |
| *Irrigation* | | | | |
| Alfalfa | 68,000 | 109,000 | 66,000 | 104,000 |
| Other hay | 25,000 | 28,000 | 24,000 | 27,000 |
| Irrigated pasture | 31,000 | 37,000 | 30,000 | 36,000 |
| Corn | 66,000 | 89,000 | 63,000 | 85,000 |
| Sugar beets | 33,000 | 44,000 | 32,000 | 42,000 |
| Dry beans | 17,000 | 25,000 | 16,000 | 24,000 |
| Oats | 2,000 | 3,000 | 2,000 | 3,000 |
| Barley | 5,000 | 7,000 | 5,000 | 7,000 |
| Winter wheat | 2,000 | 3,000 | 2,000 | 3,000 |
| Spring wheat | 0 | 0 | 0 | 0 |
| *Subtotal* | 249,000 | 345,000 | 240,000 | 331,000 |
| *Livestock* | 700 | 700 | 700 | 700 |
| **Municipal/Rural Domestic** | 3,600 | 5,300 | 4,100 | 6,200 |
| **Industrial** | | | | |
| *Oil refining and production* | 800 | 800 | 900 | 900 |
| *Coal and uranium mining* | 0 | 0 | 0 | 0 |
| *Power generation* | 0 | 0 | 0 | 0 |
| *Miscellaneous and other* | 3,400 | 3,400 | 2,700 | 2,700 |
| **Total Water Usage** | 257,500 | 355,200 | 248,400 | 341,500 |
| Surface Water | 233,200 | 320,400 | 225,500 | 308,400 |
| Ground Water | 24,300 | 34,800 | 22,900 | 33,100 |
| Share Water Usage | | | | |
| Surface Water | 91% | 90% | 91% | 90% |
| Ground Water | 9% | 10% | 9% | 10% |

Source: Harvey Economics, 2016.

Exhibit 4-A-18: Guernsey to State Line Subbasin Current and Projected Annual Water Demand Annual Consumptive Use in Acre-Feet per Year, Mid Scenario

| | Current (2015) | | Projected (2045) | |
|---|---|---|---|---|
| **Economic Sector** | **Normal** | **Max** | **Normal** | **Max** |
| **Agricultural** | | | | |
| *Irrigation* | | | | |
| Alfalfa | 29,000 | 46,000 | 28,000 | 45,000 |
| Other hay | 11,000 | 12,000 | 10,000 | 11,000 |
| Irrigated pasture | 13,000 | 16,000 | 13,000 | 15,000 |
| Corn | 29,000 | 38,000 | 28,000 | 37,000 |
| Sugar beets | 14,000 | 19,000 | 14,000 | 18,000 |
| Dry beans | 7,000 | 11,000 | 7,000 | 10,000 |
| Oats | 1,000 | 1,000 | 1,000 | 1,000 |
| Barley | 2,000 | 3,000 | 2,000 | 3,000 |
| Winter wheat | 1,000 | 1,000 | 1,000 | 1,000 |
| Spring wheat | 0 | 0 | 0 | 0 |
| *Subtotal* | 107,000 | 147,000 | 104,000 | 141,000 |
| *Livestock* | 700 | 700 | 700 | 700 |
| **Municipal/Rural Domestic** | 1,800 | 2,700 | 2,100 | 3,200 |
| **Industrial** | | | | |
| *Oil refining and production* | 800 | 800 | 900 | 900 |
| *Coal and uranium mining* | 0 | 0 | 0 | 0 |
| *Power generation* | 0 | 0 | 0 | 0 |
| *Miscellaneous and other* | 3,400 | 3,400 | 2,700 | 2,700 |
| **Total Water Usage** | 113,700 | 154,600 | 110,400 | 148,500 |
| Surface Water | 100,800 | 137,200 | 98,400 | 132,300 |
| Ground Water | 12,900 | 17,400 | 12,000 | 16,200 |
| Share Water Usage | | | | |
| Surface Water | 89% | 89% | 89% | 89% |
| Ground Water | 11% | 11% | 11% | 11% |

Source: Harvey Economics, 2016.

Exhibit 4-A-19: Upper Laramie Subbasin Current and Projected Annual Water Demand
Annual Diversions in Acre-Feet per Year, Low Scenario

| | Current (2015) | | Projected (2045) | |
|---|---|---|---|---|
| **Economic Sector** | **Normal** | **Max** | **Normal** | **Max** |
| **Agricultural** | | | | |
| *Irrigation* | | | | |
| Alfalfa | 7,000 | 10,000 | 7,000 | 10,000 |
| Other hay | 112,000 | 177,000 | 113,000 | 179,000 |
| Irrigated pasture | 69,000 | 121,000 | 70,000 | 123,000 |
| Corn | 0 | 0 | 0 | 0 |
| Sugar beets | 0 | 0 | 0 | 0 |
| Dry beans | 0 | 0 | 0 | 0 |
| Oats | 0 | 0 | 0 | 0 |
| Barley | 0 | 0 | 0 | 0 |
| Winter wheat | 0 | 0 | 0 | 0 |
| Spring wheat | 0 | 0 | 0 | 0 |
| *Subtotal* | 188,000 | 308,000 | 190,000 | 312,000 |
| *Livestock* | 600 | 600 | 600 | 600 |
| **Municipal/Rural Domestic** | 7,100 | 10,600 | 9,100 | 13,500 |
| **Industrial** | | | | |
| *Oil refining and production* | 100 | 100 | 100 | 100 |
| *Coal and uranium mining* | 0 | 0 | 0 | 0 |
| *Power generation* | 0 | 0 | 0 | 0 |
| *Miscellaneous and other* | 2,700 | 2,700 | 3,600 | 3,600 |
| **Total Water Usage** | 198,500 | 322,000 | 203,400 | 329,800 |
| Surface Water | 180,400 | 291,300 | 184,200 | 297,600 |
| Ground Water | 18,100 | 30,700 | 19,200 | 32,200 |
| Share Water Usage | | | | |
| Surface Water | 91% | 90% | 91% | 90% |
| Ground Water | 9% | 10% | 9% | 10% |

Source: Harvey Economics, 2016.

Exhibit 4-A-20: Upper Laramie Subbasin Current and Projected Annual Water Demand
Annual Consumptive Use in Acre-Feet per Year, Low Scenario

| | Current (2015) | | Projected (2045) | |
|---|---|---|---|---|
| **Economic Sector** | **Normal** | **Max** | **Normal** | **Max** |
| **Agricultural** | | | | |
| *Irrigation* | | | | |
| Alfalfa | 3,000 | 4,000 | 3,000 | 4,000 |
| Other hay | 48,000 | 75,000 | 48,000 | 75,000 |
| Irrigated pasture | 30,000 | 52,000 | 30,000 | 52,000 |
| Corn | 0 | 0 | 0 | 0 |
| Sugar beets | 0 | 0 | 0 | 0 |
| Dry beans | 0 | 0 | 0 | 0 |
| Oats | 0 | 0 | 0 | 0 |
| Barley | 0 | 0 | 0 | 0 |
| Winter wheat | 0 | 0 | 0 | 0 |
| Spring wheat | 0 | 0 | 0 | 0 |
| *Subtotal* | 81,000 | 131,000 | 81,000 | 131,000 |
| *Livestock* | 600 | 600 | 600 | 600 |
| **Municipal/Rural Domestic** | 3,600 | 5,300 | 4,500 | 6,700 |
| **Industrial** | | | | |
| *Oil refining and production* | 100 | 100 | 100 | 100 |
| *Coal and uranium mining* | 0 | 0 | 0 | 0 |
| *Power generation* | 0 | 0 | 0 | 0 |
| *Miscellaneous and other* | 2,700 | 2,700 | 3,600 | 3,600 |
| **Total Water Usage** | 88,000 | 139,700 | 89,800 | 142,000 |
| Surface Water | 79,000 | 125,400 | 80,200 | 126,900 |
| Ground Water | 9,000 | 14,300 | 9,600 | 15,100 |
| Share Water Usage | | | | |
| Surface Water | 90% | 90% | 89% | 89% |
| Ground Water | 10% | 10% | 11% | 11% |

Source: Harvey Economics, 2016.

Exhibit 4-A-21: Upper Laramie Subbasin Current and Projected Annual Water Demand
Annual Diversions in Acre-Feet per Year, High Scenario

| | Current (2015) | | Projected (2045) | |
|---|---|---|---|---|
| **Economic Sector** | **Normal** | **Max** | **Normal** | **Max** |
| **Agricultural** | | | | |
| *Irrigation* | | | | |
| Alfalfa | 7,000 | 10,000 | 8,000 | 12,000 |
| Other hay | 112,000 | 177,000 | 137,000 | 215,000 |
| Irrigated pasture | 69,000 | 121,000 | 85,000 | 148,000 |
| Corn | 0 | 0 | 0 | 0 |
| Sugar beets | 0 | 0 | 0 | 0 |
| Dry beans | 0 | 0 | 0 | 0 |
| Oats | 0 | 0 | 0 | 0 |
| Barley | 0 | 0 | 0 | 0 |
| Winter wheat | 0 | 0 | 0 | 0 |
| Spring wheat | 0 | 0 | 0 | 0 |
| *Subtotal* | 188,000 | 308,000 | 230,000 | 375,000 |
| *Livestock* | 600 | 600 | 500 | 500 |
| **Municipal/Rural Domestic** | 7,080 | 10,620 | 7,880 | 11,720 |
| **Industrial** | | | | |
| *Oil refining and production* | 100 | 100 | 100 | 100 |
| *Coal and uranium mining* | 0 | 0 | 0 | 0 |
| *Power generation* | 0 | 0 | 0 | 0 |
| *Miscellaneous and other* | 2,700 | 2,700 | 2,800 | 2,800 |
| **Total Water Usage** | 198,480 | 322,020 | 241,280 | 390,120 |
| Surface Water | 180,400 | 291,300 | 219,700 | 353,400 |
| Ground Water | 18,080 | 30,720 | 21,580 | 36,720 |
| Share Water Usage | | | | |
| Surface Water | 91% | 90% | 91% | 91% |
| Ground Water | 9% | 10% | 9% | 9% |

Source: Harvey Economics, 2016.

Exhibit 4-A-22: Upper Laramie Subbasin Current and Projected Annual Water Demand
Annual Consumptive Use in Acre-Feet per Year, High Scenario

| | Current (2015) | | Projected (2045) | |
|---|---|---|---|---|
| **Economic Sector** | **Normal** | **Max** | **Normal** | **Max** |
| **Agricultural** | | | | |
| *Irrigation* | | | | |
| Alfalfa | 3,000 | 4,000 | 4,000 | 5,000 |
| Other hay | 48,000 | 75,000 | 60,000 | 93,000 |
| Irrigated pasture | 30,000 | 52,000 | 37,000 | 64,000 |
| Corn | 0 | 0 | 0 | 0 |
| Sugar beets | 0 | 0 | 0 | 0 |
| Dry beans | 0 | 0 | 0 | 0 |
| Oats | 0 | 0 | 0 | 0 |
| Barley | 0 | 0 | 0 | 0 |
| Winter wheat | 0 | 0 | 0 | 0 |
| Spring wheat | 0 | 0 | 0 | 0 |
| *Subtotal* | 81,000 | 131,000 | 101,000 | 162,000 |
| *Livestock* | 600 | 600 | 500 | 500 |
| **Municipal/Rural Domestic** | 3,590 | 5,290 | 3,890 | 5,890 |
| **Industrial** | | | | |
| *Oil refining and production* | 100 | 100 | 100 | 100 |
| *Coal and uranium mining* | 0 | 0 | 0 | 0 |
| *Power generation* | 0 | 0 | 0 | 0 |
| *Miscellaneous and other* | 2,700 | 2,700 | 2,800 | 2,800 |
| **Total Water Usage** | 87,990 | 139,690 | 108,290 | 171,290 |
| Surface Water | 79,000 | 125,400 | 97,700 | 154,200 |
| Ground Water | 8,990 | 14,290 | 10,590 | 17,090 |
| Share Water Usage | | | | |
| Surface Water | 90% | 90% | 90% | 90% |
| Ground Water | 10% | 10% | 10% | 10% |

Source: Harvey Economics, 2016.

Exhibit 4-A-23: Upper Laramie Subbasin Current and Projected Annual Water Demand
Annual Diversions in Acre-Feet per Year, Mid Scenario

| | Current (2015) | | Projected (2045) | |
|---|---|---|---|---|
| **Economic Sector** | **Normal** | **Max** | **Normal** | **Max** |
| **Agricultural** | | | | |
| *Irrigation* | | | | |
| Alfalfa | 7,000 | 10,000 | 7,000 | 11,000 |
| Other hay | 112,000 | 177,000 | 122,000 | 192,000 |
| Irrigated pasture | 69,000 | 121,000 | 76,000 | 132,000 |
| Corn | 0 | 0 | 0 | 0 |
| Sugar beets | 0 | 0 | 0 | 0 |
| Dry beans | 0 | 0 | 0 | 0 |
| Oats | 0 | 0 | 0 | 0 |
| Barley | 0 | 0 | 0 | 0 |
| Winter wheat | 0 | 0 | 0 | 0 |
| Spring wheat | 0 | 0 | 0 | 0 |
| *Subtotal* | 188,000 | 308,000 | 205,000 | 335,000 |
| *Livestock* | 600 | 600 | 600 | 600 |
| **Municipal/Rural Domestic** | 7,080 | 10,620 | 8,280 | 12,320 |
| **Industrial** | | | | |
| *Oil refining and production* | 100 | 100 | 100 | 100 |
| *Coal and uranium mining* | 0 | 0 | 0 | 0 |
| *Power generation* | 0 | 0 | 0 | 0 |
| *Miscellaneous and other* | 2,700 | 2,700 | 3,200 | 3,200 |
| **Total Water Usage** | 198,480 | 322,020 | 217,180 | 351,220 |
| Surface Water | 180,400 | 291,300 | 197,200 | 317,600 |
| Ground Water | 18,080 | 30,720 | 19,980 | 33,620 |
| Share Water Usage | | | | |
| Surface Water | 91% | 90% | 91% | 90% |
| Ground Water | 9% | 10% | 9% | 10% |

Source: Harvey Economics, 2016.

Exhibit 4-A-24: Upper Laramie Subbasin Current and Projected Annual Water Demand
Annual Consumptive Use in Acre-Feet per Year, Mid Scenario

| | Current (2015) | | Projected (2045) | |
|---|---|---|---|---|
| **Economic Sector** | **Normal** | **Max** | **Normal** | **Max** |
| **Agricultural** | | | | |
| *Irrigation* | | | | |
| Alfalfa | 3,000 | 4,000 | 3,000 | 5,000 |
| Other hay | 48,000 | 75,000 | 53,000 | 83,000 |
| Irrigated pasture | 30,000 | 52,000 | 33,000 | 57,000 |
| Corn | 0 | 0 | 0 | 0 |
| Sugar beets | 0 | 0 | 0 | 0 |
| Dry beans | 0 | 0 | 0 | 0 |
| Oats | 0 | 0 | 0 | 0 |
| Barley | 0 | 0 | 0 | 0 |
| Winter wheat | 0 | 0 | 0 | 0 |
| Spring wheat | 0 | 0 | 0 | 0 |
| *Subtotal* | 81,000 | 131,000 | 89,000 | 145,000 |
| *Livestock* | 600 | 600 | 600 | 600 |
| **Municipal/Rural Domestic** | 3,590 | 5,290 | 4,090 | 6,190 |
| **Industrial** | | | | |
| *Oil refining and production* | 100 | 100 | 100 | 100 |
| *Coal and uranium mining* | 0 | 0 | 0 | 0 |
| *Power generation* | 0 | 0 | 0 | 0 |
| *Miscellaneous and other* | 2,700 | 2,700 | 3,200 | 3,200 |
| **Total Water Usage** | 87,990 | 139,690 | 96,990 | 155,090 |
| Surface Water | 79,000 | 125,400 | 87,000 | 139,100 |
| Ground Water | 8,990 | 14,290 | 9,990 | 15,990 |
| Share Water Usage | | | | |
| Surface Water | 90% | 90% | 90% | 90% |
| Ground Water | 10% | 10% | 10% | 10% |

Source: Harvey Economics, 2016.

Exhibit 4-A-25: Lower Laramie Subbasin Current and Projected Annual Water Demand
Annual Diversions in Acre-Feet per Year, High Scenario

| | Current (2015) | | Projected (2045) | |
|---|---|---|---|---|
| **Economic Sector** | **Normal** | **Max** | **Normal** | **Max** |
| **Agricultural** | | | | |
| *Irrigation* | | | | |
| Alfalfa | 64,000 | 84,000 | 89,000 | 117,000 |
| Other hay | 58,000 | 80,000 | 81,000 | 113,000 |
| Irrigated pasture | 30,000 | 47,000 | 41,000 | 65,000 |
| Corn | 20,000 | 27,000 | 27,000 | 37,000 |
| Sugar beets | 11,000 | 16,000 | 15,000 | 23,000 |
| Dry beans | 8,000 | 12,000 | 12,000 | 16,000 |
| Oats | 3,000 | 5,000 | 4,000 | 7,000 |
| Barley | 5,000 | 6,000 | 7,000 | 9,000 |
| Winter wheat | 2,000 | 2,000 | 3,000 | 3,000 |
| Spring wheat | 0 | 0 | 0 | 0 |
| *Subtotal* | 201,000 | 279,000 | 279,000 | 390,000 |
| *Livestock* | 800 | 800 | 1,200 | 1,200 |
| **Municipal/Rural Domestic** | 2,500 | 3,500 | 3,700 | 5,200 |
| **Industrial** | | | | |
| *Oil refining and production* | 800 | 800 | 900 | 900 |
| *Coal and uranium mining* | 0 | 0 | 0 | 0 |
| *Power generation* | 18,500 | 18,500 | 18,500 | 18,500 |
| *Miscellaneous and other* | 800 | 800 | 1,200 | 1,200 |
| **Total Water Usage** | 224,400 | 303,400 | 304,500 | 417,000 |
| Surface Water | 205,200 | 275,700 | 278,800 | 379,200 |
| Ground Water | 19,200 | 27,700 | 25,700 | 37,800 |
| Share Water Usage | | | | |
| Surface Water | 91% | 91% | 92% | 91% |
| Ground Water | 9% | 9% | 8% | 9% |

Source: Harvey Economics, 2016.

Exhibit 4-A-26: Lower Laramie Subbasin Current and Projected Annual Water Demand
Annual Consumptive Use in Acre-Feet per Year, High Scenario

| | Current (2015) | | Projected (2045) | |
|---|---|---|---|---|
| **Economic Sector** | **Normal** | **Max** | **Normal** | **Max** |
| **Agricultural** | | | | |
| *Irrigation* | | | | |
| Alfalfa | 28,000 | 36,000 | 38,000 | 49,000 |
| Other hay | 25,000 | 34,000 | 34,000 | 48,000 |
| Irrigated pasture | 13,000 | 20,000 | 17,000 | 27,000 |
| Corn | 9,000 | 11,000 | 12,000 | 16,000 |
| Sugar beets | 5,000 | 7,000 | 7,000 | 10,000 |
| Dry beans | 4,000 | 5,000 | 5,000 | 7,000 |
| Oats | 1,000 | 2,000 | 2,000 | 3,000 |
| Barley | 2,000 | 3,000 | 3,000 | 4,000 |
| Winter wheat | 1,000 | 1,000 | 1,000 | 1,000 |
| Spring wheat | 0 | 0 | 0 | 0 |
| *Subtotal* | 88,000 | 119,000 | 119,000 | 165,000 |
| *Livestock* | 800 | 800 | 1,200 | 1,200 |
| **Municipal/Rural Domestic** | 1,200 | 1,800 | 1,900 | 2,600 |
| **Industrial** | | | | |
| *Oil refining and production* | 800 | 800 | 900 | 900 |
| *Coal and uranium mining* | 0 | 0 | 0 | 0 |
| *Power generation* | 18,500 | 18,500 | 18,500 | 18,500 |
| *Miscellaneous and other* | 800 | 800 | 1,200 | 1,200 |
| **Total Water Usage** | 110,100 | 141,700 | 142,700 | 189,400 |
| Surface Water | 99,900 | 128,000 | 129,800 | 171,400 |
| Ground Water | 10,200 | 13,700 | 12,900 | 18,000 |
| Share Water Usage | | | | |
| Surface Water | 91% | 90% | 91% | 90% |
| Ground Water | 9% | 10% | 9% | 10% |

Source: Harvey Economics, 2016.

Exhibit 4-A-27: Lower Laramie Subbasin Current and Projected Annual Water Demand
Annual Diversions in Acre-Feet per Year, Low Scenario

| | Current (2015) | | Projected (2045) | |
|---|---|---|---|---|
| **Economic Sector** | **Normal** | **Max** | **Normal** | **Max** |
| **Agricultural** | | | | |
| *Irrigation* | | | | |
| Alfalfa | 64,000 | 84,000 | 36,000 | 47,000 |
| Other hay | 58,000 | 80,000 | 33,000 | 45,000 |
| Irrigated pasture | 30,000 | 47,000 | 17,000 | 26,000 |
| Corn | 20,000 | 27,000 | 11,000 | 15,000 |
| Sugar beets | 11,000 | 16,000 | 6,000 | 9,000 |
| Dry beans | 8,000 | 12,000 | 5,000 | 7,000 |
| Oats | 3,000 | 5,000 | 2,000 | 3,000 |
| Barley | 5,000 | 6,000 | 3,000 | 4,000 |
| Winter wheat | 2,000 | 2,000 | 1,000 | 1,000 |
| Spring wheat | 0 | 0 | 0 | 0 |
| *Subtotal* | 201,000 | 279,000 | 114,000 | 157,000 |
| *Livestock* | 800 | 800 | 700 | 700 |
| **Municipal/Rural Domestic** | 2,500 | 3,500 | 2,700 | 3,900 |
| **Industrial** | | | | |
| *Oil refining and production* | 800 | 800 | 800 | 800 |
| *Coal and uranium mining* | 0 | 0 | 0 | 0 |
| *Power generation* | 18,500 | 18,500 | 18,500 | 18,500 |
| *Miscellaneous and other* | 800 | 800 | 800 | 800 |
| **Total Water Usage** | 224,400 | 303,400 | 137,500 | 181,700 |
| Surface Water | 205,200 | 275,700 | 125,000 | 164,400 |
| Ground Water | 19,200 | 27,700 | 12,500 | 17,300 |
| Share Water Usage | | | | |
| Surface Water | 91% | 91% | 91% | 90% |
| Ground Water | 9% | 9% | 9% | 10% |

Source: Harvey Economics, 2016.

Exhibit 4-A-28: Lower Laramie Subbasin Current and Projected Annual Water Demand
Annual Consumptive Use in Acre-Feet per Year, Low Scenario

| | Current (2015) | | Projected (2045) | |
|---|---|---|---|---|
| **Economic Sector** | **Normal** | **Max** | **Normal** | **Max** |
| **Agricultural** | | | | |
| *Irrigation* | | | | |
| Alfalfa | 28,000 | 36,000 | 16,000 | 20,000 |
| Other hay | 25,000 | 34,000 | 14,000 | 20,000 |
| Irrigated pasture | 13,000 | 20,000 | 7,000 | 11,000 |
| Corn | 9,000 | 11,000 | 5,000 | 6,000 |
| Sugar beets | 5,000 | 7,000 | 3,000 | 4,000 |
| Dry beans | 4,000 | 5,000 | 2,000 | 3,000 |
| Oats | 1,000 | 2,000 | 1,000 | 1,000 |
| Barley | 2,000 | 3,000 | 1,000 | 2,000 |
| Winter wheat | 1,000 | 1,000 | 0 | 1,000 |
| Spring wheat | 0 | 0 | 0 | 0 |
| *Subtotal* | 88,000 | 119,000 | 49,000 | 68,000 |
| *Livestock* | 800 | 800 | 700 | 700 |
| **Municipal/Rural Domestic** | 1,200 | 1,800 | 1,300 | 2,000 |
| **Industrial** | | | | |
| *Oil refining and production* | 800 | 800 | 800 | 800 |
| *Coal and uranium mining* | 0 | 0 | 0 | 0 |
| *Power generation* | 18,500 | 18,500 | 18,500 | 18,500 |
| *Miscellaneous and other* | 800 | 800 | 800 | 800 |
| **Total Water Usage** | 110,100 | 141,700 | 71,100 | 90,800 |
| Surface Water | 99,900 | 128,000 | 64,000 | 81,500 |
| Ground Water | 10,200 | 13,700 | 7,100 | 9,300 |
| Share Water Usage | | | | |
| Surface Water | 91% | 90% | 90% | 90% |
| Ground Water | 9% | 10% | 10% | 10% |

Source: Harvey Economics, 2016.

Exhibit 4-A-29: Lower Laramie Subbasin Current and Projected Annual Water Demand
Annual Diversions in Acre-Feet per Year, Mid Scenario

| | Current (2015) | | Projected (2045) | |
|---|---|---|---|---|
| **Economic Sector** | **Normal** | **Max** | **Normal** | **Max** |
| **Agricultural** | | | | |
| *Irrigation* | | | | |
| Alfalfa | 64,000 | 84,000 | 50,000 | 66,000 |
| Other hay | 58,000 | 80,000 | 45,000 | 63,000 |
| Irrigated pasture | 30,000 | 47,000 | 23,000 | 36,000 |
| Corn | 20,000 | 27,000 | 15,000 | 21,000 |
| Sugar beets | 11,000 | 16,000 | 9,000 | 13,000 |
| Dry beans | 8,000 | 12,000 | 6,000 | 9,000 |
| Oats | 3,000 | 5,000 | 2,000 | 4,000 |
| Barley | 5,000 | 6,000 | 4,000 | 5,000 |
| Winter wheat | 2,000 | 2,000 | 1,000 | 2,000 |
| Spring wheat | 0 | 0 | 0 | 0 |
| *Subtotal* | 201,000 | 279,000 | 155,000 | 219,000 |
| *Livestock* | 800 | 800 | 800 | 800 |
| **Municipal/Rural Domestic** | 2,500 | 3,500 | 3,000 | 4,200 |
| **Industrial** | | | | |
| *Oil refining and production* | 800 | 800 | 900 | 900 |
| *Coal and uranium mining* | 0 | 0 | 0 | 0 |
| *Power generation* | 18,500 | 18,500 | 18,500 | 18,500 |
| *Miscellaneous and other* | 800 | 800 | 1,000 | 1,000 |
| **Total Water Usage** | 224,400 | 303,400 | 179,200 | 244,400 |
| Surface Water | 205,200 | 275,700 | 163,300 | 221,500 |
| Ground Water | 19,200 | 27,700 | 15,900 | 22,900 |
| Share Water Usage | | | | |
| Surface Water | 91% | 91% | 91% | 91% |
| Ground Water | 9% | 9% | 9% | 9% |

Source: Harvey Economics, 2016.

Exhibit 4-A-30: Lower Laramie Subbasin Current and Projected Annual Water Demand
Annual Consumptive Use in Acre-Feet per Year, Mid Scenario

| | Current (2015) | | Projected (2045) | |
|---|---|---|---|---|
| **Economic Sector** | **Normal** | **Max** | **Normal** | **Max** |
| **Agricultural** | | | | |
| *Irrigation* | | | | |
| Alfalfa | 28,000 | 36,000 | 22,000 | 28,000 |
| Other hay | 25,000 | 34,000 | 20,000 | 27,000 |
| Irrigated pasture | 13,000 | 20,000 | 10,000 | 16,000 |
| Corn | 9,000 | 11,000 | 7,000 | 9,000 |
| Sugar beets | 5,000 | 7,000 | 4,000 | 5,000 |
| Dry beans | 4,000 | 5,000 | 3,000 | 4,000 |
| Oats | 1,000 | 2,000 | 1,000 | 2,000 |
| Barley | 2,000 | 3,000 | 2,000 | 2,000 |
| Winter wheat | 1,000 | 1,000 | 1,000 | 1,000 |
| Spring wheat | 0 | 0 | 0 | 0 |
| *Subtotal* | 88,000 | 119,000 | 70,000 | 94,000 |
| *Livestock* | 800 | 800 | 800 | 800 |
| **Municipal/Rural Domestic** | 1,200 | 1,800 | 1,400 | 2,200 |
| **Industrial** | | | | |
| *Oil refining and production* | 800 | 800 | 900 | 900 |
| *Coal and uranium mining* | 0 | 0 | 0 | 0 |
| *Power generation* | 18,500 | 18,500 | 18,500 | 18,500 |
| *Miscellaneous and other* | 800 | 800 | 1,000 | 1,000 |
| **Total Water Usage** | 110,100 | 141,700 | 92,600 | 117,400 |
| Surface Water | 99,900 | 128,000 | 83,600 | 105,600 |
| Ground Water | 10,200 | 13,700 | 9,000 | 11,800 |
| Share Water Usage | | | | |
| Surface Water | 91% | 90% | 90% | 90% |
| Ground Water | 9% | 10% | 10% | 10% |

Source: Harvey Economics, 2016.

Exhibit 4-A-31: Horse Creek Subbasin Current and Projected Annual Water Demand
Annual Diversions in Acre-Feet per Year, High Scenario

| | Current (2015) | | Projected (2045) | |
|---|---|---|---|---|
| **Economic Sector** | **Normal** | **Max** | **Normal** | **Max** |
| **Agricultural** | | | | |
| *Irrigation* | | | | |
| Alfalfa | 31,000 | 41,000 | 44,000 | 59,000 |
| Other hay | 12,000 | 25,000 | 18,000 | 37,000 |
| Irrigated pasture | 7,000 | 25,000 | 10,000 | 37,000 |
| Corn | 30,000 | 32,000 | 44,000 | 46,000 |
| Sugar beets | 15,000 | 17,000 | 21,000 | 24,000 |
| Dry beans | 8,000 | 9,000 | 11,000 | 13,000 |
| Oats | 2,000 | 1,000 | 2,000 | 2,000 |
| Barley | 3,000 | 4,000 | 4,000 | 6,000 |
| Winter wheat | 3,000 | 3,000 | 4,000 | 4,000 |
| Spring wheat | 0 | 0 | 0 | 0 |
| *Subtotal* | 111,000 | 157,000 | 158,000 | 228,000 |
| *Livestock* | 500 | 500 | 600 | 600 |
| **Municipal/Rural Domestic** | 600 | 800 | 900 | 1,400 |
| **Industrial** | | | | |
| *Oil refining and production* | 500 | 500 | 600 | 600 |
| *Coal and uranium mining* | 0 | 0 | 0 | 0 |
| *Power generation* | 0 | 0 | 0 | 0 |
| *Miscellaneous and other* | 7,400 | 7,400 | 8,500 | 8,500 |
| **Total Water Usage** | 120,000 | 166,200 | 168,600 | 239,100 |
| Surface Water | 103,600 | 144,900 | 147,600 | 210,700 |
| Ground Water | 16,400 | 21,300 | 21,000 | 28,400 |
| Share Water Usage | | | | |
| Surface Water | 86% | 87% | 88% | 88% |
| Ground Water | 14% | 13% | 12% | 12% |

Source: Harvey Economics, 2016.

Exhibit 4-A-32: Horse Creek Subbasin Current and Projected Annual Water Demand
Annual Consumptive Use in Acre-Feet per Year, High Scenario

| | Current (2015) | | Projected (2045) | |
|---|---|---|---|---|
| **Economic Sector** | **Normal** | **Max** | **Normal** | **Max** |
| **Agricultural** | | | | |
| *Irrigation* | | | | |
| Alfalfa | 13,000 | 18,000 | 19,000 | 25,000 |
| Other hay | 5,000 | 11,000 | 8,000 | 15,000 |
| Irrigated pasture | 3,000 | 11,000 | 4,000 | 15,000 |
| Corn | 13,000 | 14,000 | 19,000 | 19,000 |
| Sugar beets | 6,000 | 7,000 | 9,000 | 10,000 |
| Dry beans | 3,000 | 4,000 | 5,000 | 5,000 |
| Oats | 1,000 | 1,000 | 1,000 | 1,000 |
| Barley | 1,000 | 2,000 | 2,000 | 2,000 |
| Winter wheat | 1,000 | 1,000 | 2,000 | 2,000 |
| Spring wheat | 0 | 0 | 0 | 0 |
| *Subtotal* | 46,000 | 69,000 | 69,000 | 94,000 |
| *Livestock* | 500 | 500 | 600 | 600 |
| **Municipal/Rural Domestic** | 300 | 400 | 500 | 700 |
| **Industrial** | | | | |
| *Oil refining and production* | 500 | 500 | 600 | 600 |
| *Coal and uranium mining* | 0 | 0 | 0 | 0 |
| *Power generation* | 0 | 0 | 0 | 0 |
| *Miscellaneous and other* | 7,400 | 7,400 | 8,500 | 8,500 |
| **Total Water Usage** | 54,700 | 77,800 | 79,200 | 104,400 |
| Surface Water | 43,300 | 64,100 | 65,100 | 87,600 |
| Ground Water | 11,400 | 13,700 | 14,100 | 16,800 |
| Share Water Usage | | | | |
| Surface Water | 79% | 82% | 82% | 84% |
| Ground Water | 21% | 18% | 18% | 16% |

Source: Harvey Economics, 2016.

Exhibit 4-A-33: Horse Creek Subbasin Current and Projected Annual Water Demand
Annual Diversions in Acre-Feet per Year, Low Scenario

| | Current (2015) | | Projected (2045) | |
|---|---|---|---|---|
| **Economic Sector** | **Normal** | **Max** | **Normal** | **Max** |
| **Agricultural** | | | | |
| *Irrigation* | | | | |
| Alfalfa | 31,000 | 41,000 | 16,000 | 22,000 |
| Other hay | 12,000 | 25,000 | 7,000 | 14,000 |
| Irrigated pasture | 7,000 | 25,000 | 4,000 | 14,000 |
| Corn | 30,000 | 32,000 | 16,000 | 17,000 |
| Sugar beets | 15,000 | 17,000 | 8,000 | 9,000 |
| Dry beans | 8,000 | 9,000 | 4,000 | 5,000 |
| Oats | 2,000 | 1,000 | 1,000 | 1,000 |
| Barley | 3,000 | 4,000 | 1,000 | 2,000 |
| Winter wheat | 3,000 | 3,000 | 1,000 | 2,000 |
| Spring wheat | 0 | 0 | 0 | 0 |
| *Subtotal* | 111,000 | 157,000 | 58,000 | 86,000 |
| *Livestock* | 500 | 500 | 500 | 500 |
| **Municipal/Rural Domestic** | 600 | 800 | 600 | 800 |
| **Industrial** | | | | |
| *Oil refining and production* | 500 | 500 | 500 | 500 |
| *Coal and uranium mining* | 0 | 0 | 0 | 0 |
| *Power generation* | 0 | 0 | 0 | 0 |
| *Miscellaneous and other* | 7,400 | 7,400 | 7,500 | 7,500 |
| **Total Water Usage** | 120,000 | 166,200 | 67,100 | 95,300 |
| Surface Water | 103,600 | 144,900 | 54,700 | 80,000 |
| Ground Water | 16,400 | 21,300 | 12,400 | 15,300 |
| Share Water Usage | | | | |
| Surface Water | 86% | 87% | 82% | 84% |
| Ground Water | 14% | 13% | 18% | 16% |

Source: Harvey Economics, 2016.

Exhibit 4-A-34: Horse Creek Subbasin Current and Projected Annual Water Demand
Annual Consumptive Use in Acre-Feet per Year, Low Scenario

| | Current (2015) | | Projected (2045) | |
|---|---|---|---|---|
| **Economic Sector** | **Normal** | **Max** | **Normal** | **Max** |
| **Agricultural** | | | | |
| *Irrigation* | | | | |
| Alfalfa | 13,000 | 18,000 | 7,000 | 10,000 |
| Other hay | 5,000 | 11,000 | 3,000 | 6,000 |
| Irrigated pasture | 3,000 | 11,000 | 2,000 | 6,000 |
| Corn | 13,000 | 14,000 | 7,000 | 7,000 |
| Sugar beets | 6,000 | 7,000 | 3,000 | 4,000 |
| Dry beans | 3,000 | 4,000 | 2,000 | 2,000 |
| Oats | 1,000 | 1,000 | 0 | 0 |
| Barley | 1,000 | 2,000 | 1,000 | 1,000 |
| Winter wheat | 1,000 | 1,000 | 1,000 | 1,000 |
| Spring wheat | 0 | 0 | 0 | 0 |
| *Subtotal* | 46,000 | 69,000 | 26,000 | 37,000 |
| *Livestock* | 500 | 500 | 500 | 500 |
| **Municipal/Rural Domestic** | 300 | 400 | 300 | 400 |
| **Industrial** | | | | |
| *Oil refining and production* | 500 | 500 | 500 | 500 |
| *Coal and uranium mining* | 0 | 0 | 0 | 0 |
| *Power generation* | 0 | 0 | 0 | 0 |
| *Miscellaneous and other* | 7,400 | 7,400 | 7,500 | 7,500 |
| **Total Water Usage** | 54,700 | 77,800 | 34,800 | 45,900 |
| Surface Water | 43,300 | 64,100 | 25,000 | 34,900 |
| Ground Water | 11,400 | 13,700 | 9,800 | 11,000 |
| Share Water Usage | | | | |
| Surface Water | 79% | 82% | 72% | 76% |
| Ground Water | 21% | 18% | 28% | 24% |

Source: Harvey Economics, 2016.

Exhibit 4-A-35: Horse Creek Subbasin Current and Projected Annual Water Demand
Annual Diversions in Acre-Feet per Year, Mid Scenario

| | Current (2015) | | Projected (2045) | |
|---|---|---|---|---|
| **Economic Sector** | **Normal** | **Max** | **Normal** | **Max** |
| **Agricultural** | | | | |
| *Irrigation* | | | | |
| Alfalfa | 31,000 | 41,000 | 24,000 | 32,000 |
| Other hay | 12,000 | 25,000 | 10,000 | 19,000 |
| Irrigated pasture | 7,000 | 25,000 | 6,000 | 19,000 |
| Corn | 30,000 | 32,000 | 23,000 | 24,000 |
| Sugar beets | 15,000 | 17,000 | 11,000 | 13,000 |
| Dry beans | 8,000 | 9,000 | 6,000 | 7,000 |
| Oats | 2,000 | 1,000 | 1,000 | 1,000 |
| Barley | 3,000 | 4,000 | 2,000 | 3,000 |
| Winter wheat | 3,000 | 3,000 | 2,000 | 2,000 |
| Spring wheat | 0 | 0 | 0 | 0 |
| *Subtotal* | 111,000 | 157,000 | 85,000 | 120,000 |
| *Livestock* | 500 | 500 | 500 | 500 |
| **Municipal/Rural Domestic** | 600 | 800 | 800 | 1,100 |
| **Industrial** | | | | |
| *Oil refining and production* | 500 | 500 | 500 | 500 |
| *Coal and uranium mining* | 0 | 0 | 0 | 0 |
| *Power generation* | 0 | 0 | 0 | 0 |
| *Miscellaneous and other* | 7,400 | 7,400 | 7,600 | 7,600 |
| **Total Water Usage** | 120,000 | 166,200 | 94,400 | 129,700 |
| Surface Water | 103,600 | 144,900 | 79,900 | 111,400 |
| Ground Water | 16,400 | 21,300 | 14,500 | 18,300 |
| Share Water Usage | | | | |
| Surface Water | 86% | 87% | 85% | 86% |
| Ground Water | 14% | 13% | 15% | 14% |

Source: Harvey Economics, 2016.

Exhibit 4-A-36: Horse Creek Subbasin Current and Projected Annual Water Demand
Annual Consumptive Use in Acre-Feet per Year, Mid Scenario

| | Current (2015) | | Projected (2045) | |
|---|---|---|---|---|
| **Economic Sector** | **Normal** | **Max** | **Normal** | **Max** |
| **Agricultural** | | | | |
| *Irrigation* | | | | |
| Alfalfa | 13,000 | 18,000 | 10,000 | 14,000 |
| Other hay | 5,000 | 11,000 | 4,000 | 8,000 |
| Irrigated pasture | 3,000 | 11,000 | 2,000 | 8,000 |
| Corn | 13,000 | 14,000 | 10,000 | 10,000 |
| Sugar beets | 6,000 | 7,000 | 5,000 | 6,000 |
| Dry beans | 3,000 | 4,000 | 3,000 | 3,000 |
| Oats | 1,000 | 1,000 | 1,000 | 0 |
| Barley | 1,000 | 2,000 | 1,000 | 1,000 |
| Winter wheat | 1,000 | 1,000 | 1,000 | 1,000 |
| Spring wheat | 0 | 0 | 0 | 0 |
| *Subtotal* | 46,000 | 69,000 | 37,000 | 51,000 |
| *Livestock* | 500 | 500 | 500 | 500 |
| **Municipal/Rural Domestic** | 300 | 400 | 400 | 600 |
| **Industrial** | | | | |
| *Oil refining and production* | 500 | 500 | 500 | 500 |
| *Coal and uranium mining* | 0 | 0 | 0 | 0 |
| *Power generation* | 0 | 0 | 0 | 0 |
| *Miscellaneous and other* | 7,400 | 7,400 | 7,600 | 7,600 |
| **Total Water Usage** | 54,700 | 77,800 | 46,000 | 60,200 |
| Surface Water | 43,300 | 64,100 | 35,300 | 47,900 |
| Ground Water | 11,400 | 13,700 | 10,700 | 12,300 |
| Share Water Usage | | | | |
| Surface Water | 79% | 82% | 77% | 80% |
| Ground Water | 21% | 18% | 23% | 20% |

Source: Harvey Economics, 2016.

Exhibit 4-A-37: South Platte Subbasin Current and Projected Annual Water Demand
Annual Diversions in Acre-Feet per Year, High Scenario

| | Current (2015) | | Projected (2045) | |
|---|---|---|---|---|
| **Economic Sector** | **Normal** | **Max** | **Normal** | **Max** |
| **Agricultural** | | | | |
| *Irrigation* | | | | |
| Alfalfa | 28,000 | 44,000 | 30,000 | 47,000 |
| Other hay | 28,000 | 51,000 | 30,000 | 55,000 |
| Irrigated pasture | 3,000 | 7,000 | 3,000 | 7,000 |
| Corn | 5,000 | 8,000 | 6,000 | 8,000 |
| Sugar beets | 3,000 | 3,000 | 3,000 | 3,000 |
| Dry beans | 5,000 | 6,000 | 5,000 | 6,000 |
| Oats | 2,000 | 3,000 | 2,000 | 3,000 |
| Barley | 5,000 | 6,000 | 6,000 | 6,000 |
| Winter wheat | 6,000 | 9,000 | 7,000 | 9,000 |
| Spring wheat | 1,000 | 1,000 | 1,000 | 1,000 |
| *Subtotal* | 86,000 | 138,000 | 93,000 | 145,000 |
| *Livestock* | 700 | 700 | 700 | 700 |
| **Municipal/Rural Domestic** | 19,000 | 28,400 | 35,600 | 52,900 |
| **Industrial** | | | | |
| *Oil refining and production* | 8,700 | 8,700 | 10,400 | 10,400 |
| *Coal and uranium mining* | 0 | 0 | 0 | 0 |
| *Power generation* | 600 | 600 | 1,000 | 1,000 |
| *Miscellaneous and other* | 8,900 | 8,900 | 10,500 | 10,500 |
| **Total Water Usage** | 123,900 | 185,300 | 151,200 | 220,500 |
| Surface Water | 94,300 | 148,300 | 113,500 | 173,300 |
| Ground Water | 29,600 | 37,000 | 37,700 | 47,200 |
| Share Water Usage | | | | |
| Surface Water | 76% | 80% | 75% | 79% |
| Ground Water | 24% | 20% | 25% | 21% |

Source: Harvey Economics, 2016.

Exhibit 4-A-38: South Platte Subbasin Current and Projected Annual Water Demand
Annual Consumptive Use in Acre-Feet per Year, High Scenario

| | Current (2015) | | Projected (2045) | |
|---|---|---|---|---|
| **Economic Sector** | **Normal** | **Max** | **Normal** | **Max** |
| **Agricultural** | | | | |
| *Irrigation* | | | | |
| Alfalfa | 12,000 | 19,000 | 13,000 | 20,000 |
| Other hay | 12,000 | 22,000 | 13,000 | 23,000 |
| Irrigated pasture | 1,000 | 3,000 | 1,000 | 3,000 |
| Corn | 2,000 | 3,000 | 2,000 | 4,000 |
| Sugar beets | 1,000 | 1,000 | 1,000 | 1,000 |
| Dry beans | 2,000 | 2,000 | 2,000 | 3,000 |
| Oats | 1,000 | 1,000 | 1,000 | 1,000 |
| Barley | 2,000 | 3,000 | 2,000 | 3,000 |
| Winter wheat | 3,000 | 4,000 | 3,000 | 4,000 |
| Spring wheat | 0 | 0 | 0 | 0 |
| *Subtotal* | 36,000 | 58,000 | 38,000 | 62,000 |
| *Livestock* | 700 | 700 | 700 | 700 |
| **Municipal/Rural Domestic** | 9,500 | 14,200 | 17,800 | 26,500 |
| **Industrial** | | | | |
| *Oil refining and production* | 8,700 | 8,700 | 10,400 | 10,400 |
| *Coal and uranium mining* | 0 | 0 | 0 | 0 |
| *Power generation* | 600 | 600 | 1,000 | 1,000 |
| *Miscellaneous and other* | 8,900 | 8,900 | 10,500 | 10,500 |
| **Total Water Usage** | 65,700 | 92,500 | 80,500 | 113,400 |
| Surface Water | 42,200 | 65,600 | 51,200 | 79,600 |
| Ground Water | 23,500 | 26,900 | 29,300 | 33,800 |
| Share Water Usage | | | | |
| Surface Water | 64% | 71% | 64% | 70% |
| Ground Water | 36% | 29% | 36% | 30% |

Source: Harvey Economics, 2016.

Exhibit 4-A-39: South Platte Subbasin Current and Projected Annual Water Demand
Annual Diversions in Acre-Feet per Year, Low Scenario

| | Current (2015) | | Projected (2045) | |
|---|---|---|---|---|
| **Economic Sector** | **Normal** | **Max** | **Normal** | **Max** |
| **Agricultural** | | | | |
| *Irrigation* | | | | |
| Alfalfa | 28,000 | 44,000 | 25,000 | 39,000 |
| Other hay | 28,000 | 51,000 | 25,000 | 46,000 |
| Irrigated pasture | 3,000 | 7,000 | 3,000 | 6,000 |
| Corn | 5,000 | 8,000 | 5,000 | 7,000 |
| Sugar beets | 3,000 | 3,000 | 2,000 | 3,000 |
| Dry beans | 5,000 | 6,000 | 4,000 | 5,000 |
| Oats | 2,000 | 3,000 | 2,000 | 2,000 |
| Barley | 5,000 | 6,000 | 5,000 | 5,000 |
| Winter wheat | 6,000 | 9,000 | 6,000 | 8,000 |
| Spring wheat | 1,000 | 1,000 | 1,000 | 1,000 |
| *Subtotal* | 86,000 | 138,000 | 78,000 | 122,000 |
| *Livestock* | 700 | 700 | 700 | 700 |
| **Municipal/Rural Domestic** | 19,000 | 28,400 | 24,000 | 35,400 |
| **Industrial** | | | | |
| *Oil refining and production* | 8,700 | 8,700 | 8,700 | 8,700 |
| *Coal and uranium mining* | 0 | 0 | 0 | 0 |
| *Power generation* | 600 | 600 | 1,000 | 1,000 |
| *Miscellaneous and other* | 8,900 | 8,900 | 8,900 | 8,900 |
| **Total Water Usage** | 123,900 | 185,300 | 121,300 | 176,700 |
| Surface Water | 94,300 | 148,300 | 90,800 | 139,000 |
| Ground Water | 29,600 | 37,000 | 30,500 | 37,700 |
| Share Water Usage | | | | |
| Surface Water | 76% | 80% | 75% | 79% |
| Ground Water | 24% | 20% | 25% | 21% |

Source: Harvey Economics, 2016.

Exhibit 4-A-40: South Platte Subbasin Current and Projected Annual Water Demand
Annual Consumptive Use in Acre-Feet per Year, Low Scenario

| | Current (2015) | | Projected (2045) | |
|---|---|---|---|---|
| **Economic Sector** | **Normal** | **Max** | **Normal** | **Max** |
| **Agricultural** | | | | |
| *Irrigation* | | | | |
| Alfalfa | 12,000 | 19,000 | 11,000 | 17,000 |
| Other hay | 12,000 | 22,000 | 11,000 | 20,000 |
| Irrigated pasture | 1,000 | 3,000 | 1,000 | 3,000 |
| Corn | 2,000 | 3,000 | 2,000 | 3,000 |
| Sugar beets | 1,000 | 1,000 | 1,000 | 1,000 |
| Dry beans | 2,000 | 2,000 | 2,000 | 2,000 |
| Oats | 1,000 | 1,000 | 1,000 | 1,000 |
| Barley | 2,000 | 3,000 | 2,000 | 2,000 |
| Winter wheat | 3,000 | 4,000 | 2,000 | 3,000 |
| Spring wheat | 0 | 0 | 0 | 0 |
| *Subtotal* | 36,000 | 58,000 | 33,000 | 52,000 |
| *Livestock* | 700 | 700 | 700 | 700 |
| **Municipal/Rural Domestic** | 9,500 | 14,200 | 12,000 | 17,700 |
| **Industrial** | | | | |
| *Oil refining and production* | 8,700 | 8,700 | 8,700 | 8,700 |
| *Coal and uranium mining* | 0 | 0 | 0 | 0 |
| *Power generation* | 600 | 600 | 1,000 | 1,000 |
| *Miscellaneous and other* | 8,900 | 8,900 | 8,900 | 8,900 |
| **Total Water Usage** | 64,400 | 91,100 | 64,300 | 89,000 |
| Surface Water | 41,100 | 64,400 | 40,200 | 61,600 |
| Ground Water | 23,300 | 26,700 | 24,100 | 27,400 |
| Share Water Usage | | | | |
| Surface Water | 64% | 71% | 63% | 69% |
| Ground Water | 36% | 29% | 37% | 31% |

Source: Harvey Economics, 2016.

Exhibit 4-A-41: South Platte Subbasin Current and Projected Annual Water Demand
Annual Diversions in Acre-Feet per Year, Mid Scenario

| | Current (2015) | | Projected (2045) | |
|---|---|---|---|---|
| **Economic Sector** | **Normal** | **Max** | **Normal** | **Max** |
| **Agricultural** | | | | |
| *Irrigation* | | | | |
| Alfalfa | 28,000 | 44,000 | 27,000 | 42,000 |
| Other hay | 28,000 | 51,000 | 27,000 | 49,000 |
| Irrigated pasture | 3,000 | 7,000 | 3,000 | 6,000 |
| Corn | 5,000 | 8,000 | 5,000 | 8,000 |
| Sugar beets | 3,000 | 3,000 | 3,000 | 3,000 |
| Dry beans | 5,000 | 6,000 | 4,000 | 5,000 |
| Oats | 2,000 | 3,000 | 2,000 | 3,000 |
| Barley | 5,000 | 6,000 | 5,000 | 6,000 |
| Winter wheat | 6,000 | 9,000 | 6,000 | 8,000 |
| Spring wheat | 1,000 | 1,000 | 1,000 | 1,000 |
| *Subtotal* | 86,000 | 138,000 | 83,000 | 131,000 |
| *Livestock* | 700 | 700 | 700 | 700 |
| **Municipal/Rural Domestic** | 19,000 | 28,400 | 28,600 | 41,900 |
| **Industrial** | | | | |
| *Oil refining and production* | 8,700 | 8,700 | 9,600 | 9,600 |
| *Coal and uranium mining* | 0 | 0 | 0 | 0 |
| *Power generation* | 600 | 600 | 1,000 | 1,000 |
| *Miscellaneous and other* | 8,900 | 8,900 | 9,500 | 9,500 |
| **Total Water Usage** | 123,900 | 185,300 | 132,400 | 193,700 |
| Surface Water | 94,300 | 148,300 | 98,900 | 152,100 |
| Ground Water | 29,600 | 37,000 | 33,500 | 41,600 |
| Share Water Usage | | | | |
| Surface Water | 76% | 80% | 75% | 79% |
| Ground Water | 24% | 20% | 25% | 21% |

Source: Harvey Economics, 2016.

Exhibit 4-A-42: South Platte Subbasin Current and Projected Annual Water Demand
Annual Consumptive Use in Acre-Feet per Year, Mid Scenario

| | Current (2015) | | Projected (2045) | |
|---|---|---|---|---|
| **Economic Sector** | **Normal** | **Max** | **Normal** | **Max** |
| **Agricultural** | | | | |
| *Irrigation* | | | | |
| Alfalfa | 12,000 | 19,000 | 12,000 | 18,000 |
| Other hay | 12,000 | 22,000 | 12,000 | 21,000 |
| Irrigated pasture | 1,000 | 3,000 | 1,000 | 3,000 |
| Corn | 2,000 | 3,000 | 2,000 | 3,000 |
| Sugar beets | 1,000 | 1,000 | 1,000 | 1,000 |
| Dry beans | 2,000 | 2,000 | 2,000 | 2,000 |
| Oats | 1,000 | 1,000 | 1,000 | 1,000 |
| Barley | 2,000 | 3,000 | 2,000 | 2,000 |
| Winter wheat | 3,000 | 4,000 | 3,000 | 4,000 |
| Spring wheat | 0 | 0 | 0 | 0 |
| *Subtotal* | 36,000 | 58,000 | 36,000 | 55,000 |
| *Livestock* | 700 | 700 | 700 | 700 |
| **Municipal/Rural Domestic** | 9,500 | 14,200 | 14,300 | 21,000 |
| **Industrial** | | | | |
| *Oil refining and production* | 8,700 | 8,700 | 9,600 | 9,600 |
| *Coal and uranium mining* | 0 | 0 | 0 | 0 |
| *Power generation* | 600 | 600 | 1,000 | 1,000 |
| *Miscellaneous and other* | 8,900 | 8,900 | 9,500 | 9,500 |
| **Total Water Usage** | 64,400 | 91,100 | 71,100 | 96,800 |
| Surface Water | 41,100 | 64,400 | 44,800 | 66,900 |
| Ground Water | 23,300 | 26,700 | 26,300 | 29,900 |
| Share Water Usage | | | | |
| Surface Water | 64% | 71% | 63% | 69% |
| Ground Water | 36% | 29% | 37% | 31% |

Source: Harvey Economics, 2016.

# Platte River Basin Plan 2016 Update
# Volume 5
# Future Water Use Issues and Water Supply Strategies




*Prepared for:*

## Wyoming Water Development Commission

6920 Yellowtail Road
Cheyenne, WY 82002


*Prepared by:*
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WENCK ASSOCIATES
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*In Association With:*
Lidstone & Associates, a Wenck Company
Harvey Economics
HDR Engineering

**PLATTE RIVER BASIN PLAN 2016 UPDATE**
**VOLUME 5**
**FUTURE WATER USE ISSUES AND**
**WATER SUPPLY STRATEGIES**

December 2016

**Explanation of Cover Photos**

Lake Marie in the Snowy Range Mountains. Lake Marie lies south in the shadow of the quartzite massif of 12,847-foot Medicine Bow Peak at an elevation of 11,000-feet. Winter and Spring precipitation in the Snowing Range constitutes an important portion of the water supply in the Platte River Basin.

The bald eagle (*Haliaeetus leucocephalus*, from Greek hali "sea", aiētos "eagle", leuco "white", cephalos "head"). It is a common, frequently observed breeding and winter resident in the North Platte Basin of Wyoming. The bird is strongly associated with large rivers, lakes and reservoirs with an abundant food supply and riparian environments with large trees used for roosting and nesting. The bald eagle is an opportunistic predator which subsists primarily on fish. During the winter, they also feed on dead or injured waterfowl and road or winter killed deer and antelope. The bald eagle is both the national bird and national animal of the United States of America. It is the most familiar success story of the Federal Endangered Species Act. During the latter half of the 20th century it was on the brink of extirpation in the contiguous United States and was one of the first species to receive protections under the precursor to the Endangered Species Act in 1967. Populations have since recovered and the species was removed from the U.S. government's list of endangered species on July 12, 1995 and transferred to the list of threatened species. It was removed from the List of Endangered and Threatened Wildlife in the Lower 48 States on June 28, 2007 but remains protected under the provisions of the Bald and Golden Eagle Protection Act.

Historical photo of flood irrigation. Flood irrigation is an ancient method of irrigating crops and was the first form of irrigation used by humans as they began cultivating crops. In the Platte River Basin, it is still commonly used to irrigate grass hay. In areas of the Platte River Basin where higher value crops are raised such as corn, sugar beets and alfalfa hay, conversion to sprinkler irrigation has the dual benefits of improved crop yields while conserving water.

The Dave Johnston Power Plant is named for W.D. “Dave” Johnston a former PacifiCorp Vice-President. The plant generates power by burning coal that produces steam under high pressure. The steam drives turbines and the turbine blades to engage generator that produce electricity. The plant was commissioned in 1958. There have been four phases of plant expansion to-date and numerous upgrades to comply with changing environmental requirements. The present power generation capacity is 817 megawatts.

# PLATTE RIVER BASIN PLAN 2016 UPDATE
# VOLUME 5
# FUTURE WATER USE ISSUES AND WATER SUPPLY STRATEGIES

December 2016

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**The Platte River Basin Plan 2016 Update is a planning tool developed for the Wyoming Water Development Office. It presents estimated current and estimated future uses of water in Wyoming's Platte River Basin. The Plan is not intended to be used to determine compliance with the administration of state law, federal law, court decrees, interstate compacts, or interstate agreements.**

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# 5.0 Summary

***"However beautiful the strategy, you should occasionally look at the results"***
- Winston Churchill

## 5.1 INTRODUCTION

This volume discusses the issues affecting water supply development and use in the Platte River Basin and strategies for developing water supplies to meet future demands.

There are significant constraints imposed on the use of water in the Platte River Basin (Basin) based on allocations and apportionment within the North Platte Modified Decree, the Laramie River Decree and Wyoming's participation within the Platte River Recovery Implementation Program (PRRIP). The limitations affect the management of existing water uses and future water opportunities. A timeline presenting these legal, institutional and environmental activities is presented in **Figure 5.1**. Any new major water developments within the Basin are unlikely without mitigation efforts to offset the proposed new depletions. Constraints to development of new water supplies in the Platte River Basin are discussed in Section 5.2 (*Issues Affecting Future Water Use*) of this volume.

Small water development projects resulting in net water depletions less than 20 acre-feet per year are allowed under the provisions of Wyoming's Depletion Plan and include future developments that serve domestic, stock, recreation, fish and wildlife, environmental and other deminimus uses. The Depletion Plan presently provides coverage for depletions authorized by existing uses and water activities with valid Wyoming water rights with a priority date prior to July 1, 1997, the date negotiations began to frame and develop the PRRIP. **Figure 5.2** presents a graphic summary showing the complexity of Platte River water supply allocations between Wyoming, Colorado and Nebraska.

Also discussed in Section 5.2 are the Federal environmental laws notably the Clean Water Act and the Endangered Species Act that impose compliance requirements on the development of many large and small water supply projects. These and other state and federal environmental laws and programs need to be considered in the planning and permitting of surface and groundwater supplies.

Section 5.3 presents the water quality impairments, progress made since the 2006 Platte Basin Plan and measures that are being taken to address water quality that is not supporting designated uses in specific reaches within the Platte River Basin. Climate and weather issues are addressed in Section 5.4. Data is presented showing precipitation and temperature trends since the late 1800's.

# Figure 5.1 Platte River Significant Water Resources Events

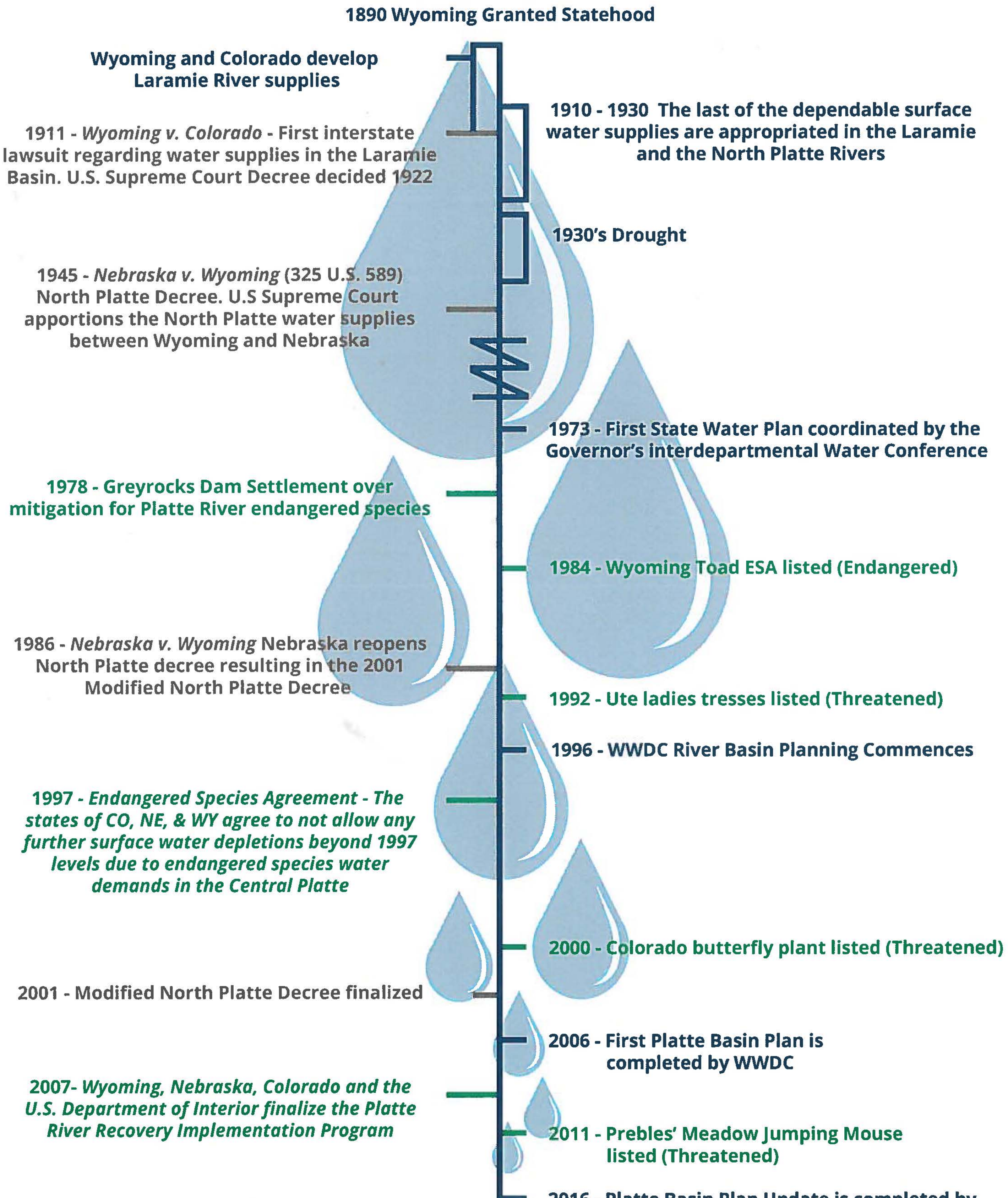


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**Figure 5.2: North Platte and Laramie River Decrees and Environmental Regulations**

1. Intentionally irrigated acreage limitation for the **Laramie River,** downstream of Wheatland Irrigation District's Tunnel No. 2 and its tributaries including irrigation by hydrologically connected groundwater wells, exclusive of Wheatland Irrigation District lands.

2. For the **North Platte River** and its tributaries above Pathfinder Reservoir and for Pathfinder to Guernsey Reservoir subbasins, including water from hydrologically connected groundwater wells, Wyoming is enjoined from consuming more than quantities of water historically consumed for irrigation from such sources in any consecutive ten-year period according to Decree approved methods.

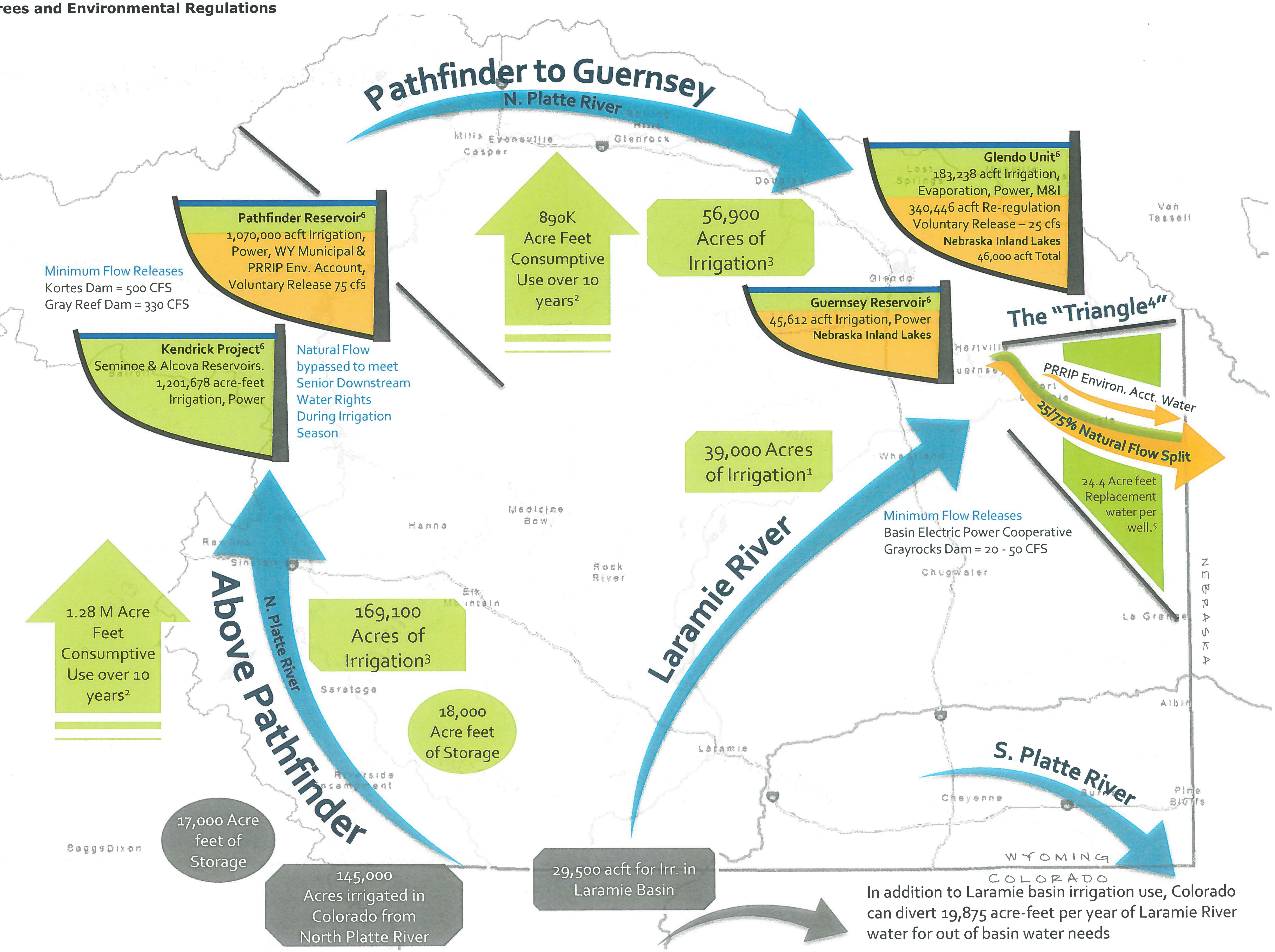
3. Intentionally irrigated acreage limitations for the **North Platte River** and its tributaries above Pathfinder Reservoir and for Pathfinder to Guernsey Reservoir subbasins, including water from hydrologically connected groundwater wells, in Wyoming during any one irrigation season, exclusive of the Kendrick Project.

4. 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.

5. During a period of natural flow deficiency, Wyoming must provide **replacement water** annually of 24.4 acre feet per well for every active baseline well in the year following the year in which the wells were active. New wells are assessed 80 acre feet per well per year. Wells with priority dates prior to Oct. 1945 (date of the original North Platte Decree) are not affected.

6. The **federal reservoir storage** in the North Platte is segregated among various storage ownership accounts and allocations and physically stored in different reservoirs within the system. The total ownership water right quantities are provided along with the water right uses for each of the reservoirs. The color shading indicates that reservoir storage ownerships are shared between Wyoming and Nebraska appropriators for North Platte Project reservoirs and for Glendo Reservoir. The Environmental Account in Pathfinder Reservoir is operated to benefit endangered species within Central Nebraska under the PRRIP.

**Sources:** Purcell. 2014. *Settlement of the Nebraska v. Wyoming Lawsuit, North Platte River Basin Plan Update.* WY Water Development Commission
Trihydro Corp. 2006. *Summary of the North Platte River and Laramie River Decrees, Chapter 1 Appendix, North Platte River Basin Plan.* WY Water Development Commission

The efforts and outcomes of evaluating water strategies in the Basin and seeking input from stakeholders to gather, assess, and recommend strategies are documented in Sections 5.3, 5.5, and 5.7 of this updated Basin Plan. The 2006 Platte River Basin Plan included a list of structural and non-structural opportunities for the Basin. The current Basin Plan team members reviewed the short list of opportunities. The purpose of this review effort was to evaluate any changes or updates, and gather any new information that became available since the previous Basin Plan. The high priority strategies were sorted into three major categories. The categories were evaluated to develop and define other opportunities and to align the strategies with the anticipated growth and demands and water use changes over the 10 to 30-year planning horizon. The high priority categories, individual strategies and implementations efforts summarized in this volume are:

- Operational Enhancements – Existing Storage and Conservation
  - ◊ Re-operation of Glendo Reservoir
  - ◊ Above Pathfinder - Irrigation Reservoir Storage
  - ◊ Municipal and Agricultural Water Use Conservation
  - ◊ Weather Modification

- New, Imported, Exchanged, and Transferred Water Supplies
  - ◊ Industrial Water Use Changes
  - ◊ Transbasin Diversions
  - ◊ Watershed Planning and Small Storage Program

- Control and Enhancement of Groundwater Resources
  - ◊ Laramie County Regulatory Controls
  - ◊ Aquifer Storage and Recovery

These water opportunities and strategies are successfully being implemented in the North Platte River basin with new and expanded activities anticipated in the future.

- The development of non-hydrologically connected groundwater sources for existing and new wells serving municipal and other water uses are being used extensively for domestic and agricultural use in Laramie County. The Cities of Cheyenne, Laramie and Douglas have also tapped non-hydrologically connected groundwater sources to meet some of their water supply needs.

- The development and reliance on raw water sources to irrigate municipal green areas. Laramie, Rawlins and Casper have implemented or are studying the feasibility of developing or expanding raw water supplies for new or existing golf courses and other open space areas.

- Expansions are planned for the City of Cheyenne's successful reuse system.

- Pathfinder Modification Project provides water storage helping to secure water supplies for Wyoming's municipalities affected by water rights administration and provides replacement water for groundwater wells in the "triangle" located below Whalen Diversion Dam and extending downstream on both sides of the North Platte River in Goshen County.

- Reapportioning conserved water as successfully demonstrated in a cooperative project between Casper-Alcova Irrigation District (CAID) and the City of Casper with an agricultural conservation project that benefits municipal water needs.

Wyoming is a premier destination for hunting, fishing, camping and all forms of outdoor recreation and tourism. These asset qualities depend upon the availability of adequate water supplies and existing land uses that need to be properly protected and enhanced. This Basin Plan update offers strategies and opportunities for addressing recreation and environmental water needs. The existing agricultural water uses provide for a ranching and farming lifestyle that can be very complementary to other water use sectors. The anticipated water use changes may occur by relying on strategies and agreements to conserve and transfer water supplies to meet a variety of anticipated water needs in the future. One particular strategy is future cooperative agreements between agricultural and recreation and environmental organizations, with the shared goal of conserving irrigation water for the benefit of multiple water users by wisely and effectively meeting agricultural water needs as well as addressing the water needs of fish and wildlife, recreation and the environment. Future updates to this Basin Plan are needed to capture substantial changes and to provide updated socioeconomic forecasting. A repeat development of the entire Platte River Basin planning process would not be necessary or efficient in the near future.

Ongoing, consistent implementation of a focused and effective public information and involvement program is essential to building and maintaining support for water management and development projects in the Platte River Basin. Some of the activities that are recommended for implementation include: 1) Periodic newsletters e-mailed to interested organizations and individuals, 2) Booths and displays at meetings of water users, the State Fair and county fairs, 3) Wyoming Water Development Commission (WWDC) sponsored seminars and activities addressing water supply needs and planning efforts, 4) Annual or bi-annual economic updates in each basin using data compiled by the Wyoming Department of Administration and Information, and, 5) Working with Conservation Districts to encourage development of small storage projects under the Small Water Project Program (SWPP) to benefit agriculture, wildlife and public recreation.

## 5.2 ISSUES AFFECTING FUTURE WATER USE

### 5.2.1 Introduction

The primary objective of this section is to identify issues that influence future water management strategies and water use opportunities in the Basin. The North Platte basin is unique in Wyoming with the federal reservoir system that serves a variety of water needs in addition to providing agricultural water supplies to meet both in-state and out-of-state needs. The North Platte 2001 Modified Decree governs the allocation of uses of water in the North Platte basin. In addition, the PRRIP requires tracking and reporting of water uses in both the North and South Platte basins. A detailed description of this interstate decree and the endangered species recovery program is provided in **Appendix 5-A**. Brief synopses are included here to summarize how the interstate issues affect management strategies and future water use opportunities in the Basin.

In Wyoming, the North Platte River Basin is considered fully appropriated. In a fully appropriated basin there are more water permits allowing the diversion of water than there is water available in drier or lower runoff years. Therefore, water rights filed for a new "current day" priority would not produce a reliable or firm water supply.

### 5.2.2 Interstate Decrees and Settlements

Litigation and the court decrees affect the apportionment and future management of water supplies within the North Platte Basin. The key apportionment and entitlements within the basin were defined within the 1945 North Platte Decree and amended within the 2001 Modified North Platte Decree. A review and analysis of the modified decree has been prepared by Mike Purcell and is presented in **Appendix 5-A**.

#### North Platte River Basin

The basin consisting of the North Platte River mainstem and tributaries in southeast Wyoming extends from the Colorado Stateline to the Nebraska Stateline. The different subbasins within the North Platte Basin are affected differently by the interstate decrees and settlements.

**Intentionally Irrigated Acreage Limitation.** The 2001 Modified North Platte Decree established a limitation of 226,000 intentionally irrigated acreage. The acreage was further allocated to 56,900 acres in the Guernsey Reservoir to Pathfinder Reservoir reach and 169,100 for the basin above Pathfinder Reservoir.

Intentionally irrigated acreage is monitored and mapped by inspectors performing annual on-the-ground surveys for the Wyoming State Engineer's Office (SEO). This acreage limitation for the above Guernsey Reservoir reach does not include the Kendrick Project, which is operated and maintained by the CAID. The Kendrick Project is limited to 24,248.23 irrigated acres in accordance with its water right. The irrigated acreage of the Kendrick Project is monitored by the U.S. Bureau of Reclamation (USBR) in Mills, Wyoming.

The lands solely irrigated by non-hydrologically connected groundwater wells are excluded from the intentionally irrigated acreage limitation. A non-hydrologically connected groundwater well is a well located and constructed such that if water were intentionally withdrawn by the well continuously for 40 years, the cumulative stream depletion would be less than 28% of the total groundwater withdrawn by that well. "Green area" maps have

been developed and are available in the Wyoming Water Development Office (WWDO) and the SEO website. These maps depict the areas in which the groundwater is deemed non-hydrologically connected and, therefore, well construction and groundwater use are not subject to limitations under the Decree. In addition, any returns flow from the water uses supplied by the non-hydrologically connected wells can be considered as an accretion to the overall North Platte River system.

**Water Rights Administration.** The 2001 modified decree established specific conditions when water rights administration would occur within designated reaches of the Basin. Water rights administration can occur during a water shortage period referred to as an "allocation year" when it is forecasted that the overall irrigation water supply for the North Platte Project (storage ownerships of Pathfinder Reservoir, Guernsey Reservoir, and the Inland Lakes) is less than an established trigger level of 1,100,000 acre-feet. During an "allocation" year, USBR automatically places a call for the benefit of the federal reservoirs. If the SEO agrees USBR's call is valid, water rights administration occurs.

Water rights may be administered above Pathfinder Reservoir for the benefit of Pathfinder Reservoir in February, March, and April with a priority date of December 6, 1904. Water rights may be administered for the above Guernsey Reservoir reach in February, March, and April for the benefit of Guernsey Reservoir with a priority date of April 20, 1923. Glendo Reservoir may exercise a call with a priority date of August 30, 1951. In addition, water rights in this reach may be subject to administration in April for the benefit of the Inland Lakes in Nebraska with a priority date of December 6, 1904. Further, irrigation rights can be regulated on the mainstem of the North Platte River between Guernsey and Pathfinder Reservoirs in an "allocation" year when diversions exceed 6,600 acre-feet in a 2-week period. During the irrigation season this limitation is monitored by the SEO staff. The mainstem irrigation diversions have not exceeded this limitation since the North Platte Decree was modified in 2001.

Another water rights administration condition known as "negative natural flow" can occur in the Pathfinder to Guernsey. Reclamation releases storage water from Pathfinder Reservoir through Gray Reef Dam. The Modified Decree procedures apply conveyance losses to the releases to determine the amount of storage water that should pass the North Platte River above Glendo Reservoir at the Orin gage. If water measured at the Orin gage is less than the amount anticipated by water managers, water rights could be administered to rectify the situation. This situation has rarely occurred and when it did occur, the situation was managed without strict water rights administration. If municipal and other irrigation season water uses increase in the future within this reach, the possibility of a "negative natural flow" situation becomes more likely to occur later in the irrigation season. If the conditions cannot be justified based on errors in the streamflow data and conveyance timing considerations, junior irrigation water rights would likely be the water rights that are administered first to address the situation.

**Consumptive Use Limitations.** Consumptive use limitations for irrigation use were established in the Modified North Platte Decree. The above Pathfinder Reservoir consumptive use limitation for irrigation is 1,280,000 acre-feet for the preceding 10-year period. Within the Pathfinder to Guernsey Reservoirs reach, consumptive use is limited to 890,000 acre-feet for the10-year period. The limitation is monitored by the decree parties as a 10-year running average. The annual consumptive use is calculated in the same

manner that was used to develop the limitation although the parties to the decree have considered alternate methods to calculate consumptive use. The annual methodology to calculate consumptive use remains consistent with the methods prescribed during the establishment of the limitation. To comply with the modified decree, SEO calculates consumptive use for irrigation above Guernsey Reservoir on an annual basis and reports to the parties.

**Triangle Groundwater Depletions.** During the settlement proceedings, Nebraska alleged that Wyoming had violated the 1945 Decree due to surface water depletions and reductions in return flows reaching Nebraska because of Wyoming's development of groundwater resources. Wyoming groundwater development was reviewed throughout the basin but the focus of the depletion concerns centered in an area defined as the "triangle" located below Whalen Diversion Dam that extends downstream on both sides of the North Platte River in Goshen County. Through the settlement negotiations and expert reports prepared by both parties, an approach was developed for tracking the active pumping of wells and for Wyoming to provide a source of replacement water during the following irrigation season to supplement impacts to natural flows in the reach of the North Platte River between Whalen Diversion Dam and the Nebraska Stateline. This reach of the river is subject to a 25% to 75% apportionment of natural flow between Wyoming and Nebraska during May 1 through September 30, a longstanding mutually-agreed allocation that originated within the 1945 Decree. The settlement proceeding placed a requirement for Wyoming to provide replacement water due to the operation of irrigation wells in the "triangle" area based on an average effect on natural flow of 24.4 acre-feet per well.

#### Laramie River Basin

The Laramie River drainage was not addressed in the 1945 North Platte Decree. In 1911 Wyoming started proceedings in the Supreme Court against Colorado to limit State of Colorado diversions from the Laramie River. The case was settled with a court decree in 1922. The 1922 Laramie River Decree allowed Colorado to divert 4,250 acre-feet annually to irrigate meadows and 33,500 acre-feet for transbasin water needs. In 1957 the 1922 Decree was vacated and a new decree was entered by the Supreme Court allowing Colorado 19,875 acre-feet of water per year for transbasin water needs and 29,500 acre-feet for irrigation of meadows that were mapped and attached to the decree.

During the 1978 construction of Grayrocks Dam along the Laramie River, the State of Nebraska and several environmental groups filed a complaint and an injunction against the Basin Electric Power Cooperative and the U.S. Army Corps of Engineers (USACE). Their complaints stated that the environmental impact statement and issuance of federal 404 Permit did not address impacts to endangered species and their habitat in Central Platte River in Nebraska. A settlement was reached by the end of 1978 which resulted in payments to a Whooping Crane Trust and increased minimum flow releases from Grayrocks Dam for the downstream purposes serving fish and wildlife.

During the *Nebraska v. Wyoming* lawsuit proceedings, Nebraska was concerned about Wyoming's irrigation uses in the Lower Laramie River basin and its effect on the inflows into Grayrocks Reservoir. Wyoming agreed to annually inspect, map, and report intentionally irrigated acreage in the Lower Laramie River basin, exclusive of the Wheatland Irrigation District (WID), subject to an annual acreage limitation of 39,000 acres. The 2001 Modified Decree requirement does not apportion flows of the Lower Laramie River basin and lands irrigated within the WID which are excluded because of their entitlement under the Laramie River Decree.

### 5.2.3 Regulatory Issues and Constraints

New or rehabilitation water projects in the Basin involving federal lands, funding, authorizations, and programs would be subject to the National Environmental Policy Act (NEPA) and other federal regulations. The federal regulations are administered primarily through various federal agencies based on the land ownership and applicable regulatory authorization; i.e., U.S. Bureau of Land Management (BLM), USACE, U.S. Environmental Protection Agency (EPA), Natural Resources Conservation Service (NRCS), U.S. Forest Service (USFS), and U.S. Fish and Wildlife Service (USFWS). State agencies with regulatory oversight and permitting approval that would require coordination on water projects include, but are not limited to, the SEO, Wyoming Department of Environmental Quality (DEQ), State Historic Preservation Office, State Lands and Investment Board (SLIB), and Wyoming Game and Fish Department (WGFD). A list of the major environmental regulations and general description of the permitting processes are discussed below.

The actual permit and clearance approvals for the proposed projects would depend on the site-specific project and its location. Permitting and clearance requirements for a specific project should be identified in the initial planning to achieve regulatory compliance, lower project costs, and avoid construction interruptions or design modifications.

### National Environmental Policy Act

Compliance with the National Environmental Policy Act of 1969 (42 U.S.C., §4321) applies whenever the proposed project in the basin is located within federal lands, would need right-of-way across federal lands, would be funded entirely or partially by federal agencies or programs, or would require federal permits or federal authorizations. The NEPA process is intended to help sponsors and agencies perform a review of the potential project effects and involve the public in making informed decisions about the environmental consequences of the proposed water project.

With a significant amount of both USFS and BLM federal lands within the basin, the BLM or the USFS could likely be considered the lead agencies in the NEPA process. Typically, these federal agencies execute a Memorandum of Understanding (MOU) to outline responsibilities and roles of the agencies when a proposed project involves multiple agencies. The NEPA process facilitates the approvals of meeting other environmental review requirements; such as, the Endangered Species Act; the National Historic Preservation Act; and other federal, state, tribal, and local laws and regulations.

Other potentially applicable environmental regulations and agencies include:

- Clean Water Act, Section 404 (U.S. Army Corps of Engineers)
- Clean Water Act, Section 401 (Wyoming Department of Environmental Quality)
- Endangered Species Act (U.S. Fish and Wildlife Service)
- Safe Drinking Water Act (U.S. Environmental Protection Agency)
- 1964 Wilderness Act
- Fish and Wildlife Coordination Act (U.S. Fish and Wildlife Service and Wyoming Game and Fish Department)
- Wyoming State Engineer’s Office
- Wyoming State Lands and Investments Board
- Natural Resources Conservation Service
- U.S. Bureau of Reclamation
- Wyoming Game and Fish Department
- Special Use Permits/Rights-of-Way/Easements

### Clean Water Act

The federal Water Pollution Control Act was passed in 1972 and amended in 1977, when the law became known as the Clean Water Act (CWA), 33 U.S.C. §§ 1251 through 1387. CWA regulates the discharges of pollutants into the waters of the United States. The CWA laws have generally been adopted by state environmental agencies. A significant change in the original 1977 CWA legislation is expanding the regulatory focus from water chemistry to biological and physical properties and from point sources of potential water pollution to non-point sources.

CWA Section 404 established a program to regulate the discharge of dredged or fill materials into waters of the United States. The premise behind the 404 program is that no discharge of dredged or fill material may be permitted if a practical alternative exists that is less damaging to the aquatic environment or if the nation's waters would be significantly degraded. The USACE Wyoming Regulatory Office is responsible for issuing 404 Dredge and Fill Permits in Wyoming. Dredge/fill activities can be authorized under USACE Nationwide, Wyoming Regional General or Individual Permits. Common activities that typically require a 404 Dredge and Fill Permit include, but are not limited to:

- Placement of fill in a wetland or other water
- Dredging or excavating bodies of water
- Stream bank stabilization or alteration
- Stream channel or bank restoration
- Construction of a bridge, road, utility or pipeline crossing over a waterbody
- Dredging or excavating potentially contaminated sediments
- Construction of any type of permanent or temporary dam, causeway, levee or other related structure
- Construction of a pond, wetland, detention basin or related feature
- Dock/ramp construction
- Hydroelectric Power Projects: Federal licensing for hydroelectric power projects by the Federal Energy Regulatory Commission.

Elements of the CWA are administered in Wyoming by the WDEQ, Water Quality Division (WQD) consistent with the Wyoming Environmental Quality Act. The WQD administers the National Pollution Discharge Elimination System (NPDES) Permit and Section 401 Certification. Wyoming point sources of pollution are administered by WQD through the Wyoming Pollutant Discharge Elimination System (WYPDES) Program. The Section 401 Certification is the State's approval to ensure that the activities authorized under Section 404 meet state water quality standards and do not degrade water quality. Any discharge of pollutants into the broadly defined "waters of the state" requires application to, and permit issuance by WQD, in accord with WQD's Rules and Regulations. This body of regulations sets forth classification of surface and groundwater uses and establishes water quality standards. The permits issued by the State's WYPDES Program provide site-specific discharge criteria for municipal wastewater treatment plants, confined animal feeding operations, industrial and commercial wastewater treatment plants, stormwater discharges in larger municipalities, and erosion and sediment control at construction sites.

### Endangered Species Act

The federal Endangered Species Act (ESA), 16 U.S.C. §1531 through 1544, was adopted in 1973 based on the intent to protect plant and animal species that are believed to be on the "brink of extinction" by protecting ecosystems that are inhabited by such species. The ESA is administered primarily by the USFWS of the U.S. Department of the Interior (DOI) and the National Oceanic and Atmospheric Administration (NOAA) of the U.S. Department of Commerce. Under the ESA, plant and animal species may be listed as either "endangered" or "threatened" based on assessment of the imminent or foreseeable risk of extinction. This Act requires that federal agencies insure that any action authorized, funded, or carried out by the federal agencies would not likely jeopardize the continued existence of the listed species or modify their critical habitats.

The lead federal agency prepares a biological assessment to determine project effects on threatened and endangered plant and animal species listed or proposed for listing (candidate species) under the Endangered Species Act (16 U.S.C. §1531 et. Seq.). USFWS would then issue an opinion on whether federal actions are likely to jeopardize the continued existence of a threatened or endangered species, or destroy or adversely modify critical habitat. USFWS must approve the preparation of a biological assessment to comply with the ESA in order to render its decision. If USFWS determines that the preferred alternative would jeopardize the continued existence of a species, it may offer a reasonable and prudent alternative that would preclude jeopardy.

#### Platte River Recovery Implementation Program

Water management and development in the North Platte River Basin has been constrained since designation of critical habitat for whooping cranes, piping plover, and least terns in the Central Platte River in Nebraska was finalized in the 1970s. In 2007 the states of Wyoming, Nebraska, and Colorado entered into a cooperative agreement for the PRRIP with the DOI. The term of the first period is 13 years. The ESA provided the USFWS the authority to require the replacement of existing water depletions in Nebraska and the upstream states to achieve a water supply goal for the critical habitat in the Central Platte River in Nebraska. The water supply goal for the PRRIP was 417,000 acre-feet per year. In addition, the USFWS could assess depletion fees to acquire 29,000 acres of habitat in the Central Platte River in Nebraska.

The PRRIP serves as the reasonable and prudent alternative under the ESA for irrigation, municipal, industrial, and other water uses in place on or before July 1, 1997 in each state. Without the PRRIP, the USFWS would use the ESA consultations required for future federal actions (permits, including renewals; funding; contracts; easements; and others) to require water users (irrigators, municipalities, industries, and others) to replace existing and proposed new depletions until the water goals were met.

The goal of the PRRIP is to provide approximately 150,000 acre-feet of water and 10,000 acres of habitat in the Central Platte River. In addition, the states agreed to curtail new depletions that would impact the PRRIP's water goals. Water users seeking a reliable water supply in Wyoming would likely need to transfer water rights from other uses to secure a firm supply. A transfer of water rights from other uses is not considered a new depletion under the PRRIP.

Each state completed a depletion plan to address managing existing and future water depletions. The Wyoming Depletions Plan (referred to as the "Depletion Plan") identifies existing and new water related activities that are covered by the PRRIP. The Depletion Plan presently provides coverage for depletions authorized by existing, valid Wyoming water rights with a priority date prior to July 1, 1997; the date negotiations began to formulate the PRRIP. In addition, the Depletion Plan addresses new depletions in the North Platte River basin if the proposed water project does not exceed 20 acre-feet per year in water depletions. It is the State of Wyoming's goal to provide any necessary offset or mitigation to any permitted water use activity with a pre-July 1, 1997 priority water right. If Wyoming is unable to provide the offset and all the state-sponsored mitigation that is required in the future, the State may require water users to provide their own mitigation.

Water users seeking water rights for water projects exceeding 20 acre-feet per year of net depletions will likely need to mitigate those depletions by retiring existing water uses in the same quantities and timing as the new depletions or by providing other forms of mitigation.

The SEO North Platte Coordinator is responsible for determining whether the depletions can be covered by the Depletion Plan, reviewing new depletions, and approving any proposed mitigation plans required for new depletions. Prior to 2019, the states and the federal government will likely extend the PRRIP with a second increment.

### Other Threatened or Endangered Species in the Platte River Basin in Wyoming

There are four other species associated with aquatic and wetland environments found in the Platte River Basin of Wyoming. When evaluating the feasibility of new or enlarged surface water development projects, compliance with the ESA is required and USFWS office in Cheyenne should be contacted. These species include:

- The Wyoming toad (*Anaxyrus baxteri*) is a federally listed Endangered Species and is found only in Albany County. A description of the toad and map showing the Area of Influence where any project located within it should consider potential effects to the species is shown in **Appendix 5-B**.
- The Preble's meadow jumping mouse (*Zapus hudsonius preblei*) is a federally listed Threatened Species and is found in Albany, Converse, Laramie, Goshen and Platte Counties. A description of the mouse and map showing the Area of Influence where any project located within it should consider potential effects to the species is shown in **Appendix 5-B**.
- Ute Ladies'-tresses (*Spiranthes diluvialis*) is a Threatened Species of orchid that is widely distributed but nonetheless rare throughout its range. The plant is potentially found in every county within the Platte River Basin in Wyoming. A description of the plant and map showing the Area of Influence where any project located within it should consider potential effects to the species is shown in **Appendix 5.B**.
- The Threatened Colorado butterfly plant (*Gaura neomexicana coloradensis*) is a perennial herb endemic to moist soils in wet meadows of flood plain areas. This plant occurs in southeastern Wyoming, north-central Colorado, and extreme western Nebraska between elevations of 5,000 and 6,400 feet. In Wyoming, this plant is known to occur in Laramie, Goshen and Platte Counties. A description of the plant and map showing the Area of Influence and designated critical habitat is shown in **Appendix 5.B. It is important to note that critical habitats have been designated in Laramie and Platte Counties.**

### National Historic Preservation Act

Because federal approvals are likely involved with any of the identified alternatives, a consideration of effects on cultural resources must be undertaken (Section 106 consultation), as required under the National Historic Preservation Act of 1966 (16 U.S.C. § 470 et seq.).

### Wyoming Board of Land Commissioners

The Wyoming Board of Land Commissioners through SLIB is responsible for regulating all activities on state lands, including granting of rights-of-way. Any facility, utility, road, railroad, ditch or reservoir to be constructed on state or school lands must have a right-of-way, as required in the "Rules and Regulations Governing the Issuance of Rights Of Way" (W.S. 36-20 and W.S. 36-202).

### Wyoming State Engineer's Office

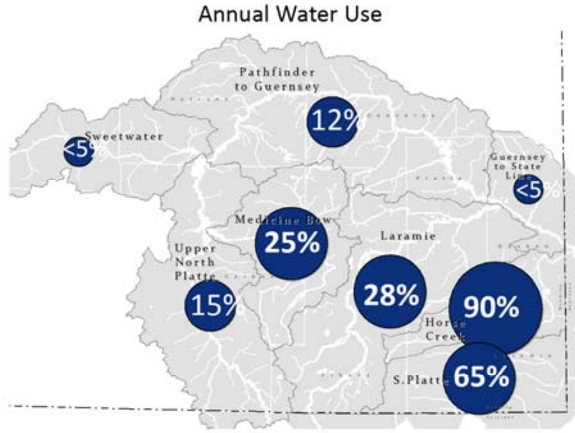
The SEO administers the water rights system of appropriation within the state. New water right permits are obtained from the Surface Water and Groundwater Divisions of the SEO. The applicant must obtain the necessary water rights permits from the State of Wyoming for the diversion and storage of the State's groundwater and surface water. The Wyoming Dam Safety Law requires that any persons, public company, government entity or private company who proposes to construct a dam which is greater than 20 feet high or which will impound more than 50 acre-feet of water, must obtain approval for construction of the dam or ditch from the SEO. The approval by the SEO of a dam's construction is contingent upon the Office's review and approval of all dam plans and specifications, which must be prepared by a registered professional engineer licensed in Wyoming. Design, construction, and operation of jurisdictional dams must also comply with dam safety regulations promulgated pursuant to the Dam Safety Act.

### 5.2.4 Water Resiliency

Quantifying water availability on a system as managed and sought after as the Platte is difficult and perhaps unnecessary given that water is considered fully appropriated in the Basin. However, providing an understanding of how well the system can handle short term disturbance to supply is possible using a few key indicators from the modeling work:

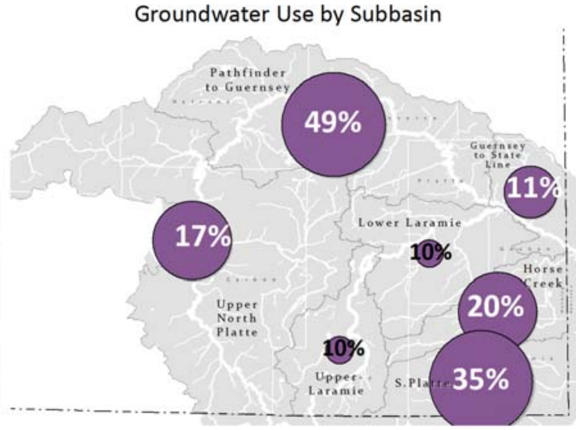
- Water use (relative to the amount of water in the subbasin)
- Access and reliance on groundwater,
- Variability in stream flows from a wet to a dry year, and
- Availability of stored water in reservoirs.

Annual Water Use



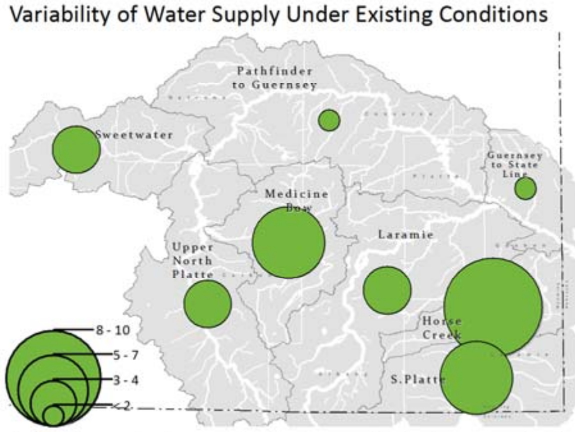

Water Use as a % of annual yield (gains) on average.

Groundwater Use by Subbasin



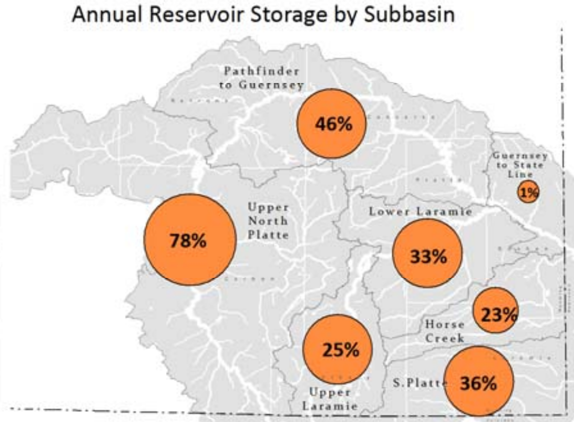

Proportion of consumptive use from groundwater.

Variability of Water Supply Under Existing Conditions




Ratio of annual wet year gains to dry year. Higher is more variable.

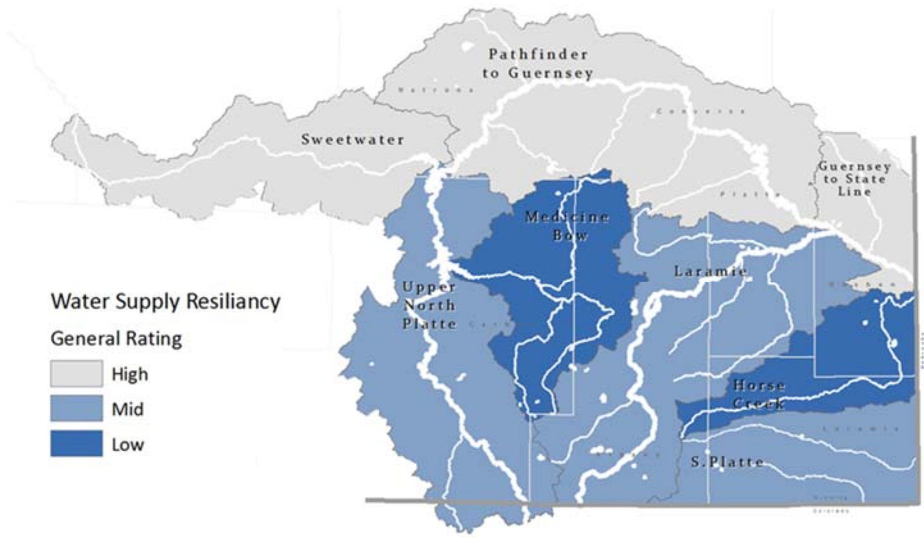
Annual Reservoir Storage by Subbasin




Proportion of avg. annual yield (gains) stored in reservoirs.

Using these four variables we can get an idea of how resilient a subbasin might be to short term impacts to water supply. For example, water users in a subbasin with a highly variable streamflow regime, with a high amount of surface water use and low storage supply would be highly impacted by drought. Conversely, if there are fairly consistent stream flows from a wet to dry year, and a low water use, a drought may not be as serious of a problem.

This map summarizes the four indicators to illustrate short term water resiliency relative to other subbasins within the Platte. A high resiliency rating means a more dependable water supply. The results are described below:




**Above Pathfinder** has significant spring runoff available due to the high mountain ranges on either side of the valley and varies less from a wet to dry year than in lower ranges of the Platte. Even with the highest amount of irrigation of any subbasin, the consumptive use is low compared to the natural yield of the Basin. Within the subbasin, the **Medicine Bow** stands out as highly variable stream flows and a relatively high amount of water use. This is somewhat buffered by storage in the Basin; however, most of the storage is not available in the Medicine Bow since it is stored in Seminoe and Pathfinder reservoirs. High overall resiliency rating on **Sweetwater** subbasin reflects the low water use average of 6,500 acre feet.

**Pathfinder to Guernsey** subbasin is more resilient relative to other subbasins due to availability of reservoir storage, low amount of water use, consistency of stream flows, and significant amount of groundwater use.

**Guernsey to State Line** has a high resiliency due to the consistency of flows, largely due to regulated flows from Guernsey and other upstream federal reservoir projects.

**Upper Laramie** has a fairly high amount of annual use to yield, and a lower access to stored water than the North Platte or the Lower Laramie subbasins. With an annual stream flow that is only three times lower on a dry year from wet year the lower variability improves its resiliency.

**Lower Laramie** has a similar score to Upper Laramie but mainly due to the amount of storage that is available.

**Horse Creek** subbasin gets the lowest resiliency score due to highly variable streamflows from dry years to wet years, a low amount of storage on average under 25% of water yield, and a high amount of water use.

**South Platte** also has highly variable stream flows, but is moderated by reservoir storage and diversions from outside of the South Platte subbasin and significant groundwater use. For these reasons, it has a higher resilience than the similar Horse Creek subbasin.

### 5.2.5 Funding Sources

Various state and federal funding sources could be available for different water supply projects within the Platte River Basin depending upon the type of the project being planned and the specific funding requirements and available funds of the respective funding agencies.

#### State of Wyoming Funding Sources

**Table 5.1** at the end of this section summarizes the requirements and limitations of the potential State of Wyoming funding programs described below.

**Table 5.1: State of Wyoming Funding Programs**

| Program | Agency | Grant/Loan Requirements | Maximum Funding Amount |
|---|---|---|---|
| **Non-Point Source Pollution Control** | WDEQ | Grant funds to address water quality issues | $200,000 |
| Level I and II Planning Studies | WWDC | Grant funding for reconnaissance and feasibility level studies | |
| Level III New Development and Rehab Program | WWDC | 67% grant / 33% loan or equivalent local match Grant % up to 75% based on public/non-agricultural benefits and sponsor hardship | $15M |
| Level III Dam and Reservoir Program | WWDC | 67% grant / 33% loan or equivalent local match Grant % up to 75% based on public/non-agricultural benefits and sponsor hardship | Subject to Legislative approval |
| Small Water Project Program | WWDC | Total costs must be less than $135,000. Maximum WWDC contribution 50% of project costs or $35,000 maximum. | $35,000 |
| State Loan and Investment Board Farm Loan Program | Office of State Lands and Investments | Grant/Loan Program, legal entity meeting individual requirements | $600,000 or $150,000 loans (subject to appropriation for some programs) |
| Wyoming Wildlife and Natural Resource Trust | Independent Wyoming State Agency | Grant funds, applications accepted in September and April | $200,000 or more large project |

**Wyoming Department of Environmental Quality.** The DEQ has a non-point source program which focuses on water quality issues and may be a funding source depending on the project. These are Federal monies administered by the DEQ. The drawback is that the maximum funding is in the $200,000 range and only $2 million per year is available through this program for the entire state of Wyoming. The priority for this program is those projects or improvements that reduce seepage or return flows thereby improving the water quality of the receiving waters of the State.

**State Lands and Investment Board.** The Wyoming SLIB provides farm loans to foster and encourage agriculture, dairying, and livestock production in the State. Loans are also available for the development and improvement of farm lands. SLIB offers regular farm loans, beginning agricultural producer's loans, and small water development project loans. The specific information for SLIB loan programs is summarized below.

Single regular farm loans or combination of loans made to an individual, or entity, shall not exceed $600,000. The loan interest rates vary (depending on the amount of the loan versus the appraised value of the security land and improvements) and are established by SLIB rules with the term of the loan not exceeding 30 years.

Small water development project loans have been authorized to finance projects for development and use of water upon agricultural lands for agricultural purposes. Individual loans may be made for sums not to exceed $150,000 at interest rates established by SLIB rules (term not to exceed 30 years). Loans may be provided to court-approved water districts, agencies of State and local government, persons, corporations, associations, and other legal entities in the State of Wyoming.

Federal mineral royalty capital construction grants and loans are available for municipal, county or special districts and involve the planning, construction, acquisition, improvement or emergency repair of public facilities and acquisition of emergency vehicles. Each

application is considered individually by the SLIB with the amount of funding varying, but up to 75% of the total project cost. The funding source is federal mineral royalties, and is subject to appropriation.

**Wyoming Water Development Commission.** The WWDC includes new development, rehabilitation, dam and reservoir, and water resources planning. Level I studies are reconnaissance level analysis and comparison of development alternatives. Level II projects typically consist of two phases which serve first to address project feasibility, and if a project is determined feasible, to refine the project to the status of being ready for a Level III funding request. Level III work activities include project design, permitting, land acquisition, construction and construction engineering. WWDC Level III funding packages currently offer a maximum of 67% in grant money with 33% in loans. A funding package with a higher percentage of grant monies can be sought for multi-purpose projects that propose public access and non-agricultural benefits, such as wildlife habitat enhancement and fishery benefits.

Given the age and deterioration of irrigation infrastructure within the State of Wyoming, obtaining funds through the rehabilitation program is becoming highly competitive. Furthermore, there is no guarantee of the amount of monies provided through appropriations by the State Legislature.

The Dam and Reservoir Program is applicable to 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. The funds available in this program are currently less competitive than the rehabilitation program.

**WWDC Small Water Project Program.** The SWPP is intended to be compatible with the conventional WWDC program described above. The purpose of the 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. A small project is defined as one where estimated construction or rehabilitation costs, permit procurement, construction engineering and project land procurement are $135,000 or less. Units of government and court approved special districts are eligible to apply. SWPP funding is a "one-time" grant so that ongoing operation and maintenance costs are not included. Loans are not available under SWPP. The SWPP will fund up to 50% of the total project costs up to a maximum amount of $35,000.

**Wyoming Wildlife and Natural Resource Trust.** The Wyoming Wildlife and Natural Resource Trust (WWNRT) was authorized by the Wyoming State Legislature and signed into law by the Governor in 2005 to preserve and enhance Wyoming's wildlife habitat and natural resources. Projects funded by WWNRT must provide public benefits such as continued agricultural production to maintain open space and healthy ecosystems, enhancements to water quality, and maintenance or enhancement of wildlife habitat. Funding is by grant with no matching funds required. Non-profit and governmental organizations, including watershed improvement districts, conservation districts, and irrigation districts are eligible for funding.

### Federal Government Funding Sources

**Table 5.2** lists federal funding programs which may provide funding for potential water management and improvement projects in the Basin. Most if not all programs require a local match that could be met with a WWDC grant.

**Table 5.2: Federal Funding Programs**

| Program | Agency | Eligibility Requirements | Maximum Funding Amount | Applications / Available Funding |
|---|---|---|---|---|
| **Soil and Water Conservation** | USDA NRCS | Grant – planning, applying resource conservation practices; irrigation district applicable; 50% cost share | $150,000 | |
| Watershed Protection, PL 566 | USDA NRCS | Grant – irrigation water management and other purposes; 50% local cost share | $5M w/o Congressional approval | Backing of $1.8B in projects |
| Environmental Quality Incentives (EQIP) | USDA NRCS | Focus on agricultural producers; 50% cost share | $150,000 | Up to $20M |
| Water and Environmental Programs | USDA, Rural Development WEP | Grants/Loans for governmental entities serving less than 10,000 people | Grants may be available | Up to $4.5M annually in Wyoming |
| WaterSMART | USBR | Grant – Water and Energy Efficiency, 50% cost share | $1M | Up to $14M |
| US Fish and Wildlife Service | USFWS | Grants, 50% cost share match | $50k | |

Although these programs are potential sources of funding for infrastructure upgrades, some programs are easier to access than others. Applications for funding from any Federal program will require substantial effort to prepare. All of the Federal programs will require adherence and approvals following the NEPA process before any project disturbance activities. There is always a risk that the application will not be funded and the time devoted to the application process will be unproductive.

**USDA PL 566 and Environmental Quality Incentives Program.** The U.S. Department of Agricultural (USDA) programs include Watershed Protection assistance under Public Law 566, Soil and Water Conservation funding programs, and Environmental Quality Incentives

Program (EQIP). The largest pool of money is within the PL 566 program. Eligibility for this funding is based on watershed protection. Significant water quality issues and/or threats to water quality must be documented in the application. The program requires a 50% cost share from the applicant. Up to $5M can be granted without Congressional approval. Larger amounts are available with Congressional approval.

The EQIP program requires a 50% cost share and its total funding is limited to $150,000 per project. However, if organized through farmer initiatives for projects such as lateral improvements or construction of other on-farm structures, EQIP funding is easier to obtain than other Federal monies.

The application process for USDA funding programs requires a commitment of time and effort. USDA and other federal programs are not geared to crisis response or immediate availability as the review and approval process can be lengthy. Furthermore, the money provided by federal sources is generally accompanied by more stringent permitting requirements.

**Rural Development Water and Environmental Program.** Through the Rural Utilities Service Water and Environmental Programs, rural communities obtain the technical assistance and financing necessary to develop drinking water and waste disposal systems. Safe drinking water and sanitary waste disposal systems are vital not only to public health, but also to the vitality of rural America. The program provides low interest loans and loans may be combined with grants to keep users' costs reasonable. The funds may be used to finance the acquisition, construction, or improvement of drinking water sources, treatment, storage or distribution as well as sewer collection, transmission, treatment and disposal; and storm water collection, transmission and disposal.

**WaterSMART.** The USBR provides grants for projects that implement water savings or energy efficiencies. Agricultural water saving grants are popular, particularly with irrigation districts that are served by Federal water projects. The WaterSMART funding requires a 50% cost share commitment by September 1 of the year the Funding Opportunity Announcement (FOA) is released. The FOA is released in the fall and awards are announced in the early summer months.

**U.S. Fish and Wildlife Service.** Technical and financial assistance is available to private landowners, profit or non-profit entities, public agencies, and public-private partnerships under several programs addressing the management, conservation, and restoration or enhancement of wildlife and aquatic habitat (including riparian areas, streams, wetlands, and grasslands). These programs include, but are not necessarily limited to the North American Wetlands Conservation Act Grant Program (NAWCA) and Landowner Incentive Program. The NAWCA grants are limited to $75,000 for one project.

### Local Funding Sources

Conservation Districts, county and municipal governments may have funds available for development of water focused recreation facilities, resource protection and enhancement projects.

### Private Funding Sources

There are a number of non-governmental organizations that support natural water resource and watershed conservation, protection and enhancement activities including: 1) The Nature Conservancy, 2) Ducks Unlimited, 3) Trout Unlimited, 4) The Rocky Mountain Elk Foundation and, 5) Pheasants Forever among others.

### 5.2.6 References

Platte River Recovery Implementation Program, 2006. Governance Committee, Program Document, Attachment III, Section 7, Depletions Plan, Platte River Basin, Wyoming (Wyoming's Depletions Plan), October 24, 2006.

Squillace, Mark, 1989. A Critical Look at Wyoming Water Law, Land and Water Law Review, Vol. 24, University of Wyoming, WWRC-89-44.

Wyoming Water Strategy, 2015. Leading the Charge, Governor Mathew H. Mead, State of Wyoming.

Wyoming Water Development Commission, 2006. Platte River Basin Plan, prepared by Trihydro Corp., Lidstone and Associates, Harvey Economics, Water Rights Services LLC, May 2006. Inc

Wyoming Water Development Commission, 2007. Wyoming Framework Water Plan, Volume II, Planning Recommendations, prepared by WWC Engineering, Hinckley Consulting, Collins Planning Associates, Greenwood Mapping, Inc., States West Water Resources Corporation, October 2007.

Wyoming Water Development Commission, 2014. Settlement of the Nebraska v. Wyoming Law Suit, North Platte River Basin Planning Study, Mike Purcell, March 31, 2014.

## 5.3 WATER QUALITY ISSUES

### 5.3.1 Introduction

This section presents an update on water quality issues within the Platte River Basin of Wyoming affecting existing and future uses. The principal focus of this water quality update to the Platte River Basin Plan (Trihydro, 2006) has been to identify measures that have been implemented since and during the past 10 years. This update includes the identification of areas within the Basin where water quality issues are being investigated by state, federal and other governmental entities, including the DEQ, SEO, WGFD, the Wyoming Association of Conservation Districts (WACD), BLM, NRCS, the U.S. Geologicl Survey (USGS), and the EPA.

A discussion of state and federal water quality regulations, Wyoming water quality standards, total maximum daily loads (TMDL) per Section 305(b) of the Clean Water Act, Wyoming stream classifications, the NPDES, and the DEQ Beneficial Use Reconnaissance Program within the Platte River Basin was provided in Trihydro, 2006, Technical Memorandum 5-3. Surface and groundwater impact studies performed within the Basin on selenium, storm water, nitrates and pesticides were addressed in Trihydro, 2006. Technical Memorandum 5-3 (Trihydro, 2006) also discussed ongoing (as of 2005) water quality monitoring and remediation efforts by conservation districts located within the Platte River Basin and identified water quality issues.

The information presented herein identifies and updates on-going watershed management planning being performed by state and federal agencies and discusses opportunities for cooperation and coordination of these efforts. Finally, this update provides recommendations and strategies for protecting and improving water quality within the basin.

### 5.3.2 State and Federal Regulations

In 2015, EPA finalized updates to the federal water quality standards regulations (40 CFR 131) pursuant to provisions of the CWA. The basic structure of these regulations was last revised in 1983. Minor revisions were made in 2000 ("Alaska Rule") and 2004 ("Beach Act Rule"). In finalizing these revisions, EPA stated that "*the updated rules provide a better defined pathway for states, territories and authorized tribes to improve water quality and protect high quality waters through the enhancement of the current regulation's effectiveness, water quality standards transparency, and better opportunity for meaningful public engagement at the state, territorial, tribal and local levels*" (EPA, 2015).

EPA believes that these updated regulations accomplish several goals for protecting the country's water resources, including: 1) allowing EPA, states or tribes to communicate directly on those areas where water quality standard improvements should be made and establish a more transparent regulatory process; 2) ensuring that appropriate water quality standards are in place to help restore and maintain aquatic ecosystems and promote resilience to emerging water quality stressors; 3) providing for a transparent review process of water quality standards so that states and tribes can update the standards when necessary and consider the latest science available as reflected in the CWA Section 304(a) criteria recommendations; 4) promoting public transparency and enhance antidegradation through clearer requirements and expectations of what is required; 5) promoting the appropriate use of water quality variances when applicable standards are not attainable now but may become attainable in the future; and, 6) clarifying how states and tribes can utilize permit compliance schedules while ensuring public transparency on the process.

As of November 2015, EPA is also considering several revisions to the Safe Drinking Water Act to clarify certain issues with the current lead prohibition in Section 1417 of the Rule, regulate the levels of perchlorate in drinking water, revision downward of the maximum contaminant levels for chromium, and revision of the Lead and Copper Rule to improve public health protections and further enhance the quality of the nation's drinking water.

### 5.3.3 Updated Watershed Management Activities to Resolve Water Quality Issues

#### Wyoming Department of Environmental Quality, Water Quality Division

**Total Maximum Daily Load Coordination.** In accordance with Section 305(b) of the CWA, the DEQ, WQD continues to prepare a water quality assessment report every two years describing the water quality of all navigable waters within the state. While WQD is working to complete the 2014 report, the most recent final report that is currently available was completed in 2012. As of 2012, 18,713, or 3.3% of the 569,269 acres of Wyoming's Lakes, Reservoirs and Ponds had been assessed and use support status determined, whereas 17,515, or 6.2% of the 280,804 miles of Wyoming's streams had use support determinations. EPA guidance specifies that all surface waters of the state be placed into one of five designated use attainment categories. Category 1 waters are those that support all their designated uses and have no water quality threats or impairments. Category 2 waters are those for which some designated uses are supported, but the status of others remains unknown. Category 3 waters are those waters for which insufficient data exists to make use support determinations. Category 4 waters are those waters which have a designated use that is impaired or threatened and either a TMDL has been completed (4A); other pollution control measures are expected to address the impairment (4B); or pollution (e.g. flow alteration) not a pollutant is the source of impairment (4C). Lastly, Category 5 waters, or those on the state's 303(d) List, are waters where one or more uses are either impaired or threatened and a TMDL is required. There are currently no known Category 1 streams in the state of Wyoming (WQD, 2012).

WQD includes in each report a list (required by the CWA, Section 303(d)) of Category 5 streams that are impaired or threatened from meeting beneficial uses. For each stream that is included in the 303(d) list, WQD must calculate a TMDL for each pollutant of concern within the stream. **Table 5.3.1** includes a listing of 303(d) listed streams in the Platte River Basin along with the reason for their listing and the TMDL date. Note: Streams highlighted in yellow are also 303(d) listed in 2004.

As shown on **Figures 5.3.1 through 5.3.5**, 303(d) listed and Category 4 streams have thus far been identified in five of the subbasins. The longest impaired reaches have been identified along the North Platte River near the Kendrick Project as shown on **Figure 5.3.2**, on Rock and Wheatland Creeks near Wheatland as shown on **Figure 5.3.4**, and along Crow Creek near Cheyenne as shown on **Figure 5.3.5**.

**Table 5.3.1: 2012 303(d) Listed Streams in the Platte River Basin**

| Waterbody | 305(b) Identifier | Class | Location | Miles / Acres | Uses / Use Support | Cause(s) / Source(s) | List Date | TMDL Date |
|---|---|---|---|---|---|---|---|---|
| **North Platte River Basin** | | | | | | | | |
| Lander Creek | WYNP101800060104_01 | 2AB | A 0.5 section of Lander Creek between two unnamed tributaries and adjacent to County Route 132 (in SW S8 T29N R103W, within HUC 12 boundary 101800050104) | 0.5 mi | Recreation | E. coli | 2012 | 2023 |
| | | | | | Not Supporting | Grazing | | |
| Crooks Creek | WYNP101800060603_01 | 2AB | From the confluence with Mason Creek to a point 1.4 miles downstream | 1.4 mi | Cold Water Game Fishery, Aquatic Life other than Fish | Oil and Grease | 1998 | 2012 |
| | | | | | Not Supporting | Petroleum Production | | |
| North Platte River | WYNP101800070300_01 | 2AB | From Casper Canal downstream to the confluence with the North Platte River | 36.8 mi. | Cold Water Game Fishery, Aquatic Life other than Fish | Selenium | 1998 | 2009 |
| | | | | | Not Supporting | Irrigated Crop Production, Natural Sources | | |
| Poison Spring Creek | WYNP101800070302_01 | 3B | From Casper Canal downstream to the confluence with the North Platte River | 8.2 mi. | Aquatic life other than fish | Selenium | 2000 | 2009 |
| | | | | | Not Supporting | Irrigated Crop Production, Natural Sources | | |
| Rasmus Lee Lake | WYNP101800070302_02 | 3B | Within the Kendrick Reclamation Project | 85.2 mi. | Aquatic life other than fish | Selenium | 2000 | 2009 |
| | | | | | Not Supporting | Irrigated Crop Production, Natural Sources | | |
| Goose Lake | WYNP101800070302_03 | 3B | Within the Kendrick Reclamation Project | 30.1 ac. | Aquatic life other than fish | Selenium | 2000 | 2009 |
| | | | | | Not Supporting | Irrigated Crop Production, Natural Sources | | |

**Table 5.3.1: 2012 303(d) Listed Streams in the Platte River Basin**

| Waterbody | 305(b) Identifier | Class | Location | Miles / Acres | Uses<br>Use Support | Cause(s)<br>Source(s) | List Date | TMDL Date |
|---|---|---|---|---|---|---|---|---|
| Oregon Trail Drain | WYNP101800070303_01 | 3B | Within the Kendrick Reclamation Project | 8.6 mi. | Aquatic life other than fish | Selenium | 2000 | 2009 |
| | | | | | Not Supporting | Irrigated Crop Production, Natural Sources | | |
| Poison Spider Creek | WYNP101800070406_01 | 2AB | From the confluence with the North Platte River to the confluence with Iron Creek, within the Kendrick Reclamation Project | 1.3 mi. | Cold Water Game Fishery, Aquatic Life other than Fish | Selenium | 2000 | 2009 |
| | | | | | Not Supporting | Irrigated Crop Production, Natural Sources | | |
| Poison Spider Creek | WYNP101800070406_02 | 2C | From the confluence with Iron Creek to a point 5.8 miles upstream | 5.8 mi | Non-Game Fishery, Aquatic Life other than Fish | Selenium | 2000 | 2009 |
| | | | | | Not Supporting | Irrigated Crop Production, Natural Sources | | |
| Poison Spider Creek | WYNP101800070406_03 | 3B | From the HUC 12 boundary (101800070406) to a point 6.0 miles downstream, within the Kendrick Reclamation Project | 6.0 mi | Aquatic Life other than Fish | Selenium | 2000 | 2009 |
| | | | | | Not Supporting | Irrigated Crop Production, Natural Sources | | |
| Illco Pond | WYNP101800070503_01 | 3B | NE S13 T35N R81W, within HUC 12 boundary (101800070503) | 1.1 ac | Aquatic Life other than Fish | Selenium | 2000 | 2009 |
| | | | | | Not Supporting | Irrigated Crop Production, Natural Sources | | |
| Casper Creek | WYNP101800070504_01 | 2AB | From the confluence with the North Platte River to a point 21.1 miles upstream, within the Kendrick Reclamation Project | 21.1 ac | Cold Water Game Fishery, Aquatic Life other than Fish | Selenium | 2000 | 2009 |
| | | | | | Not Supporting | Irrigated Crop Production, Natural Sources | | |
| Thirty Three Mile Reservoir | WYNP101800070703_01 | 3B | Along South Fork Casper Creek within Kendrick Reclamation Project | 30.2 ac | Aquatic Life other than Fish | Selenium | 2000 | 2009 |
| | | | | | Not Supporting | Irrigated Crop Production, Natural Sources | | |

**Table 5.3.1: 2012 303(d) Listed Streams in the Platte River Basin**

| Waterbody | 305(b) Identifier | Class | Location | Miles / Acres | Uses<br>Use Support | Cause(s)<br>Source(s) | List Date | TMDL Date |
|---|---|---|---|---|---|---|---|---|
| Laramie River | WYNP101800100201_01 | 2AB | From State Highway 10 to a point 0.3 miles upstream | 0.3 mi | Recreation<br>Not Supporting | *E. coli*<br>Unknown | 2012 | 2023 |
| Little Laramie River | WYNP101800100605_01 | 2AB | From Mandel Lane upstream to Snowy Range Road | 15.7 mi | Recreation<br>Not Supporting | *E. coli*<br>Unknown | 2012 | 2023 |
| Laramie River | WYNP101800100707_01 | 2AB | A 2.9 mile section of stream intersecting Ione Lane, below Bosler Junction | 2.9 mi | Recreation<br>Not Supporting | *E. coli*<br>Unknown | 2012 | 2023 |
| Wheatland Creek | WYNP101800110502_01 | 2C | From the confluence with Rock Creek downstream to Wheatland Highway | 2.4 mi | Non-Game Fishery, Aquatic Life other than Fish<br>Not Supporting | Ammonia<br>Municipal WWTF | 1996 | 2014 |
| Wheatland Creek | WYNP101800110502_01 | 2C | From the confluence with Rock Creek downstream to Wheatland Highway | 2.4 mi | Non-Game Fishery, Aquatic Life other than Fish<br>Not Supporting | pH<br>Municipal WWTF | 1996 | 2014 |
| Wheatland Creek | WYNP101800110502_01 | 2C | From the confluence with Rock Creek downstream to Wheatland Highway | 2.4 mi | Recreation<br>Not Supporting | Fecal Coliform<br>Unknown | 2002 | 2014 |
| Rock Creek | WYNP101800110502_02 | 2C | Entire watershed above the confluence with Wheatland Creek | 34.9 | Recreation<br>Not Supporting | Fecal Coliform<br>Unknown | 2002 | 2014 |
| **South Platte River Basin** | | | | | | | | |
| Middle Fork Crow Creek | WYSP101900090101_01 | 2AB | A 1.5 mile section of creek at FS Road 700 crossing | 1.5 mi | Recreation<br>Not Supporting | *E. coli*<br>Grazing | 2010 | 2015 |
| North Branch North Fork Crow Creek | WYSP101900090104_01 | 2AB | From FS Road 701 upstream 300 yards | 0.2 mi | Recreation<br>Not Supporting | *E. coli*<br>Grazing | 2004 | 2015 |
| Crow Creek | WYSP101900090107_01 | 2C | From the inlet of Hereford Reservoir #2 upstream to the outlet of Hereford Reservoir # | 9.4 mi | Recreation<br>Not Supporting | Fecal Coliform<br>Stormwater | 1996 | 2010 |
| Crow Creek | WYSP101900090107_02 | 2C | From 0.7 miles below Morrie Avenue downstream to the inlet of Hereford Reservoir #1 | 3.7 mi | Non-Game Fishery, Aquatic Life other than Fish<br>Not Supporting | Selenium<br>Petroleum Production | 2010 | 2010 |
| Crow Creek | WYSP101900090107_02 | 2C | From 0.7 miles below Morrie Avenue downstream to the inlet of Hereford Reservoir #1 | 3.7 mi | Recreation<br>Not Supporting | *E. coli*<br>Stormwater | 2012 | 2010 |

### Table 5.3.1: 2012 303(d) Listed Streams in the Platte River Basin

| Waterbody | 305(b) Identifier | Class | Location | Miles / Acres | Uses<br>Use Support | Cause(s)<br>Source(s) | List Date | TMDL Date |
|---|---|---|---|---|---|---|---|---|
| Crow Creek | WYSP101900090107_02 | 2C | From 0.7 miles below Morrie Avenue downstream to the inlet of Hereford Reservoir #1 | 3.7 mi | Non-Game Fishery, Aquatic Life other than Fish<br>Not Supporting | Sediment<br>Stormwater | 2012 | 2010 |
| Crow Creek | WYSP101900090107_03 | 2C | From 0.7 miles below Morrie Avenue downstream to the inlet of Hereford Reservoir #1 | 0.7 mi | Non-Game Fishery, Aquatic Life other than Fish<br>Not Supporting | Sediment<br>Stormwater | 2010 | 2010 |
| Crow Creek | WYSP101900090107_03 | 2C | From Morrie Avenue to a point 0.7 miles downstream | 0.7 mi | Recreation<br>Not Supporting | *E. Coli*<br>Stormwater | 2012 | 2010 |
| Crow Creek | WYSP101900090107_04 | 2AB | From Morrie Avenue to a point 0.7 miles downstream | 3.4 mi | Recreation<br>Not Supporting | *E. Coli*<br>Stormwater | 2012 | 2010 |
| Crow Creek | WYSP101900090107_04 | 2AB | From Morrie Avenue upstream to Happy Jack Road | 3.4 mi | Cold Water Game Fishery, Aquatic Life other than Fish<br>Not Supporting | *E. Coli*<br>Stormwater | 2012 | 2010 |
| Crow Creek | WYSP101900090107_05 | 2AB | From Morrie Avenue upstream to Happy Jack Road | 3.1 mi | Recreation<br>Not Supporting | *E. Coli*<br>Unknown | 2012 | 2010 |
| Crow Creek | WYSP101900090203_01 | 2C | From Missile Road (HWY 217) upstream to the outlet of Hereford Reservoir #2 | 10.1 mi | Recreation<br>Not Supporting | *E. Coli*<br>Unknown | 1996 | 2010 |
| Note: Streams highlighted in yellow are also 303(d) listed in 2004. | | | | | | | | |

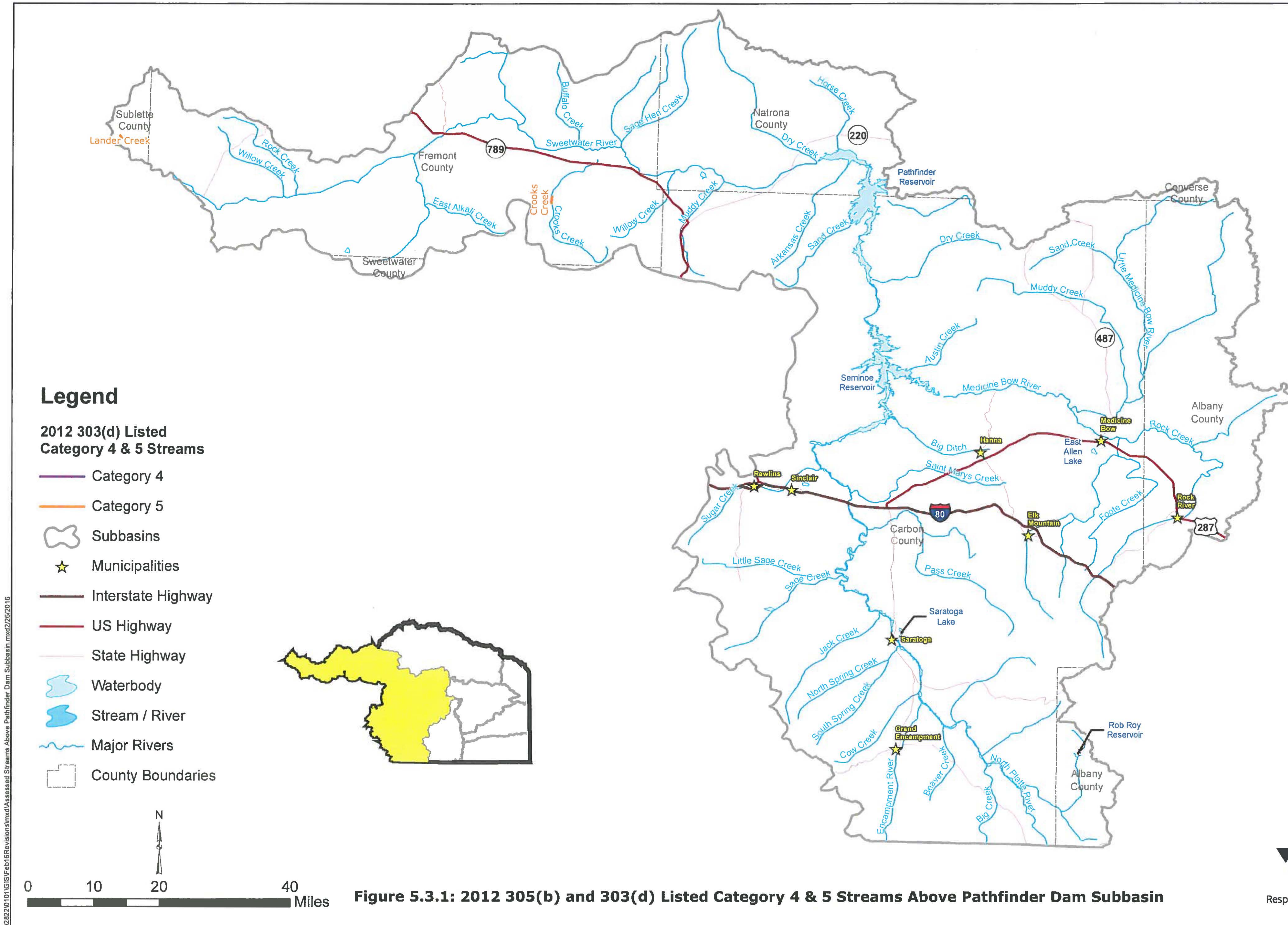



**Figure 5.3.1: 2012 305(b) and 303(d) Listed Category 4 & 5 Streams Above Pathfinder Dam Subbasin**

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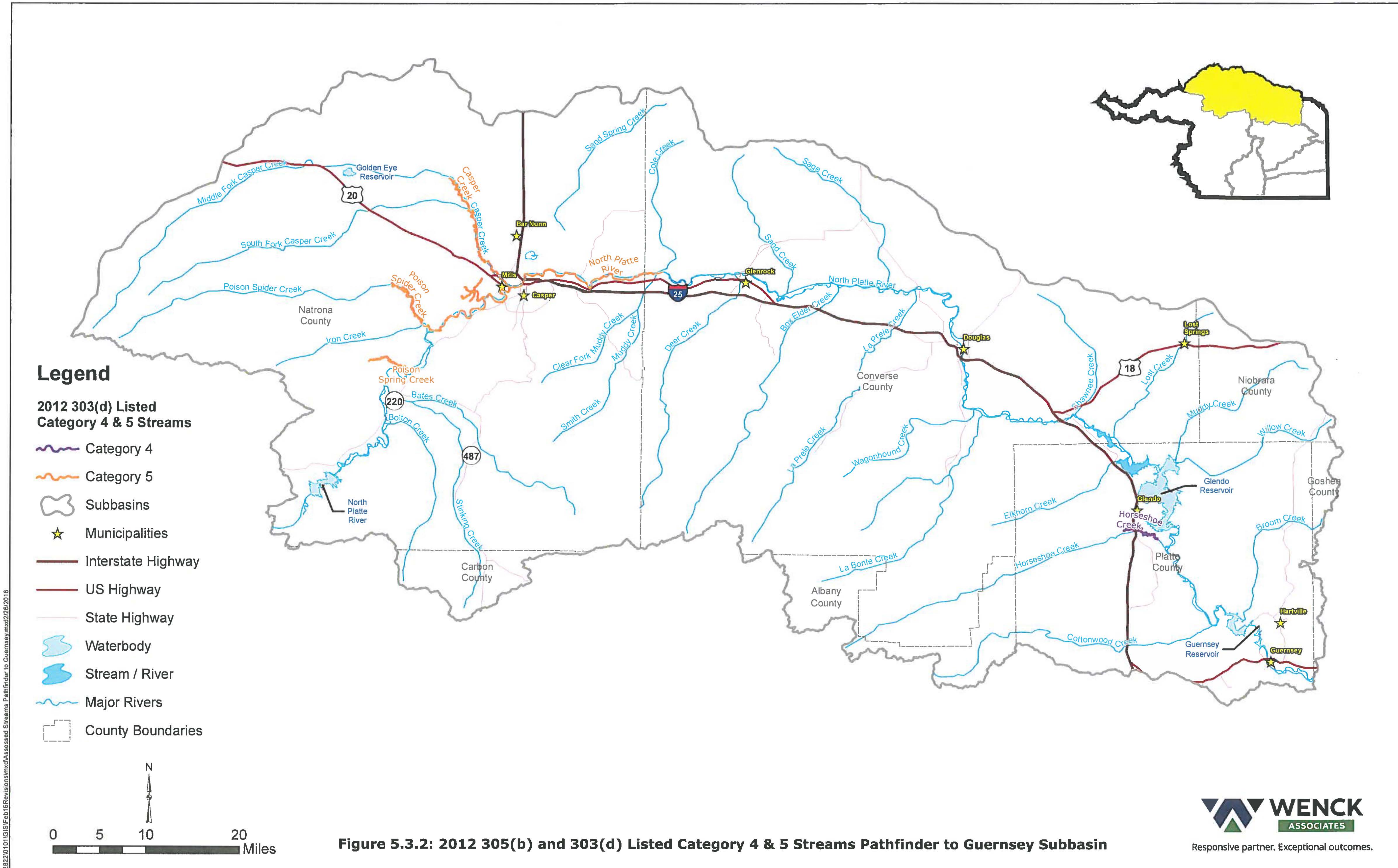


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**Figure 5.3.2: 2012 305(b) and 303(d) Listed Category 4 & 5 Streams Pathfinder to Guernsey Subbasin**

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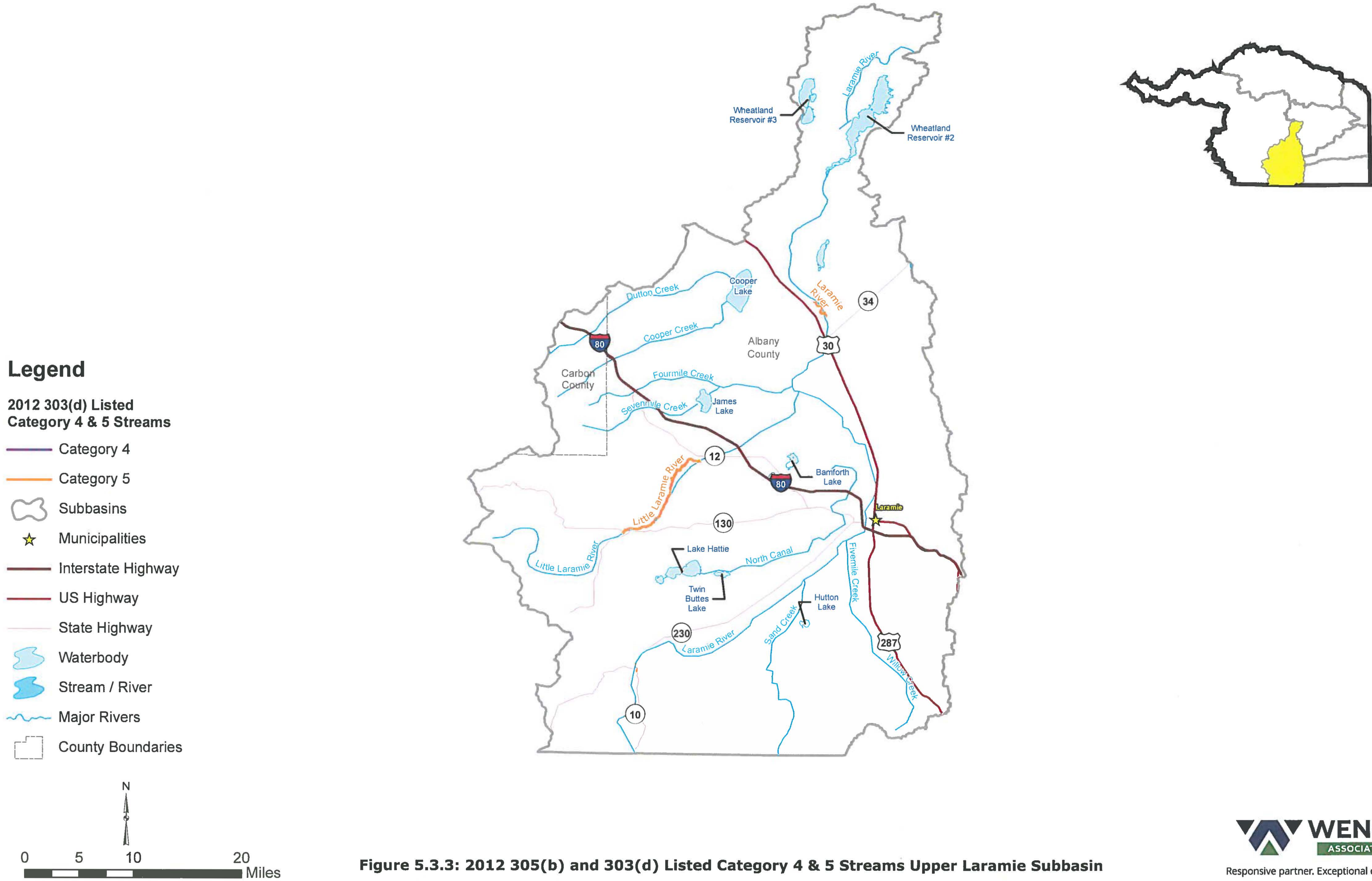


Figure 5.3.3: 2012 305(b) and 303(d) Listed Category 4 & 5 Streams Upper Laramie Subbasin

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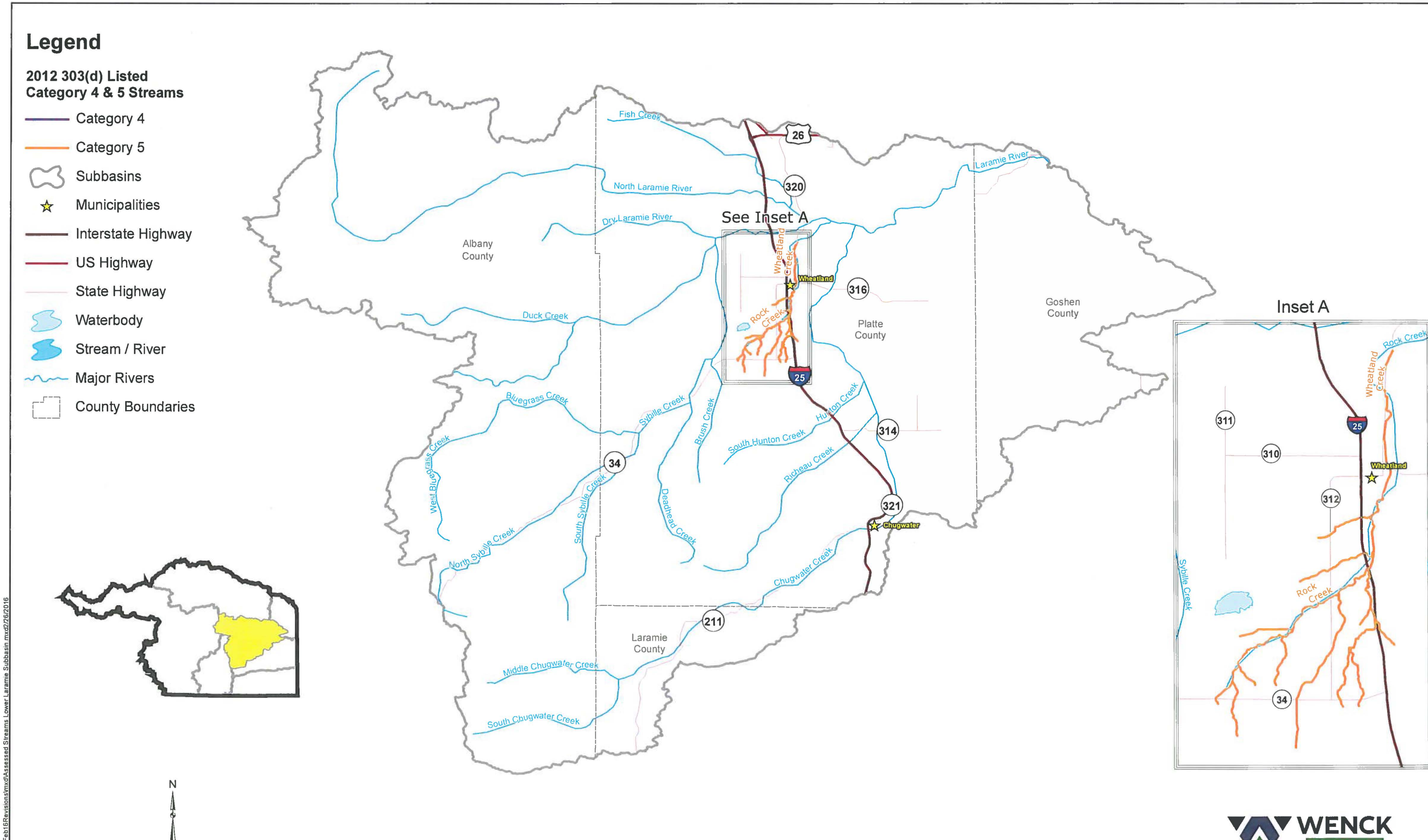


Figure 5.3.4: 2012 305(b) and 303(d) Listed Category 4 & 5 Streams Lower Laramie Subbasin

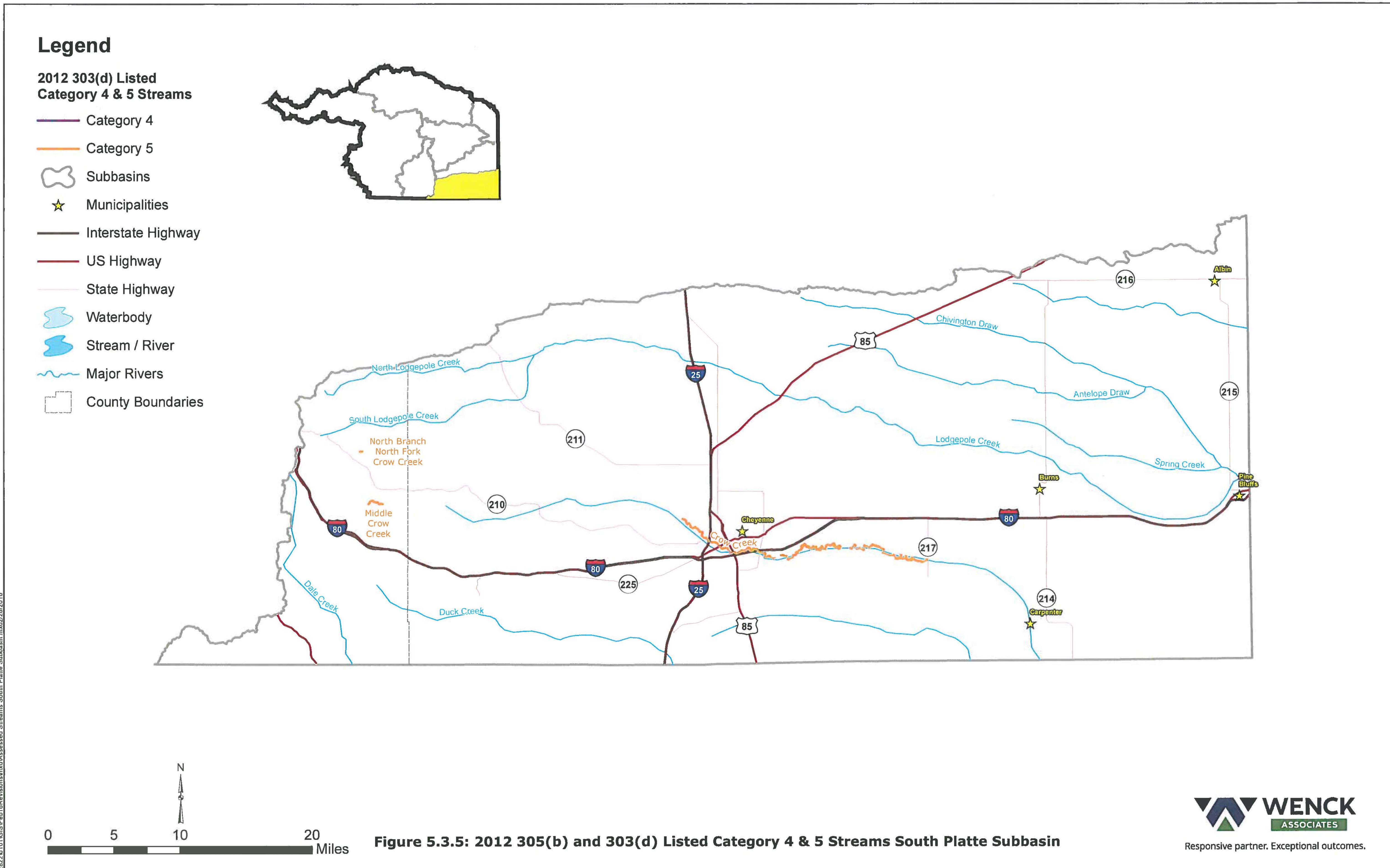


Figure 5.3.5: 2012 305(b) and 303(d) Listed Category 4 & 5 Streams South Platte Subbasin

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WQD continues to evaluate TMDL projects and actively encourages participation from local stakeholders within each watershed in the development of assumptions, calculations and restoration methods. WQD considers public outreach and involvement critical for the success of a TMDL project.

**Nutrient Reduction Plan.** To assist in the development and implementation of a nutrient reduction strategy, WQD formed the Wyoming Nutrient Workgroup comprised of a group of stakeholders, including representatives from the agriculture industry, municipalities, water and wastewater management, land and resource management and environmental groups.

Nutrients, such as nitrogen and phosphorus, are necessary for maintaining a healthy aquatic ecosystem. However, excessive quantities of these nutrients can result in excessive growth of vegetation within the system leading to oxygen depletion, high pH and general degradation of the aquatic resource. Nutrient pollution in drinking water supplies may require costly treatment, while surface waters with excessive nutrients may impact the use of water for recreation, livestock and wildlife.

In 2011, EPA issued a "Framework for Managing Nitrogen and Phosphorus Pollution" to assist in the development of a Wyoming specific nutrient reduction plan (EPA, 2011a). The framework recommends that the State:

- Prioritize watersheds on a statewide basis for nitrogen and phosphorus loading reductions.
- Set watershed load reduction goals based on the best available information.
- Ensure effectiveness of point source permits in targeted/priority sub-watersheds.
- Identify and implement agricultural conservation practices in targeted areas.
- Identify and implement improvements to storm water systems, septics, lawn fertilizers and detergents.
- Verify and document load reductions.
- Report implementation activities annually and load reductions biannually.

Since 2005, WQD has been analyzing nutrient concentrations at levels low enough to assist with nutrient criteria development. In 2013, WQD began sampling lakes and reservoirs specifically for numeric nutrient criteria development. WQD's goal for the program is to develop nutrient criteria for streams/rivers and lakes/reservoirs within the next three to six years.

### Wyoming State Geological Survey

In 2013, the Wyoming State Geological Survey, the USGS, and the Water Resources Data System (WRDS) under contract with the WWDC issued an update to the 2005 Available Groundwater Determination Technical Memorandum, titled "Platte River Basin Water Plan Update Groundwater Study Level 1 (2009-2013) – Available Groundwater Determination Technical Memorandum" (Taucher, et al., 2013). The WDEQ, SEO and the Wyoming Oil and Gas Commission were cooperating agencies in developing (Taucher, et al., 2013). Taucher, et al., (2013) updates, revises and expands the 2005 Available Groundwater Determination Technical Memorandum with a compilation of available Platte River Basin groundwater data obtained by state and federal agencies between 2005 and 2013.

Taucher, et al., (2013) included a map showing the sampling locations of groundwater from various geologic formations in the Platte River Basin. This information is presented in **Figure 5.3.6**. Groundwater samples of produced water from oil and gas operations as well

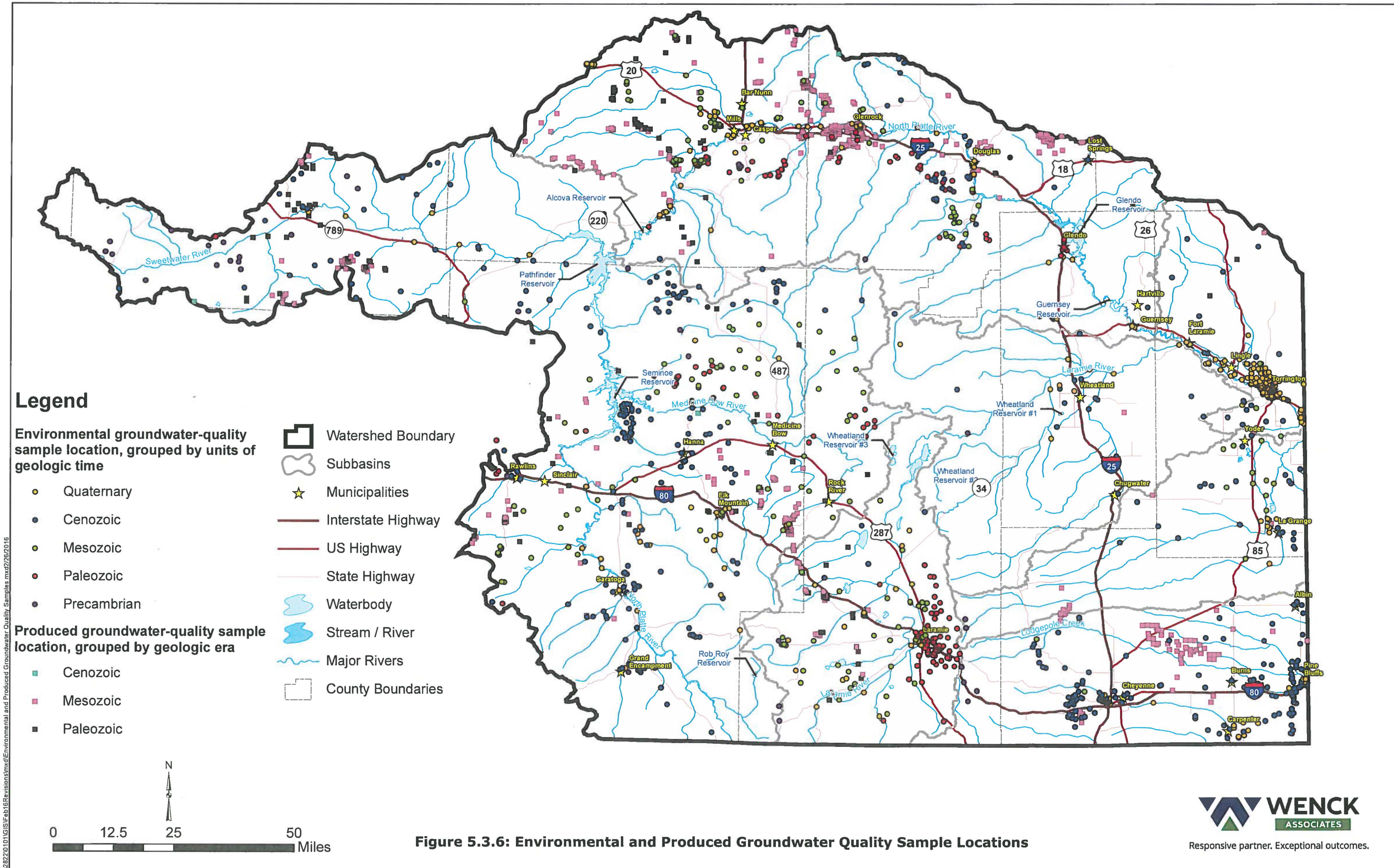


**Figure 5.3.6: Environmental and Produced Groundwater Quality Sample Locations**

as those from SEO and USGS monitoring wells, municipal wells, and environmental wells were compiled and presented in Taucher, et al., (2013).

### Wyoming State Engineer's Office

On January 1, 2007, the State of Wyoming entered the Platte River Recovery Implementation Program together with and in cooperation with the DOI, and the States of Colorado and Nebraska. The purpose of the PRRIP is to ensure the continued use and development of Wyoming's water in the Platte River Basin while maintaining compliance with the ESA. There are three primary elements to the program, including:

- Increasing stream flows in the central Platte River Basin during certain times of each year;
- Enhancing, restoring and protecting habitats for ESA target bird species; and,
- Allowing for new water related activities within the basin through approved depletion plans (SEO, 2015).

The program is being implemented incrementally, with the first increment covering the period from 2007 through 2019. The program is managed by a Governance Committee which consists of representatives from the States of Colorado, Nebraska and Wyoming, USBR, USFWS, North and South Platte River water users, Nebraska water users and environmental groups. Public involvement is implemented through use of a public calendar of program activities, landowner information and encouragement to visit the Central Platte River Basin area. Details related to the PRRIP can be found on the SEO website at http://seo.wyo.gov/interstate-streams/know-your-basin/platte-river-basin.

### Wyoming Game and Fish Department

The WGFD (WGFD, 2010) published their Wildlife Action Plan for the Platte River Basin in 2010. The report identifies areas of value for conservation of native aquatic species as well as recommending conservation actions and monitoring programs that will further enhance aquatic life in the Platte River Basin. The locations of these aquatic wildlife conservation areas are shown on **Figure 5.3.7**. Primary threats to aquatic wildlife habitat in the basin were reported to be:

- Human related water development and altered flow regimes;
- Aquatic invasive species (AIS); and
- Drought/climate change.

WGFD adopted the Strategic Habitat Plan in 2009 which guides the Department's habitat management efforts. The Strategic Habitat Plan includes five goals:

- Conserve and manage habitats that are crucial to wildlife populations now and into the future;
- Enhance, improve and manage degraded priority habitats;
- Increase wildlife-based recreation through habitat enhancements that maintain or increase wildlife productivity;
- Increase public awareness related to habitat issues; and
- Promote collaborative habitat management efforts with the public, conservation partners, private landowners, and land management agencies.

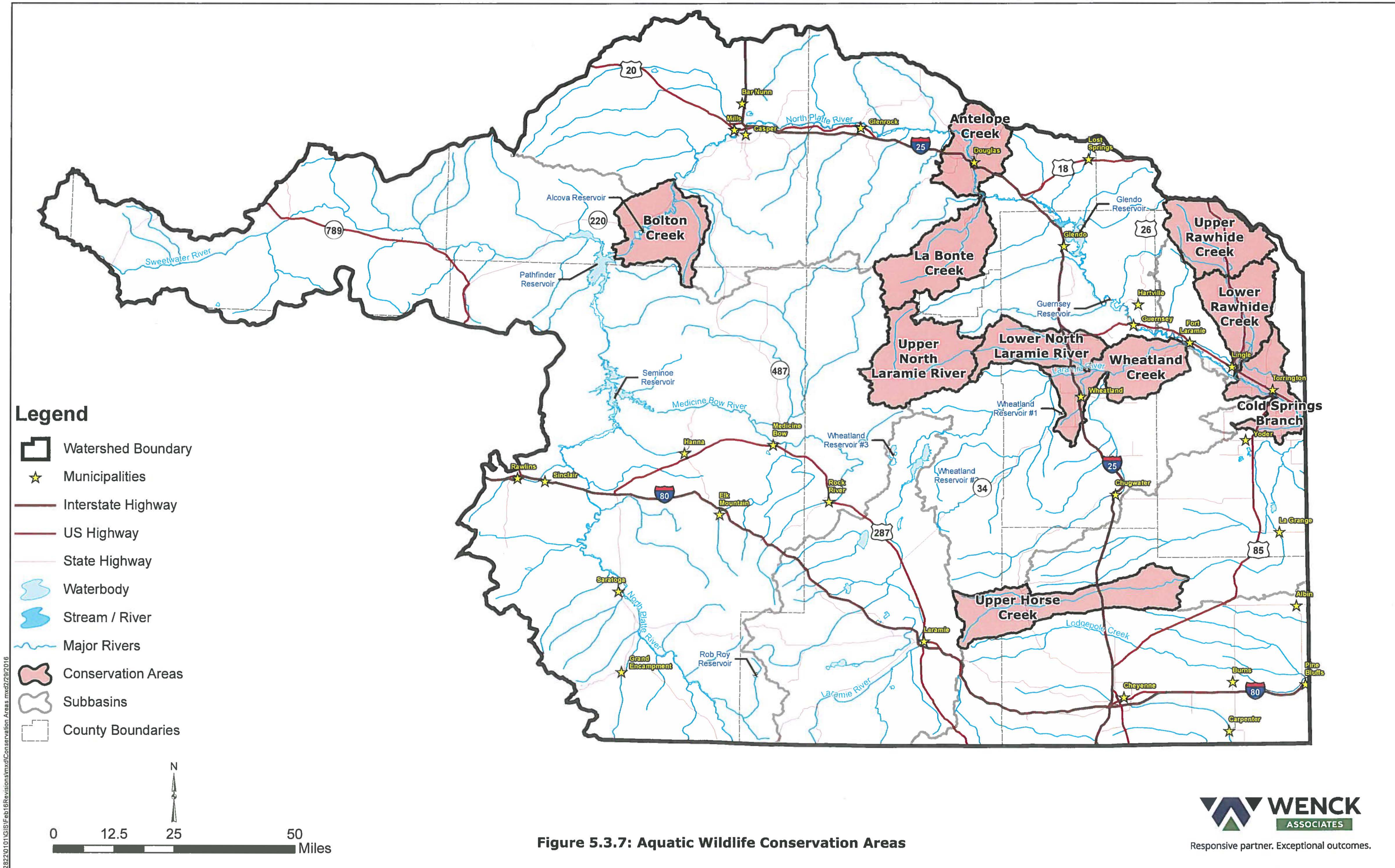


Figure 5.3.7: Aquatic Wildlife Conservation Areas

Between 2005 and 2010, WGFD conducted multiple projects to assess habitat conditions and fish communities within the Platte River Basin. These projects used multiple sources of funding and were either performed by WGFD staff or by partnering with local universities.

The Wyoming Wildlife Natural Resource Trust was created by the Wyoming Legislature in 2005 and funded by donations, legislative appropriations and interest earned on a permanent account. The purpose of the trust is to provide for enhancement and conservation of wildlife habitat and natural resource values within the state. WGFD has partnered with the WWNRT on a wide range of wildlife conservation projects across the state, including the Platte River Basin. Other entities WGFD has partnered with include Landscape Conservation Cooperatives, National Fish Habitat Action Plan and the Great Plains Fish Habitat Partnership.

WGFD continues to cooperate with other agencies, such as the SEO and WWDO by recommending in-stream flows to facilitate water rights adjudication and with private water right holders to manage stream diversions and uses. They also work cooperatively with landowners and other entities to implement water management strategies that will benefit aquatic resources.

#### Wyoming Association of Conservation Districts

The WACD represents 34 local conservation districts throughout the State of Wyoming and provides leadership for the conservation of Wyoming's soil and water resources and protection of the state's surface water and groundwater resources. Individual conservation districts within the Platte River Basin include Natrona County, Laramie County, Laramie Rivers and Platte County.

**Natrona County Conservation District.** Technical Memorandum 5.3 (Trihydro, 2006) provided a detailed history of selenium contamination at the Kendrick Irrigation Project near Casper between 1985 and 2005. The locations of the impaired streams are shown on **Figure 5.3.2**, and described in more detail in **Table 5.3.1**. Much of the investigative work performed at the Kendrick site during that time was performed by the National Irrigation Water Quality Program (NIWQP). However, as reported in the 2005 memorandum, the NIWQP stopped working on the Kendrick project in 2005 due to a lack of funding. Concurrent with the development of the 2005 technical memorandum, the Natrona County Conservation District (NCCD) prepared and released a draft Kendrick Watershed Plan. The proposed plan was discussed in detail in the 2005 Technical Memorandum 5-3. The plan was approved and signed by DEQ in 2006 and implemented by NCCD in mid-2008. Cooperating entities include the CAID, NRCS, local landowners, sportsmen and environmental groups. Despite the best management practices implemented by the plan, selenium continued to be a concern within the Kendrick watershed. Consequently, a TMDL for selenium was initiated in 2009 and completed in 2011. As of 2014, 40 to 50% of irrigators in the North Platte River drainage area had changed their irrigation methods per the recommendations of the watershed plan (Casper Journal, 2014). Even with all the efforts made, selenium remains a problem in the watershed and is being further exacerbated by increased housing development and highway construction which releases additional selenium from the soil. The NCCD continues to work with other state and federal agencies as well as landowners and other stakeholders within the watershed area to resolve the selenium issue.

**Laramie County Conservation District.** The Laramie County Conservation District (LCCD) initiated watershed planning in the early 2000s with the development of the Crow Creek Watershed Plan in 2004 and the Upper Crow Creek Watershed Plan in 2007. The locations of the impairments are shown on **Figure 5.3.5**, and described in more detail in **Table 5.3.1**. LCCD has been working with DEQ on the development of three TMDLs (E. coli, sediment, and selenium) for those portions of Crow Creek that flow through Cheyenne. The TMDL for selenium was approved by EPA in March 2013. The sediment and E. coli TMDLs have been submitted to EPA, but had not been approved as of July 2015. The district also performs its own surface water sampling program within the Crow Creek basin of the South Platte River subbasin (WACD, 2015).

**Laramie Rivers Conservation District.** From 2011 through 2014, the Laramie Rivers Conservation District (LRCD) implemented and completed the Laramie River Restoration project, which is designed to reduce non-point source sediment pollution within the City of Laramie. During the same time period, LRCD partnered with NRCS on two stream bank restoration projects. They cost shared with the NRCS and several landowners on post-fire erosion mitigation projects in the Laramie and Medicine Bow mountain ranges. The district also initiated a watershed study in 2015 through the WWDC which is designed to identify upland water development projects and funding options to carry out the projects. At locations shown on **Figure 5.3.3**, monitoring of the Big Laramie and Little Laramie Rivers has shown exceedances for E. coli in certain segments of the rivers during 2011 through 2013 (WACD, 2015).

**Platte County Resource District.** Since 2005, the Platte County Resource District completed a watershed plan for the Rock Creek area in 2007 and has been working with landowners and conservation partners to implement Best Management Practices to improve range management practices, control of invasive species, agriculture waste management practices and planting of natural windbreaks. The area of concern is shown on **Figure 5.3.4**. Since 2010, the district has been working on an animal feeding operation/ concentrated animal feeding operation project in the Rock Creek watershed area (WACD, 2015).

### Environmental Protection Agency

Acknowledging the need to increase the protection of the nation's healthy watersheds, EPA in March 2011 issued their "Coming Together for Clean Water" strategy for protecting and restoring the nation's waters (EPA, 2011b). From the strategy, EPA developed and published a Healthy Watersheds Initiative National Framework and Action Plan (EPA, 2011c). The Initiative provides an implementation framework for EPA and States to guide efforts in maintaining healthy and restored watersheds. To further promote the Healthy Watersheds Initiative, EPA entered into a MOU with The Nature Conservancy and the Association of Clean Water Administrators in February 2013 (EPA, 2013). Under the MOU, the group will work with states and other partners to identify healthy watersheds, implement healthy watershed protection plans and integrate the plans into EPA programs, and increase awareness and understanding amongst partners and the public of the importance of protecting healthy watersheds. The MOU promotes data gathering and sharing, and the evaluation of conservation and environmental outcomes resulting from watershed program implementation.

### U.S Bureau of Reclamation

The Cooperative Watershed Management Program was established in 2009 as part of the Cooperative Watershed Management Act (Public Law 111-11). The Act authorized the Secretary of the Interior to establish a grant program, development of locally led watershed groups and facilitate the development of multi-stakeholder watershed management projects. Although there is multiple agency participation in the program (USBR, USGS, and BLM), the USBR has taken the lead in the development and implementation of the program. Since implementation of the program in 2012, USBR has financial assistance to form new watershed groups, expand existing groups and/or conduct one or more watershed management projects.

Other water funding programs administered by the USBR include the Title XVI Water Reclamation and Reuse Program (Public Law 102-575, as amended) and the WaterSMART (Sustain and Manage American Resources for Tomorrow) Program. The Title XVI Program provides funding for projects that reclaim and reuse municipal, industrial, domestic, or agricultural wastewater and naturally impaired ground or surface waters. The WaterSMART Program, established in 2010, works with states, tribes, local governments, and non-governmental organizations to secure and stretch water supplies to benefit people, the economy and the environment now and into the future (USDOI, 2011). Projects for Platte River Basin watersheds would be administered by the USBR Wyoming Area Office, located in Casper.

### U.S. Bureau of Land Management

In 1995, the BLM grazing regulations were modified to better address fundamentals of rangeland health, in part, by promoting healthy, sustainable rangeland ecosystems and, accelerating restoration and improvement of public rangelands to properly functioning conditions. In 1997, the Wyoming BLM State Office adopted standards and guidelines for assessing healthy rangelands and livestock grazing management on BLM administered public lands. Assessments were initially conducted on a grazing allotment basis. However, it became apparent that assessing by allotments did not focus on all potential uses that could impact public lands. Additionally, assessing watersheds, water quality and habitats would be more effectively evaluated on a larger scale. In January 2001, BLM issued Instruction

Memorandum No. 2001-079 transmitting to field offices guidance for conducting rangeland health assessments and evaluations on a watershed basis. The assessments must consider six separate standards that address what BLM considers to be rangeland health fundamentals. These fundamentals include:

- properly functioning watersheds;
- naturally cycling water;
- nutrients and energy;
- air and water quality; and,
- habitats for special status species.

The assessment areas are defined by watershed boundaries within each field office area and are evaluated/re-evaluated on a 10-year cycle. Recommendations for enhancement projects are made in the reports and are carried out during the post assessment 10-year period. The effectiveness of these projects is assessed during the re-evaluations. Interagency cooperation between BLM, other federal agencies and the State of Wyoming as well as non-governmental stakeholders, is necessary for these evaluations to be effectively performed.

The BLM Rawlins Field Office first evaluated the Lower and Upper North Platte Watersheds in 2003 and 2004, respectively (BLM, 2004 and 2005). They were re-evaluated in 2013 (BLM, 2014) and 2014, respectively. The 2014 report for the Upper North Platte Watershed was not available as of February 2016. An evaluation of the Lower Laramie River Watershed was performed in 2006 (BLM, 2007), and is scheduled for re-evaluation during the 2016 field season. The Big Laramie River Watershed assessment was performed in 2007 (BLM, 2008 and will be re-evaluated during the 2017 field season.

### National Resource Conservation Service

The Watershed and Flood Prevention Act of 1954, as amended, authorizes the NRCS to provide watershed surveys and planning activities with the primary objective of assisting federal, state and local agencies and tribal governments with their efforts of protecting watersheds from damage caused by erosion, floods, and sediment and the conservation and development of water and land resources. Issues addressed by the program include water quality, water conservation, wetland and water storage capacity, drought issues, rural development, municipal and industrial water needs, upstream flood damages and water needs for industries based on fish, wildlife and forestry. Projects performed by the NRCS include watershed plans, river basin surveys and studies, flood hazard analyses and flood plain management.

**U.S. Geologic Survey**

The statewide baseline sampling program for pesticides described in Technical Memorandum 5-3 (Trihydro, 2006) was completed in 2006. The results of the study were published in 2009 (Eddy-Miller and others, 2009). The study results showed that of the 296 wells sampled, pesticides were detected in approximately 23%. However, no concentrations exceeded EPA drinking water standards or health advisory levels. During the period 2008-2010, the USGS, in cooperation with the Wyoming Department of Agriculture, resampled 52 of the 296 wells to compare detected compounds and concentrations between the two sampling periods and to evaluate any detections of new compounds (Eddy-Miller and others, 2013). The 52 wells were distributed similarly to the baseline study wells with respect to geography and land use. The results showed no or minor changes in pesticide types and concentrations when compared to the baseline study.

USGS has also been collecting samples from Wyoming rivers and streams for pesticide analysis since 2006 (Eddy-Miller, 2011). To date, sampling results indicate that:

- Detected concentrations are all less than associated drinking water standards;
- Most detected pesticides were herbicides or degradates of herbicides; and,
- Detections and concentrations were not flow dependent.

Other programs administered by the USGS that provide water data and information for Wyoming's watersheds include, but are not limited to, the National Water Information Service at http://waterdata.usgs.gov/wy/nwis/, the National Water Quality Assessment Program at http://water.usgs.gov/nawqa/, the Water Resources Research Institute Program at http://water.usgs.gov/wrri/index.php , and the High Plains Groundwater Availability Study at http://txpub.usgs.gov/HPWA/index.html.

### 5.3.4 Cooperation and Coordination

There continues to be good and effective interagency cooperation and coordination between local, state and federal entities. The programs described in the 2005 Technical Memorandum continue to the present or have been supplemented with enhanced monitoring and management programs. All agencies and other groups involved remain committed to improving the water quality of basin streams and educating the public on what can be done to further improve water quality within the Basin for the benefit of the public and all stakeholders.

### 5.3.5 Conclusions and Recommendations

Water quality remains a serious issue within the Platte River Basin. State, federal and local entities, both public and private, continue to work together to further improve water quality, prevent impairment and educate the public on water quality issues and the means by which the Basin's overall water quality can be further improved for the benefit of the public, wildlife and the environment.

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## 5.4 CLIMATE AND WEATHER ISSUES

### 5.4.1 Introduction

Section 5.4 provides a summary of climate in the Platte River Basin of Wyoming as it relates to water resources. We also describe climate related studies and developments at the state and national level that may be relevant to the Platte River Basin Watershed.

Most of the Platte River Basin is located within Wyoming's Climate Divisions 8 (Lower Platte) and 10 (Upper Platte) (Curtis and Grimes, 2004). The relationship between the basin and the climatic zones is shown on **Figure 5.4.1**. Climate within the basin ranges from semi-arid to humid-alpine depending on altitude, latitude, and topography. The Lower Platte tends to be one of the warmest regions of the Basin with monthly average temperatures ranging from 23°F in January to approximately 68°F in July (NOAA, 2016). **Figure 5.4.2** displays the average annual temperature of this climate division (WRDS, 2016a). The Upper Platte is slightly cooler with an average January temperature of approximately 18°F and a July average of approximately 65°F (NOAA, 2016). **Figure 5.4.3** presents the average annual temperature of this climate division since 1895 (WRDS, 2016a). According to NOAA's (NOAA, 2015) National Centers for Environmental Information, average annual temperatures in both Climate Divisions 8 and 10 have increased at a rate of 0.3°F per decade between 1895 and 2015.

The mountain ranges in the western (Medicine Bow Range), central, and northern (Laramie Range) areas of the basin capture much of the annual precipitation due to atmospheric vertical uplift. This results in greater annual precipitation in the mountainous areas while decreasing the amount of precipitation that falls in the Basin interiors as illustrated on **Figure 5.4.4**. Most of the annual precipitation at higher elevations in the mountains occurs as snow during the winter and spring months, and at lower elevations as rain related to convective thunderstorms during the summer months. As shown on **Figure 5.4.4**, average annual precipitation ranges from 9 to 15 inches in the Basin interior areas, to as much as 60 inches in the high mountain ranges (WSGS, 2013). As shown on **Figures 5.4.5 and 5.4.6** since 1895, the Lower Platte Climate Division received a higher average annual precipitation of 15 inches while the Upper Platte Climate Division received an annual average of 13 inches (WRDS, 2016b).

### 5.4.2 Climate Studies Relevant to Platte River Basin Water Resources

Since 2005, there have been several climate related studies that are relevant to water resources within the Platte River Basin. Some of the more applicable studies are summarized in this section.

Since Martner (1986) completed the original climate atlas, the Wyoming Climate Atlas was updated and published online in 2004. The primary purpose of the atlas is to provide to the public an objective assessment and as comprehensive as possible dataset of Wyoming's climatic trends. The atlas is also available in hard copy but may be accessed on the internet at http://www.wrds.uwyo.edu/sco/climateatlas/title_page.html.

The Climate Program Office (CPO), established in 2005, resides within the National Oceangic and Atmospheric Association (NOAA) and conducts climate research on:

1. Competitive grant programs that advance and extend climate research capabilities;
2. Partnerships with academia, businesses and other governmental agencies to produce climate research tools and data products; and,

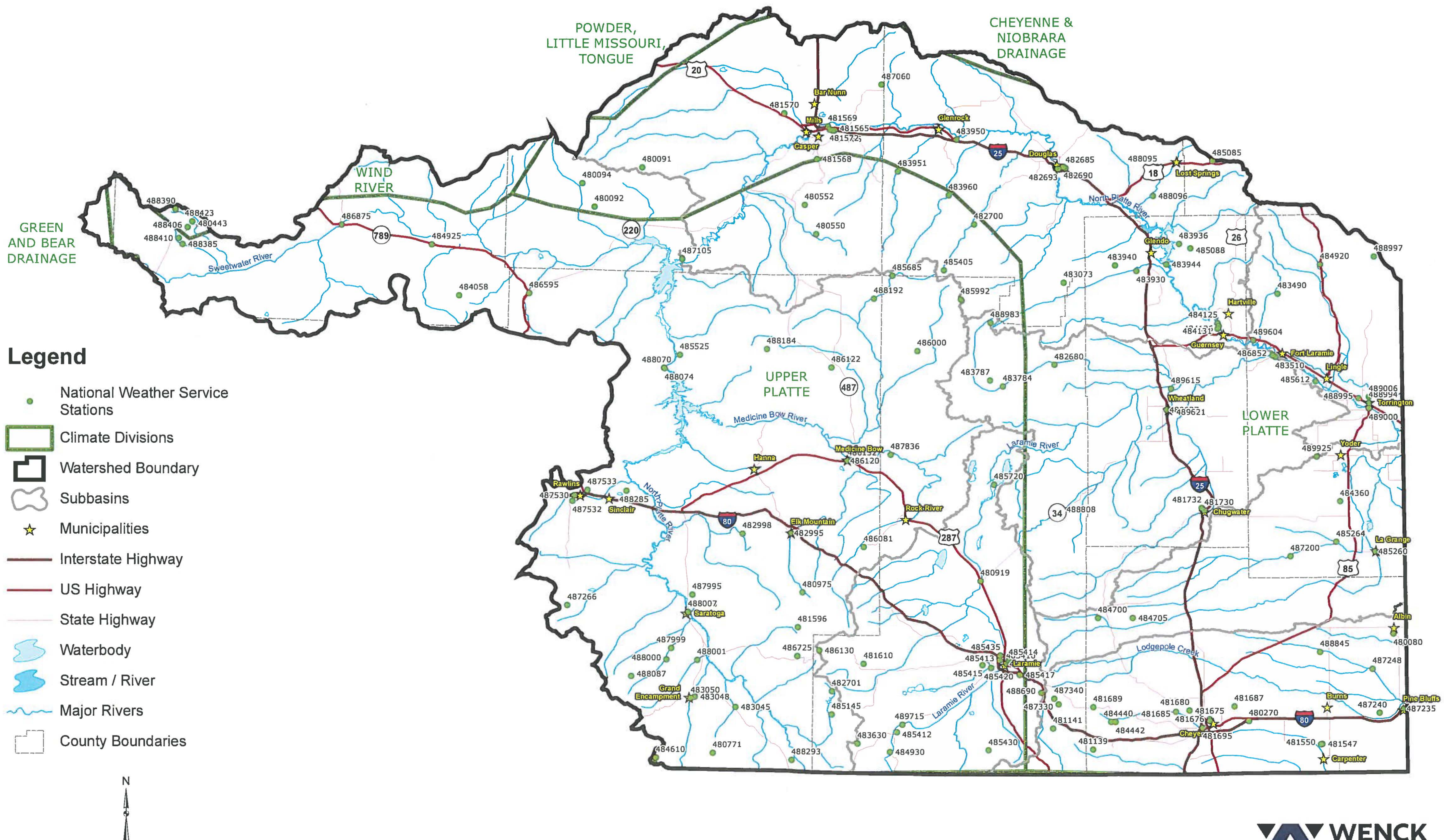


**Figure 5.4.1: Climate Divisions and Weather Stations**

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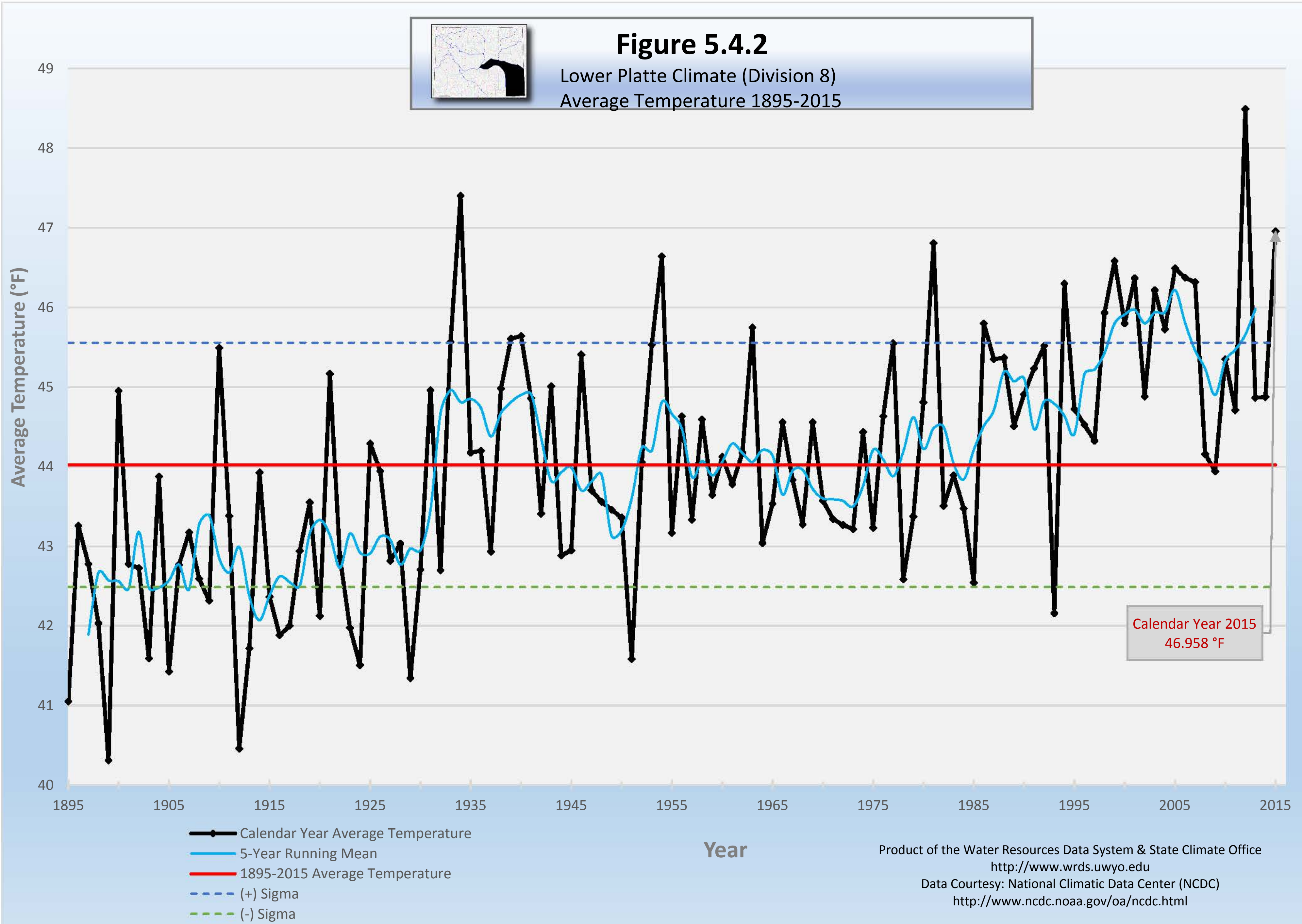

Figure 5.4.2
Lower Platte Climate (Division 8)
Average Temperature 1895-2015
Average Temperature (°F)
49
48
47
46
45
44
43
42
41
40
1895
1905
1915
1925
1935
1945
1955
1965
1975
1985
1995
2005
2015
Year
Calendar Year 2015
46.958 °F
Calendar Year Average Temperature
5-Year Running Mean
1895-2015 Average Temperature
(+) Sigma
(-) Sigma
Product of the Water Resources Data System & State Climate Office
http://www.wrds.uwyo.edu
Data Courtesy: National Climatic Data Center (NCDC)
http://www.ncdc.noaa.gov/oa/ncdc.html

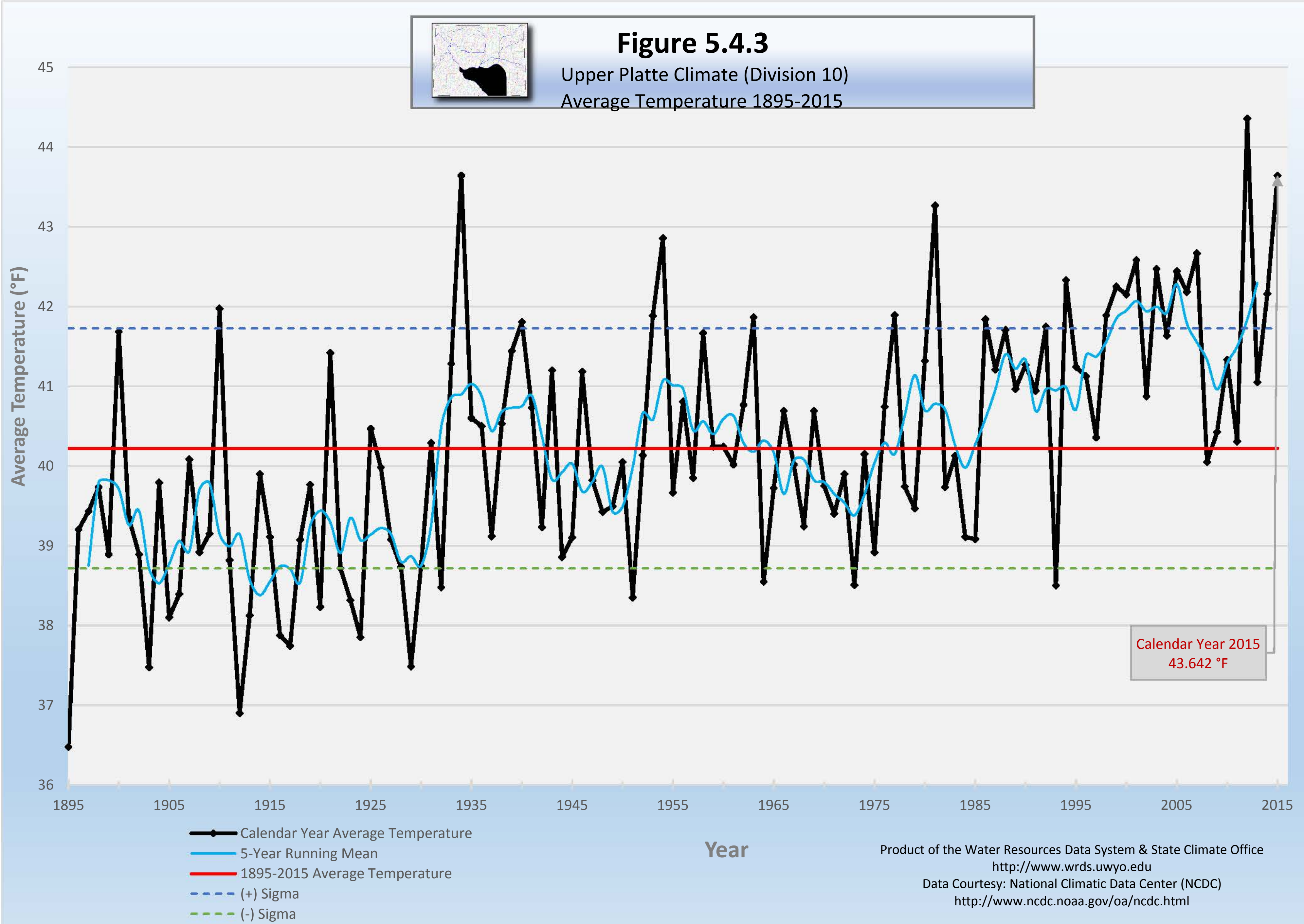
Figure 5.4.3
Upper Platte Climate (Division 10)
Average Temperature 1895-2015
Average Temperature (°F)
45
44
43
42
41
40
39
38
37
36
1895
1905
1915
1925
1935
1945
1955
1965
1975
1985
1995
2005
2015
Year
Calendar Year 2015
43.642 °F
Calendar Year Average Temperature
5-Year Running Mean
1895-2015 Average Temperature
(+) Sigma
(-) Sigma
Product of the Water Resources Data System & State Climate Office
http://www.wrds.uwyo.edu
Data Courtesy: National Climatic Data Center (NCDC)
http://www.ncdc.noaa.gov/oa/ncdc.html

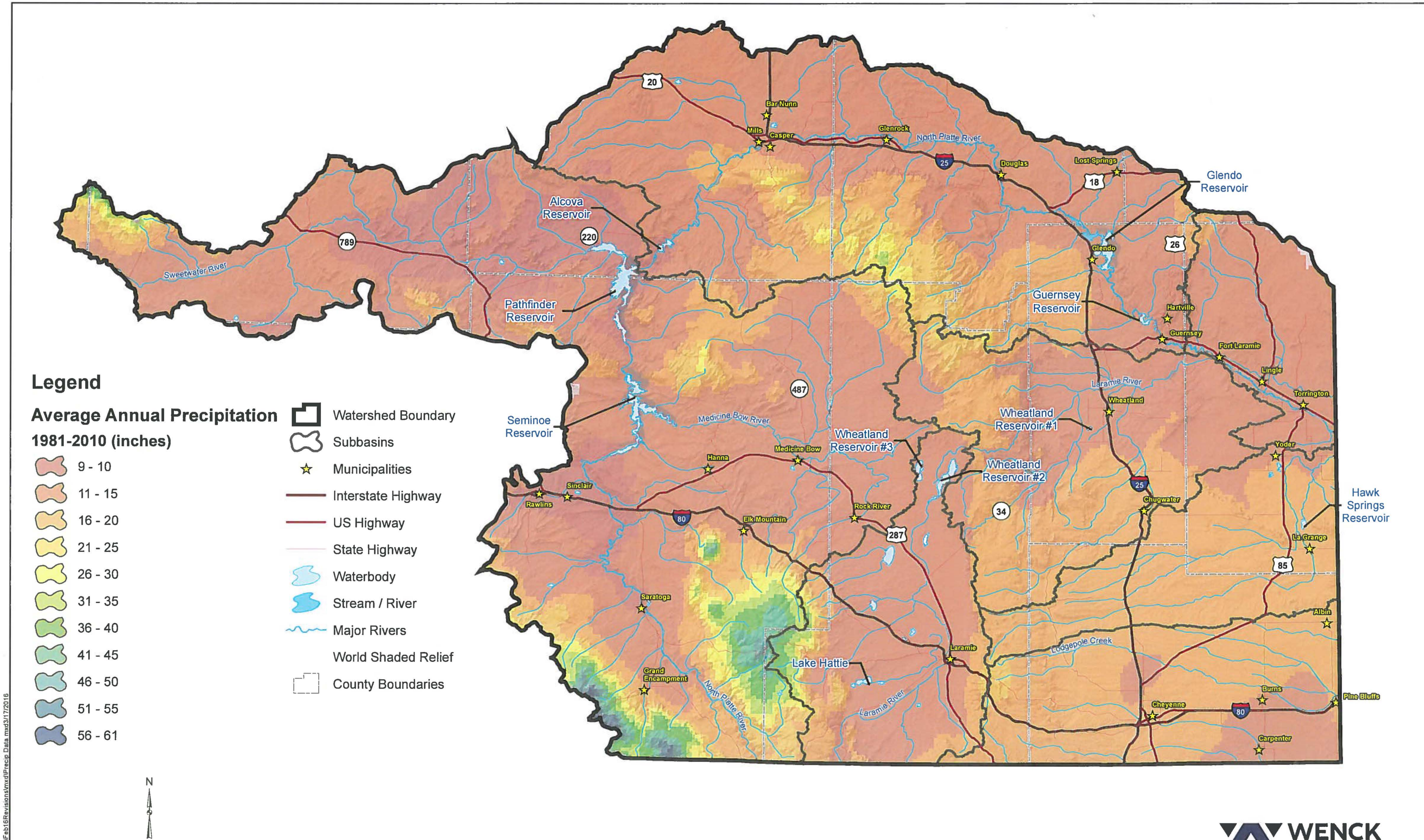


**Figure 5.4.4: Average Annual Precipitation**

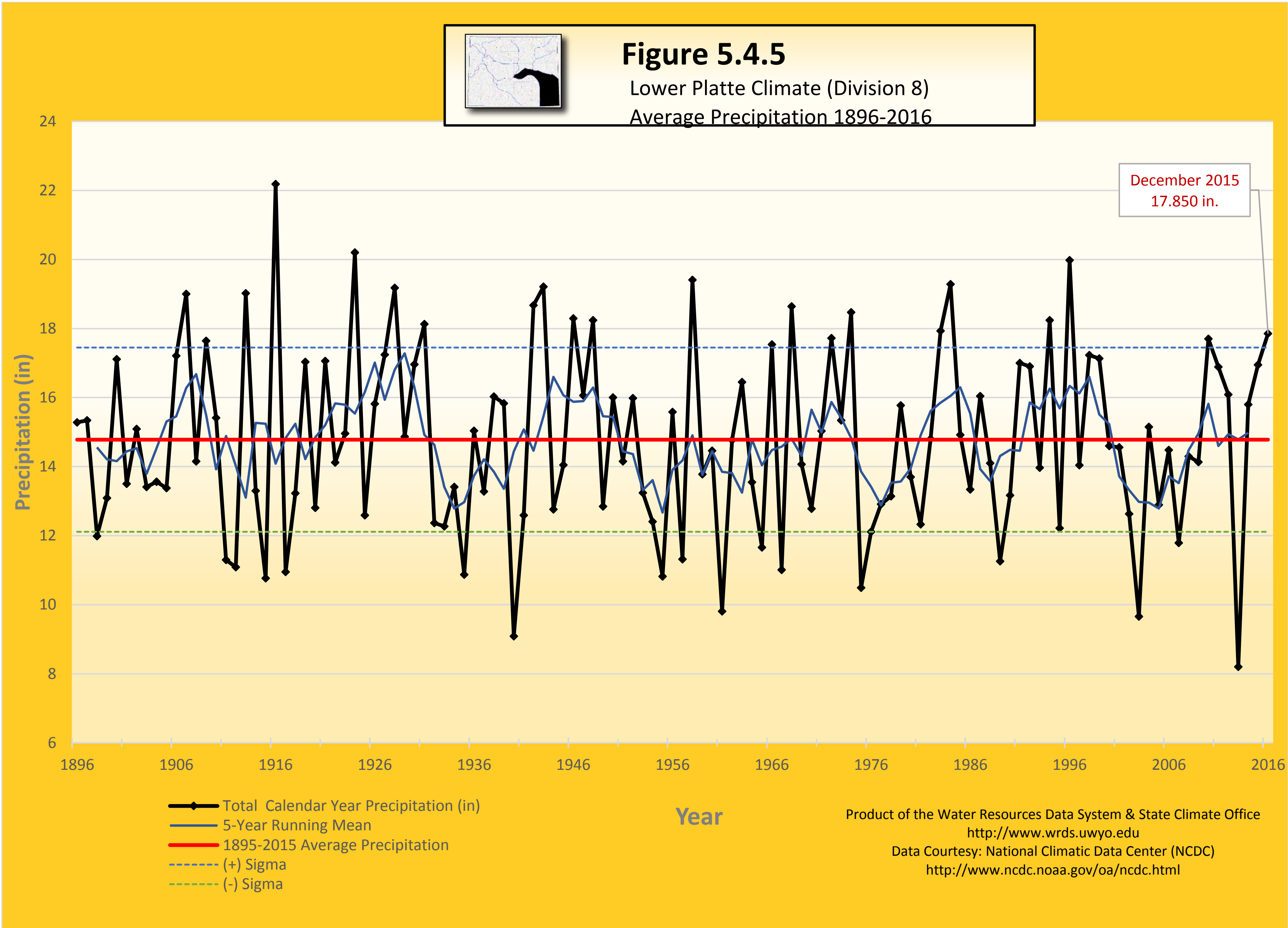

Figure 5.4.5
Lower Platte Climate (Division 8)
Average Precipitation 1896-2016
December 2015
17.850 in.
Precipitation (in)
24
22
20
18
16
14
12
10
8
6
1896
1906
1916
1926
1936
1946
1956
1966
1976
1986
1996
2006
2016
Year
Total Calendar Year Precipitation (in)
5-Year Running Mean
1895-2015 Average Precipitation
(+) Sigma
(-) Sigma
Product of the Water Resources Data System & State Climate Office
http://www.wrds.uwyo.edu
Data Courtesy: National Climatic Data Center (NCDC)
http://www.ncdc.noaa.gov/oa/ncdc.html

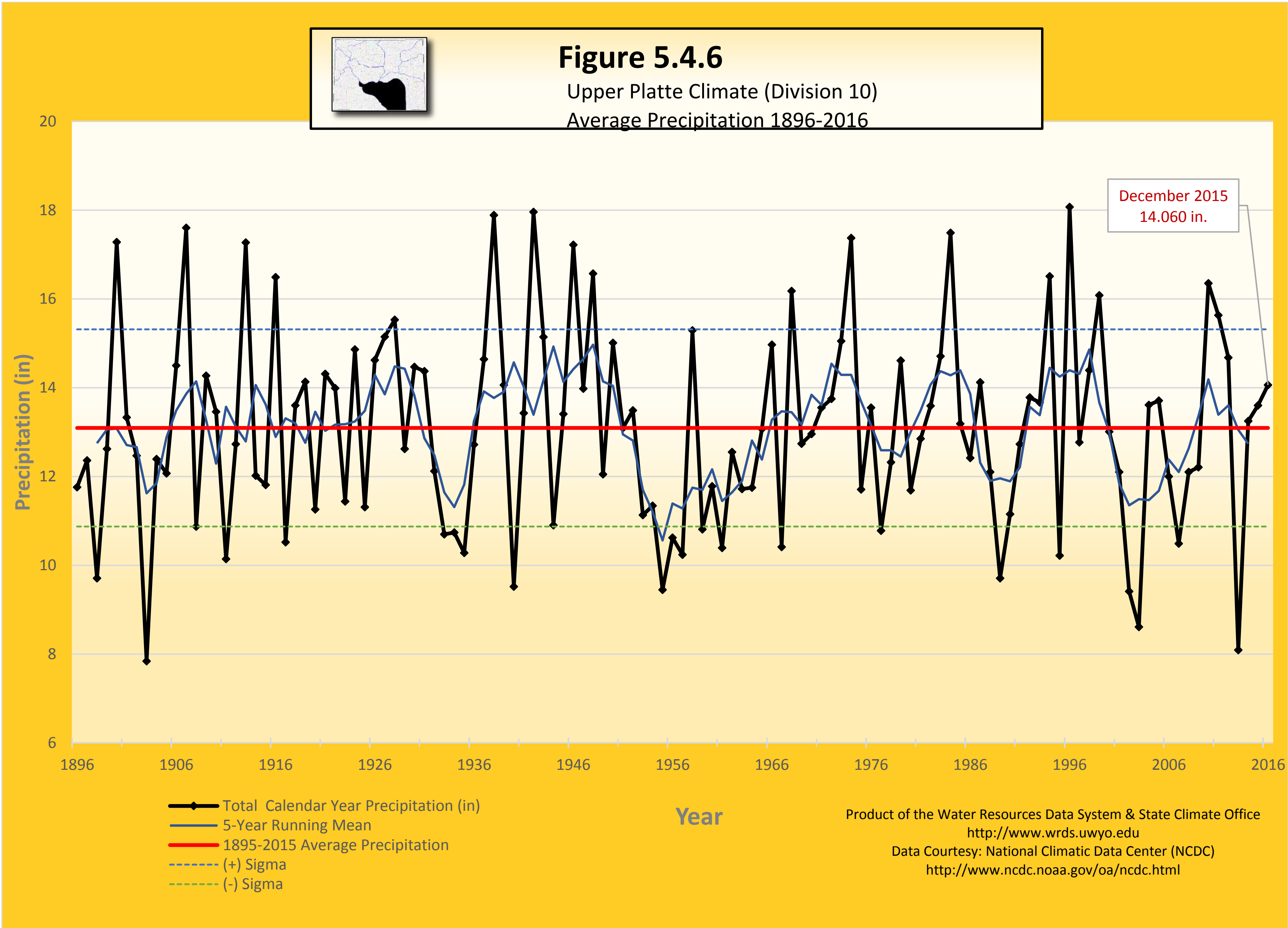

Figure 5.4.6
Upper Platte Climate (Division 10)
Average Precipitation 1896-2016
December 2015
14.060 in.
Precipitation (in)
20
18
16
14
12
10
8
6
1896
1906
1916
1926
1936
1946
1956
1966
1976
1986
1996
2006
2016
Year
Total Calendar Year Precipitation (in)
5-Year Running Mean
1895-2015 Average Precipitation
(+) Sigma
(-) Sigma
Product of the Water Resources Data System & State Climate Office
http://www.wrds.uwyo.edu
Data Courtesy: National Climatic Data Center (NCDC)
http://www.ncdc.noaa.gov/oa/ncdc.html

3. Dissemination of information that will improve public knowledge about climate and improve decision making related to maintaining economic and societal sustainability in a changing climate environment.

Through their active grant program and partnering activities, recent accomplishments by the CPO include:

1. Climate Reference Network, NOAA's nationwide climate observing network at http://cpo.noaa.gov/ClimatePrograms/ClimateObservation.aspx;

2. Implementation of the sustained Global Ocean Observing System which provides information about the state of the world's oceans and their regional variations to address important societal needs related to the Earth's climate at: http://cpo.noaa.gov/ClimatePrograms/ClimateObservation/OceanClimateObservation.aspx;

3. Support of climate training workshops;

4. Provision of climate science, data and information to the public to help in the understanding of changing climate conditions and assist in addressing climate change challenges; and,

5. More than 700 published papers each year contributing to the nation's understanding of climate variability and change.

The CPO manages competitive climate science research programs through which NOAA funds, by federal grants, climate assessments, decision support research, public outreach, and education that will advance understanding of Earth's climate system and enable effective decision making. Research is conducted in regions across the country, and includes projects focused on drought information, increased understanding of climate change and its potential impact on the environment and populations, and the effect of extreme events on water resources. Grants for 2016 that could be pertinent to planners within the North Platte River Basin include:

1. "Fires in the Western U.S.: Emissions and Chemical Transformations";

2. "Research to Advance Prediction of Subseasonal to Seasonal Phenomena";

3. "Coping with Drought in Support of the National Integrated Drought Information System"; and,

4. "Water Resources and Extreme Events".

More information on these grants and the CPO in general can be found at: http://cpo.noaa.gov/GrantsandProjects.aspx.

Climatic variability can influence the hydrological cycle, the continuous movement of water above and below the surface of the earth, which subsequently affects discharge of water to streams. Climate variability can be predicted by oceanic-atmospheric oscillations which provide opportunities for streamflow forecasts. In 2010, Soukup et al performed an evaluation of oceanic-atmospheric climate variability on streamflow in the upper North Platte River basin utilizing Singular Value Decomposition Statistics (SVD), sea surface temperatures (SST), and a 500 mbar geopotential height (Z500). SVD is considered to be the most widely-used multivariate statistical technique used in the atmospheric sciences. The purpose of the technique is to reduce a dataset containing a large number of values to a dataset containing significantly fewer values, but which still contains a large fraction of the


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variability present in the original data. (IRI, 2016). Geopotential height approximates the actual height of a pressure surface above mean sea level, considered to be a gravity-adjusted height. It is common to speak of the geopotential height of a certain pressure level, which would correspond to the geopotential height necessary to reach the given pressure. The 500 mbar geopotential height is often referred to as the steering level, as most weather systems and precipitation follow the winds at this level (IRI, 2016).

Using Upper North Platte River Basin streamflow measurements for the period 1949 to 2006, Pacific/Atlantic Ocean SSTs, the 500 mbar geopotential height values and the above statistical analysis, Soukup et al developed a ”long lead time” exceedance probability forecast model for the North Platte River that can predict streamflows at three and six month intervals. This model can be a useful predictive tool for water managers and planners.

The primary water supply of the North Platte River is summer snowmelt from mountains in northern Colorado and southeastern Wyoming and is used to support agriculture, energy development and urban/community development. Based upon multiple decisions by the U.S. Supreme Court, the Platte River water has been apportioned amongst Colorado, Wyoming and Nebraska. Negative changes in the regional climate will therefore have a direct impact on societal and economic infrastructure within the three states. Although there is tree ring evidence of severe multi-decade megadroughts during prehistoric times, there is no historic evidence or data for these types of drought during the historic period. In 2010 Shinker et al evaluated the severity of recent and prehistoric droughts using various data sources, including modern temperature, precipitation, stream gauge data, evidence of low-lake stands, and related estimates of past hydroclimate change (Shinker et al, 2010). Their evaluation of the prehistoric and modern data indicates the potential for persistent shifts in regional hydrology and climate patterns which should be considered as part of long-term economic and legal planning for future use of North Platte River waters.

In 2012, Acharya et al. published an article that assessed the long-term water availability over the North Platte River watershed utilizing hydrologic modeling and streamflow projections under anthropogenic climate change conditions. Based on their streamflow projections, the model showed a possibility for increased annual streamflow for the North Platte River watershed through 2100, with maximum streamflow occurring during the period 2085-2090. The simulated annual streamflows for future periods varied from 20% to 62% more with respect to their baseline period of 1971 to 2000 (Acharya et al., 2012). In the simulations, the wet months were getting wetter, whereas the summer months were found to be getting drier. The study was designed to be used by decision makers when developing future water supply and demand management decisions.

In 2013 Kelly (et al.) published the results of a study relating population growth and climate change in the Big Horn Basin during the Holocene. The study compares population data (radiocarbon dated archaeological site data) to temperature and moisture records, to evaluate possible association between climate changes and past human populations. The results indicated that the population within the basin over the past 13,000 years decreased during warm and dry periods and increased during cooler wet periods. The study results indicated that low effective moisture and high temperatures are both associated with low population levels. The data collected show that the average temperature in the Bighorn Basin 7,000 years ago was approximately 1.5 to 2°C warmer than during the 20$^{th}$ Century. This temperature change could cause rivers, like the Platte and Bighorn, to dry up during portions of the summer. This change in the quantity of available water would have likely impacted the human population in the area significantly as food resources became depleted due to a lack of water (Kelly, et al., 2013). Based on the Bighorn Basin study results, the authors conclude that climate may well impact cultures through episodic severe events and as a slow variable control on regional resources that can influence population size and trajectory (Kelly, et al., 2013).

### 5.4.3 Climatic Indicators Used to Track Basin Wide Drought and Water Supply Changes

Climatologists have used several different methods and indicators for determining drought conditions. Drought conditions are triggered by an extreme decrease in precipitation over an extended period of time and a corresponding increase in temperature and evaporation. Drought indices assimilate a variety of data on rainfall, snowpack, streamflow, soil moisture, and other water supply indicators into an accessible picture or framework. A drought index value is typically a single number that reveals the severity of drought based on several parameters, and can be used by decision makers to assess current and historic drought conditions. There are several indices that measure how much precipitation for a given period of time has deviated from historically established norms. Although none of the major indices is inherently superior to the rest in all circumstances, some indices are better suited than others for certain uses.

According to Curtis and Grimes (2004) and Hayes (2015), these major indices include the following:

1. The Palmer Drought Severity Index (PDSI) was developed by Wayne Palmer in the 1960s and uses temperature and rainfall information in a formula to determine dryness. While it has become the semi-official drought index, it is not necessarily the most accurate measure in Wyoming because most surface water is derived from mountain snowpack (i.e., the snow-water equivalent (SWE) as measured at a number of SNOTEL sites). Western states, with mountainous terrain and the resulting complex regional microclimates, have found it useful to supplement Palmer values with other indices such as the Surface Water Supply Index (SWSI), which takes snowpack and other unique conditions into account.

2. The Standardized Precipitation Index was developed at Colorado State University in 1993 and measures the precipitation departure using the 1971-2000 average monthly totals. The National Drought Mitigation Center has been using this index to monitor moisture supply conditions. Distinguishing traits of this index are that it identifies emerging droughts months sooner than the PDSI and that it is computed on various time scales.

3. The Crop Moisture Index (CMI) developed by Palmer in 1968 uses a meteorological approach to monitor week-to-week crop conditions and was derived from procedures within the calculation of the PDSI. Whereas the PDSI monitors long-term meteorological wet and dry spells, the CMI was designed to evaluate short-term moisture conditions across major crop-producing regions. It is based on the mean temperature and total precipitation for each week within a climate division, as well as the CMI value from the previous week.

4. The SWSI was developed by Shafer and Dezman in 1982 to complement the PDSI for moisture conditions across the state of Colorado. The PDSI is basically a soil moisture algorithm calibrated for relatively homogeneous regions, but it is not designed for large topographic variations across a region and it does not account for snow accumulation and subsequent runoff. Shafer and Dezman designed the SWSI to be an indicator of surface water conditions and described the index as "mountain water dependent", in which mountain snowpack is a major component. The objective of the SWSI was to incorporate both hydrological and climatological features into a single index value resembling the Palmer Index for each major river basin in the

state of Colorado. These values would be standardized to allow comparisons between basins. Four inputs are required within the SWSI: snowpack, streamflow, precipitation, and reservoir storage.

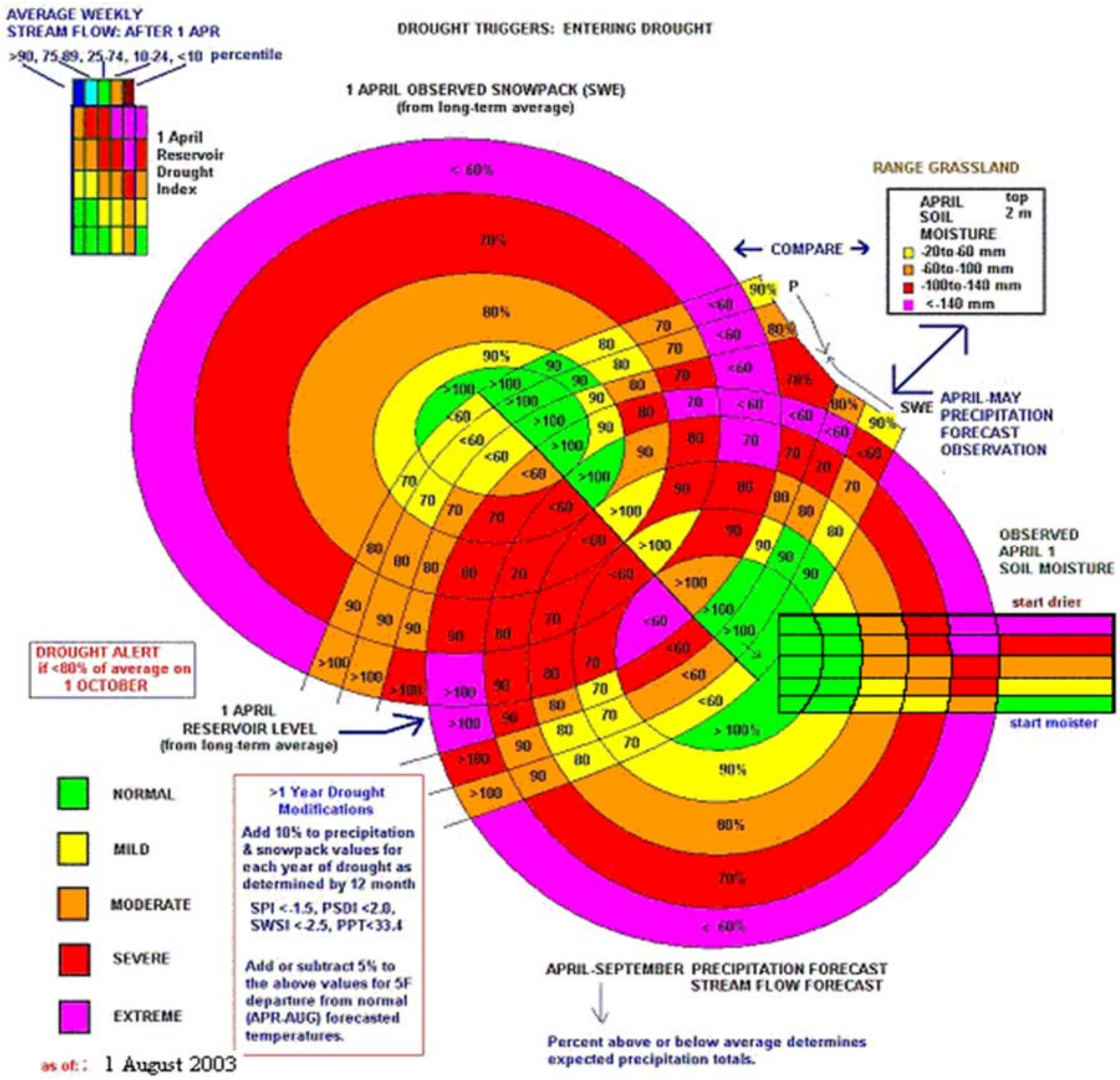
5. The Reclamation Drought Index (RDI) was developed after 1988 as a tool for defining drought severity and duration, and for predicting the onset and end of periods of drought. The impetus to devise the RDI came from the Reclamation States Drought Assistance Act of 1988, which allows states to seek assistance from the USBR to mitigate the effects of drought. Like the SWSI, the RDI is calculated at a river basin level, and incorporates the supply components of precipitation, snowpack, streamflow, and reservoir levels. The RDI differs from the SWSI in that it builds a temperature-based demand component and a duration into the index. The RDI is adaptable to particular regions and its main strength is its ability to account for both climate and water supply factors.

Curtis and Grimes (2004) presented an additional method specific to Wyoming to determine the beginning, intensity, and end of a drought. The Wyoming drought nomogram, shown on **Figure 5.4.7**, is based on snow water equivalent, soil moistures, and reservoir levels. According to the description provided by Curtis and Grimes (2004), this index begins by examining October 1 reservoir levels (the start of the water year). If levels are less than 80% of normal, a drought alert is issued. Next, the April 1 reservoir levels are compared to SWE data for the basin along with the forecasted spring and summer streamflow, and the spring and summer precipitation forecast. If, for example, a reservoir level is 70%, the SWE is 90%, and the precipitation forecast and/or streamflow forecast is 80% of normal, then the reservoir drought index is classified as "yellow", indicating a mild drought (**Figure 5.4.7**). Since streams tend to thaw after April 1, stream gauge accuracy improves after that time, and the next step in the drought assessment is to use the average weekly streamflow (upper left corner). If, as in this example, weekly streamflow is at the less than 10 percentile level, then the drought index is classified as "orange", or at a moderate drought level for agricultural and recreational interests. However, since drought is also determined by soil moisture, the template on the lower right circle can also be used. If the soil moisture is mildly dry (see range grassland table on **Figure 5.4.7**), "yellow", but the April precipitation forecast (using the same rings as the April-September precipitation forecast) is for less than 60% of normal, then, the range grassland index is determined to be "red", or severe, for ranching interests. Note that, independent of the April 1 soil moisture conditions, average precipitation during the 60 days following April 1 will probably result in normal or near normal grass yields.

Using this methodology, one would need to increase the values of the rings within each circle by 10% for each drought year as determined by the greater than one year drought modifications table (lower left corner) in **Figure 5.4.7**. Additional adjustments for above or below average summer temperatures should be made as well. The SWSI in the table refers to the Surface Water Supply Index which is produced between January and May using reservoir and streamflow data. No annual adjustment is required for the SWE or April-September streamflow forecast for rangeland forecasted conditions.

Because droughts in Wyoming are relatively common events, they are carefully monitored by the Wyoming State Engineer, the Wyoming Department of Agriculture, the Wyoming Climate Office, agricultural producers, and municipalities dependent upon surface water supplies. In addition to the indices noted above, local climatic and snowpack conditions are closely monitored by the users noted above.

## Figure 5.4.7: Wyoming Drought Nomogram



### 5.4.4 Impacts of Climatic Extremes Related to Historic Droughts

Wyoming developed a drought response plan in 2000, which was revised in 2003. The purpose of the plan is to provide an approach for minimizing the impacts of drought on the people and resources of the state. Wyoming used the already existing Nebraska and Colorado drought response plans as a template for their plan. The Wyoming State Climate Office monitors the state's climate and participates in many drought planning efforts, including:

1. Participation in the State Water Plan process;
2. Participation in the Governor's Climate Issues Committee;
3. Development of drought summaries and drought related outreach products; and,
4. Support for research on causes and consequences of drought.

Additional information can be found at http://www.wrds.uwyo.edu/sco/drought/drought.html.

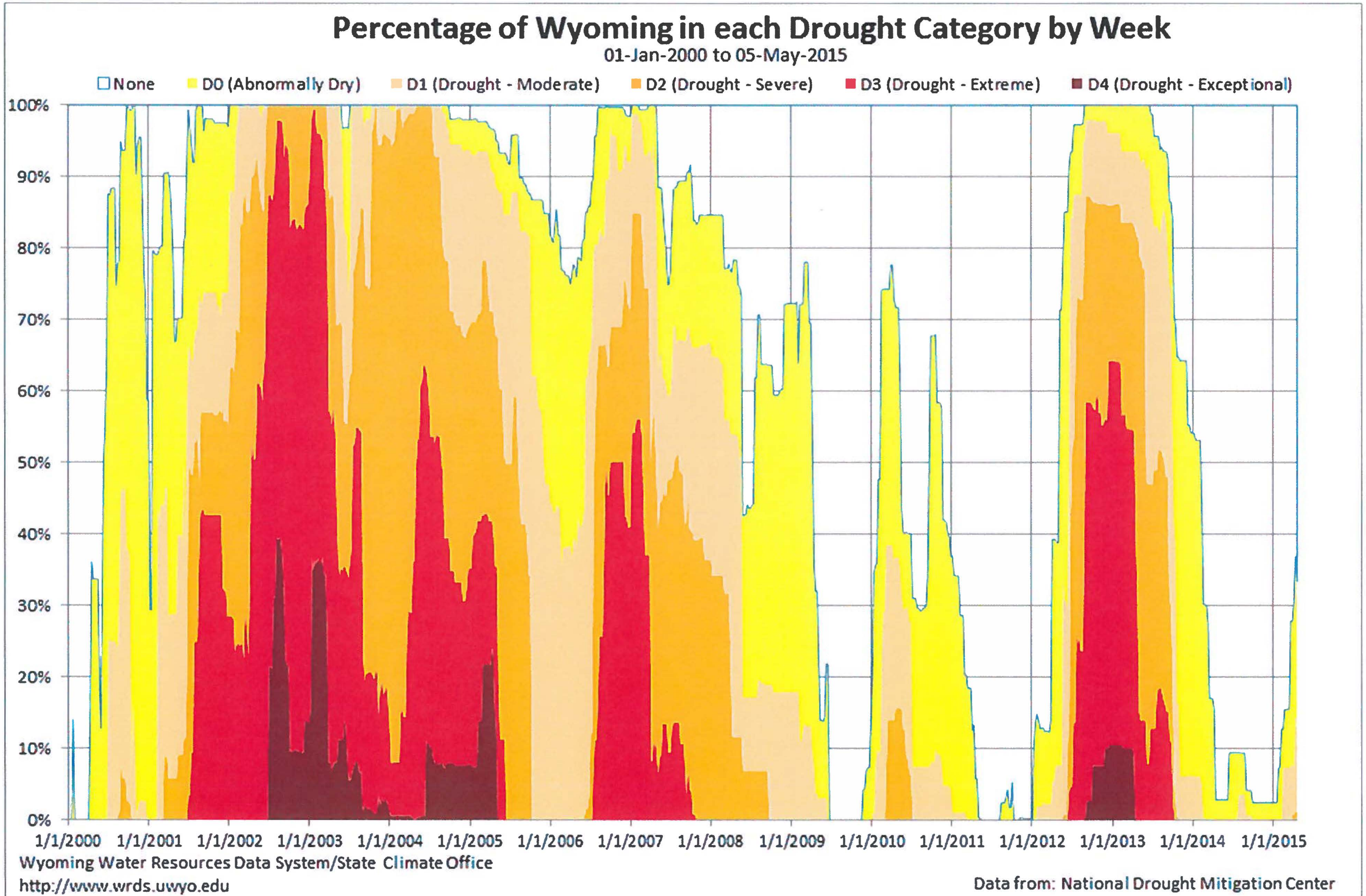
Wyoming is the fifth driest state in the country, and as such, drought is a constant threat (Wyoming State Climate Office, 2016). Drought occurs in four stages and is defined as a function of magnitude (dryness), duration, and regional extent. Severity is the most commonly used term for measuring drought conditions and is a combination of magnitude and duration (Curtis and Grimes, 2004). The first stage of drought is called meteorological drought and includes any precipitation shortfall of 75% of normal lasting for three months or longer. The second stage is called agricultural drought and occurs when soil moisture becomes deficient to the point where plants are stressed and plant yield is reduced. The third stage is called hydrological drought which results in reduced streamflow and inflows to lakes and reservoirs. The fourth stage is called socioeconomic drought and refers to the situation when water shortages begin to affect people (Curtis and Grimes, 2004; Wyoming Office of Homeland Security, 2016).

Between 2001 and 2008, more than half of the state was experiencing moderate to severe drought conditions as shown on **Figure 5.4.8**. Although this prolonged drought varied from year to year and counties or regions within the state experienced varying levels of drought impacts, this drought was a significant event, and the state will continue to feel the effects for years to come (Wyoming State Climate Office, 2016). Drought conditions returned to most of the state again from 2012 to 2014.

According to instrument records and based on the Palmer Hydrological Drought Index, there have been a total of seven severe droughts in Wyoming since 1895 that lasted for three years or more (Curtis and Grimes, 2004, Wyoming Homeland Security, 2016). Of these recorded droughts, the Platte River Basin (Climate Divisions 8 and 10) was most impacted by the 1952 to 1956 drought, based on the percent of annual average precipitation deficit (Curtis and Grimes 2004). Droughts can occur in individual river basins. In fact, Wyoming averages severe or extreme drought conditions 10% of the time in the eastern plains to more than 20% of the time in the southwestern portions of the state (Curtis and Grimes, 2004).

Numerous studies throughout the world demonstrate that instrumental weather records are insufficient for capturing the full range of climate that people need to plan for, especially for understanding extreme events like droughts. Instrumental records rarely exceed 100 years in length (since 1895 for Wyoming), and therefore provide only a small sample of single and multi-year drought events. Additionally, instrumental records are not effective when examining long term (i.e., greater than 50 years) trends and cycles that may underlie year to year precipitation variability (Curtis and Grimes, 2004).

**Figure 5.4.8: Wyoming Drought Percentage**



Most trees in the western U.S. produce a single layer of growth called a "tree-ring" for each year of their lives. During years of favorable climate, trees will produce wide rings compared to the narrower rings formed in years of unfavorable climate conditions. Tree-rings, therefore, provide a means for developing long-duration climate records that can overcome most of the limitations inherent to instrumental observations. Tree-rings yield continuous, reliably-dated proxies of climate that are highly replicated. When properly analyzed, tree-rings provide records of seasonal to annual climate, and can be used to assess climate variability on time scales of decades to millennia (Curtis and Grimes, 2004).

Tree rings have commonly been used to reconstruct the climate of the southwestern United States for more than 40 years. However, the use of tree rings in Wyoming to build a long-term climate database is relatively new. A recent study conducted in the Bighorn Basin resulted in the development of a precipitation record for the period of time between 1260 and 1998 A.D. The study results show that dry events in the 13th to 18th centuries were more severe and lasted longer than any droughts within the basin since 1900. Notably, the 14$^{th}$, 15$^{th}$ and 16$^{th}$ centuries had large numbers of droughts of greater severity and duration than any of the events recorded instrumentally since 1900 (Curtis and Grimes, 2004). Another study conducted in the Green River Basin of southwestern Wyoming identified several extended drought periods between 1576 and 1786 that equaled or exceeded the severity and duration of droughts recorded since 1900 (Curtis and Grimes, 2004).

Tree ring studies completed to date indicate that severe droughts in Wyoming and the Rocky Mountain West lasting 10 years or more have been a common climatic feature for the past 700 to 800 years (Curtis and Grimes, 2004). The results of these studies together with the instrument recorded events should assist in the planning of the State's economic and agricultural development going forward, as well as the management of the State's natural resources, including timber, wildlife, and livestock production and water resources. Although no tree ring data have been evaluated for the Platte River Basin, Shinker et al. (2010) documented the severity of recent and prehistoric droughts in the North Platte River Basin using a combination of data sources, including historic and prehistoric evidence of low lake-levels. Their evaluation showed that although lakes in the basin have only experienced minor hydrologic changes during the historic period, many were desiccated during prehistoric dry periods occurring during the past 12,000 years. Prehistoric lake shorelines indicate that water supplies were substantially smaller during previous centuries and millennia, within the timeframe of more than 8,000 to less than 5,000 years before the present. The magnitude of these droughts likely caused changes in streamflows resulting in shifts in the regional hydrology (Shinker et al. 2010). Shinker suggested that these regional hydrologic shifts be taken into consideration as part of long-term economic and legal planning for the North Platte River Basin.

Due to the uncertainty of how long drought will last and the adverse consequences of any drought, it is imperative to quickly identify and evaluate the potential impacts of drought on water resources, and to mitigate its impacts. Recognizing the potential for economic loss in every county, the Wyoming Office of Homeland Security (2016) addressed drought in its most recent Wyoming Drought Mitigation Plan. As noted by the Wyoming Office of Homeland Security (2016), most counties within the Platte River Basin have also adopted their own hazard mitigation plans. The following drought management recommendations are made by the references cited for the uses listed.

### Agricultural Use

Davitt (2011) completed a water budget for the South Platte river basin for 1979 through 2006, which included the 2002 drought. Knutson and Haigh (2013) engaged ranchers and advisors to develop a drought planning methodology for Great Plains ranch operators. Based on this work, several drought management tools were proposed, including but not limited to, the following:

- Educate community on crop insurance and education programs encompassing multi-hazard insurance for business, resident and government application.
- Monitor soil moisture, precipitation, range condition and forage production, water resources, and local weather conditions to plan crop plantings and rotations, and/or assess livestock production and health.
- Implement grazing management systems to foster desirable plant species and improve overall pasture health.
- Invest in water delivery infrastructure to allow effective grazing.
- Maintain a ranch resource inventory to identify appropriate actions and strategies given severity of drought conditions.
- Reduce overall water use based on changes in monthly and annual well production.
- Increase efficiency of water applied to the crops by improving methods of delivery. Methods vary depending on whether surface or groundwater is applied.
- Change type of crop grown to better match available water supply, including use of dryland crops.
- Reduce number of cultivated acres to reduce amount of water needed to raise crop.

#### Municipal Use

The City of Cheyenne (2011) developed its own response plan following the 2002 drought. The following strategies that the City implemented could be applied to other municipalities in the basin:

- Promote the wise use of water resources by residents served by the water system.
- Monitor the condition of all water supply sources.
- Encourage use of native vegetation and drought tolerant landscaping.
- Implement water use restrictions based on diminishing reservoir storage levels, changes to groundwater production rates from wells, or reductions in recharge to surface and groundwater sources.
- Regulate outside irrigation watering schedules for residents and municipal parks to specific days and times based on the severity of the drought.
- Reduce or implement conservation measurements on washing hard surfaces or vehicles.
- Develop programs and educate the public on the potential uses of wastewater.

#### Industrial Use

Much like municipal and agricultural users, industrial water users will have to find or develop ways to best use and manage their limited water resources as supplies shrink. Drought management recommendations include the following:

- Monitor the condition of all water supply sources.
- Implement or improve process water recycling to limit requirements for additional water.

- Develop and use water produced from fresh or brackish sources non-tributary to the North Platte River or South Platte River.
- Develop groundwater from aquifers beneath those used for other purposes to limit competition for water.
- Treat developed water to meet the intended industrial purpose.
- Acquire temporary use permits for existing water sources if the intended purpose requires short term use.
- Develop joint ventures with other industries to maximize the benefit of the water used prior to discharge.

#### Recreational and Environmental Use

Due to diminished surface water supplies, recreational and environmental uses face daunting drought challenges due to competing water uses. The following drought management strategies are presented for consideration:

- Maintain instream flows where possible to support fisheries, wildlife habitat, and recreational river uses.
- Replace golf course turf grass with a more drought tolerant grass.
- Change outside irrigation schedules to more effectively water existing turf.
- Curtail recreational access depending upon drought severity.
- Encourage wildfire risk awareness and mitigation measures especially during times of drought.

#### Water Use from Storage

As the drought develops and reservoir levels change, wise management of the remaining storage volume is imperative. The following drought management strategies are recommended:

- Maintain a drought emergency plan.
- Seek additional opportunities for water storage and augmentation.
- Continue to permit and implement the Medicine Bow Mountains weather modification program.
- Line conveyance channel to reduce seepage loss.

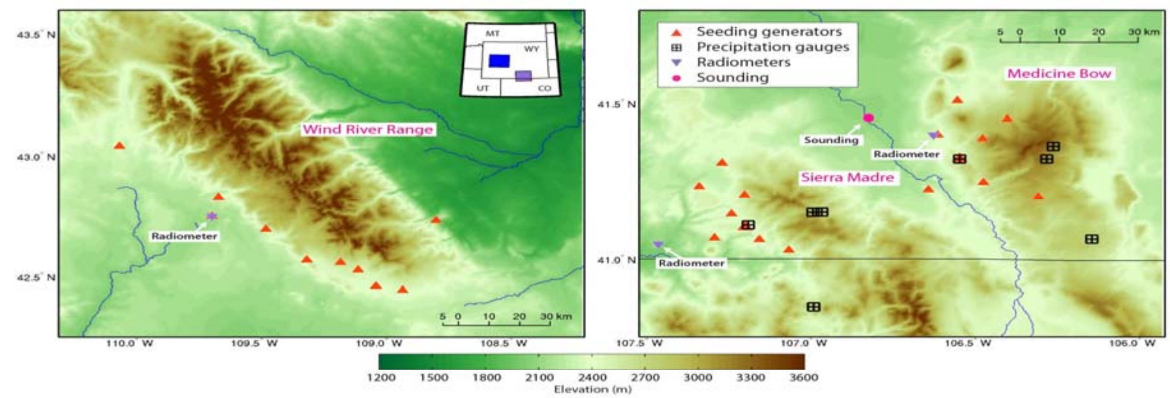
### 5.4.5 Weather Modification Efforts

Weather modification, commonly known as cloud seeding, is the application of scientific technology that can enhance a cloud's ability to produce precipitation. Interest and investment in weather modification practices have historically been driven by a need for an increase in fresh water supplies and a reduction in damage caused by hazardous weather conditions. Cloud seeding is used primarily to promote additional rain or snow to increase local water supplies. The principle of cloud seeding was first discovered in 1946, and the results of the first cloud seeding experiments were reported to Congress in 1951 (National Research Council, 2003). Efforts by private, academic, governments and military organizations worldwide to improve and refine the process have taken place periodically during the ensuing 80 years. Weather modification programs in the United States are generally funded by state and local government entities and utilities that generate hydroelectric power. Several western states, ranging from California to North Dakota and Texas have implemented operational cloud seeding programs, and other countries such as

China, Australia, France, Saudi Arabia, Turkey, Greece, and Venezuela are conducting cloud seeding research and operational studies.

Following a WWDC 2005 feasibility study that indicated potential success for cloud seeding within Wyoming, the WWDC funded the Wyoming Weather Modification Pilot Program (WWMPP) research project to determine the viability of cloud seeding to increase existing water supplies. The study also sought to quantify the potential increase in water supply due to seeding and the associated costs. The WWMPP was conducted from 2006 to 2014, and included three mountain ranges in Wyoming, the Medicine Bow and Sierra Madre Mountains (MBSM), and the Wind River Range (WRR).  The program was primarily focused on the Medicine Bow and Sierra Madre Mountains, which includes a portion of the Upper North Platte River Basin.  There were also additional evaluation and operational components that were focused on the WRR. **Figure 5.4.9** shows the location of the WWMPP study target areas. (WWMPP Draft Executive Summary, 2014).

**Figure 5.4.9: Wyoming Weather Modification Pilot Program Mountain Range Target Areas and Facilities.**




Other entities collaborating with the WWDC on the WWMPP included Weather Modification, Inc. (WMI), the National Center for Atmospheric Research (NCAR), the University of Wyoming, the Desert Research Institute (DRI), Heritage Environmental Consultants (Heritage), the University of Alabama, the University of Nevada Las Vegas, and the University of Tennessee.

The WWMPP provided a robust, state-of-the-art scientific assessment of weather modification as a strategy for long-term water management.  The accumulation of evidence from the statistical, physical and modeling analysis suggested a positive seeding effect on the order of 5 to 15% (WWMPP Draft Executive Summary, 2014).

Based on the positive results of the pilot program the Wyoming State Legislature appropriated $1.4M to "jumpstart" the transition from research to operational cloud seeding in the Medicine Bow/Sierra Madre Mountains, and to conduct a conceptual design and siting study in the Bighorn and Laramie Ranges.

NCAR, in collaboration with WMI, and Heritage was awarded the MBSM and Bighorn Mountains projects which began in June 2015. Scoping meetings for both projects were held in September 2015 in each prospective target area. Work towards developing an operational design, the siting of facilities, permitting, and a cost/benefit analysis is underway for the MBSM Mountains. Draft results from the MBSM final design and permitting study are expected to be available in the winter of 2016. During the winter of 2015/2016, a microwave radiometer and three high resolution snow gauges were installed in the Bighorn Mountains for data collection purposes. A public hearing to present the Bighorn Mountains draft results, and to receive public comment, was held on August 15, 2016 in Sheridan, Wyoming, and on August 17, 2016 in Worland, Wyoming. The final report is scheduled for completion early in 2017.

DRI, in collaboration with TREC, Inc., was awarded the Laramie Range project which also began in June 2015. During the winter of 2015/2016, a microwave radiometer was deployed in the Laramie Range for data collection purposes. A public hearing to present the Laramie Range conceptual design and siting study draft results, and to receive public comment, was held on August 18, 2016 in Douglas and Wheatland, Wyoming. The final report is scheduled for completion in early 2017.

From 2006 through the spring of 2014, cloud seeding operations in the WRR were conducted within the context of the WWMPP. Though the WWMPP concluded in the spring of 2014, local and regional interest in continuing operations remained. Recognizing this interest, funding for three operational cloud seeding seasons (2014-15, 2015-16 and 2016-17) has been provided in part by the Wyoming State Legislature in each session's "*Omnibus Water Bill – Construction*." Per the legislation, the appropriated funds could only be expended once formal cost-share agreements with interested parties were in place. For each season, Wyoming's cost-share allowance has been set at 25%, with other interested funding partners contributing the other 75%. The requested appropriation reflects the continuation of a 25/75% cost-share funding scenario between Wyoming and other interested parties. Cloud seeding operations in the WRR represent the continuation of a collaborative, operational program focused on snowpack augmentation to enhance local and regional water supplies.

#### Potential Water Rights Implications of Cloud Seeding

To mitigate potential tort litigation related to water rights or damages to landowners from the effects of weather modification efforts, states have promulgated regulations specifying how the additional water that may have been produced by weather enhancement and how adjacent landowners may be protected from potential harm caused by these operations (i.e., floods, droughts, hail damage, etc.). Pertaining to water rights, the State of California's Weather Modification Regulations state that water gained from cloud seeding is treated the same as natural supply. Many states are now writing into their permitting regulations that cloud seeding contractors provide financial proof, in the form of liability insurance that will give reasonable assurance of protection to the public in the event damages are caused by cloud seeding projects. The States of Utah and Colorado require this as part of their cloud seeding permit process. Colorado also requires a minimum $1,000,000 of liability insurance or three times the value of the cloud seeding project, whichever is greater. In Wyoming, cloud seeding operators are required to obtain a SEO permit to engage in weather modification activities. Much like California, Wyoming also mandates, in legally binding Agreements with operational cloud seeding cost-share partners that, "water developed by cloud seeding is part of the natural water supply and subject to all applicable laws." Further considerations recognized by Wyoming are addressed in the Wyoming Legislative Report (2014, 2015 and 2016) for the WRR operational program. The language states that, "no water ownership is implied by the participation in [collaborative weather modification programs], nor is there any expectation of a specific amount of water being delivered downstream, and any additional precipitation and subsequent streamflow that is produced through the program is treated as a natural event, and subject to Wyoming Water Law." Although Wyoming does not have the statutory authority to develop rules and regulations pertaining to weather modification, they have put into practice many of the same protections as other states.

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## 5.5 CONSERVATION STRATEGIES

### 5.5.1 Introduction

> ***"Conservation: a careful preservation and protection of something; especially planned management of a natural resource to prevent exploitation, destruction, or neglect."***
> - Merriam-Webster

The purpose of this section is to discuss and encourage implementation of conservation measures, identify strategies to further address the demand management side of the supply/demand equation and encourage voluntary conservation activities. Finger pointing is counter-productive. The examples cited in this discussion are intended to highlight successful strategies that are already being employed in Wyoming and to initiate discussion on the benefits of more widespread implementation.

Conservation cannot make or develop new water supplies but existing supplies can be used more wisely to serve the public good. Conservation activities can extend water supplies for beneficial uses including municipal, agricultural, recreational, environmental and industrial uses. Conservation is one cornerstone of water supply planning and can be an effective and economical way to extend usable storage. When there is widespread buy-in, an effective conservation program fosters a cooperative, collaborative environment for addressing difficult resource allocation issues and unites stakeholders with differing agendas. As a water management tool, conservation can mitigate the effects of drought by reducing both short and long term demands of domestic, agricultural and industrial users. Conservation can be a powerful unifying strategy to facilitate the dialog surrounding the dynamic and often contentious tug between water supply and demand.

In the Platte River Basin, where water supplies are fully appropriated and highly regulated, conservation plays a critical role in meeting growing demands and future needs. The benefits of effective conservation programs include 1) reducing future water storage needs, 2) increasing public awareness of a critical and limited resource, 3) reducing waste water streams, 4) facilitation of the federal permitting processes for water storage projects, and 5) considering the importance of water resource management in our daily lives. In the Platte Basin, conservation may provide the only opportunities for enhancing municipal, agricultural, industrial, and environmental/recreation water supplies. In many cases, the role of conservation in various water supply and land planning scenarios is being addressed in the WWDC's Watershed Planning Program.

> ***"Conservation is a state of harmony between men and land."***
> - Aldo Leopold

### 5.5.2 Municipal Water Conservation Strategies

Water savings resulting from conservation activities can reduce demands thus saving water providers money by reducing treatment costs and reducing the need for infrastructure expansion. The City of Cheyenne, Board of Public Utilities (BOPU) has implemented a water conservation program that includes 1) a tiered water rate schedule where the cost of 1,000 gallons of water increases with higher usage, 2) non-potable reuse for watering parks, and 3) a "Plan for Wise Water Use". Conservation measures (codified in City Ordinance) that are presented on the BOPU web page include:

1. Wasting water is prohibited. Wasting water by allowing water to run down streets is prohibited. There is a link to help homeowners learn how to keep water from their irrigation system out of the gutter.

2. Watering lawns and trees:

i. Water no more than three days per week. Avoid watering when windy or during rain.
ii. From May 1 to September 1, no watering between 10 a.m. and 5 p.m. for all users.

3. Watering gardens and flowers. From May 1 to September 1, watering between 10 a.m. and 5 p.m. is prohibited.

4. Washing vehicles. Wash cars and other vehicles using a hose equipped with a shut-off spray nozzle and/or bucket.

5. Washing parking lots, sidewalks or driveways. Cleaning hard surfaces such as parking lots, sidewalks or driveways using a hose is prohibited except for construction, safety and health reasons.

6. Watering new sod or grass seed.

   i. Soil must be amended prior to installing sod or seed with a minimum of 3.5 cubic yards of organic material per 1,000 square feet; tilled or disced to a depth of 6-inches. The web page has a link for landowners and landscapers to find out more about soil amendments.
   ii. From May 1 to September 1, no watering between 10 a.m. and 5 p.m.

7. Commercial and industrial customers must implement best management practices to save water. These include:

   i. Restaurants: Serve water only upon customer request.
   ii. Hotels and motels
      a) Offer guests staying more than one night the option of not changing linens and towels.
      b) Routinely inspect rooms for leaky faucets, showers and recreation equipment.

8. Construction sites

   i. Treated water used for construction must be used in the city.
   ii. Hoses must be equipped with shut-off nozzles.
   iii. Water used at construction sites must be metered.

9. Car washes

   i. Check equipment and facilities routinely for leaks, plugged nozzles, poor pressures or faulty equipment.
   ii. All hoses must be equipped with automatic shut-off nozzles.

The web page also provides the following advice to water users noting that there are more ways to reduce water use and save on water bills:

1. Repair leaks. Did you know that one out of every 10 gallons of water that is delivered to homes or businesses is lost to leaks?

2. Replace toilets, faucets, shower heads, washing machines and dish washing machines with water efficient models. How do you know if it is a water efficient model? Look for the ***WaterSense*** label.

3. Use less water by taking shorter showers, running full loads in the dishwasher or clothes washer, and by not letting water run from faucets or hoses when not in use.

### 5.5.3 Agricultural Water Conservation Strategies

Implementation of on-farm and irrigation conservation practices can save irrigation districts and individual irrigators money, reduce evaporation and transpiration losses, and reduce non-beneficial water consumption without affecting productivity. Secondary environmental benefits can also be realized by reducing irrigation return flows and diversions. Diverting less water can benefit carry-over reservoir storage and having water available for late season supplies irrigation. Conservation practices resulting in greater efficiency are capable of increasing crop yields and providing a buffer against drought. In the Platte River Basin, the implementation of conservation measures such as canal lining, conversion of open conveyance systems to pipes and conversion of furrow irrigation to sprinkler irrigation systems is most prevalent in Goshen, Platte, Natrona, and Converse Counties where higher value crops are grown or, in the case of the Casper-Alcova Irrigation District, Casper has provided financial assistance to the District in return for the use of the saved water. Sprinkler systems are increasingly being utilized elsewhere in the Platte River Basin where their use has reduced labor costs and improved hay yields. In Laramie County where most of the irrigated acreage uses non-tributary groundwater wells are being metered.

Irrigation provides water supplies to lands where rainfall is insufficient to meet the consumptive needs of crops. Irrigation is achieved by diverting water from streams or lakes through canals, ditches, or pipelines. Conveyance losses may occur in these facilities and the factors that affect conveyance losses are topography, soils, infrastructure type (unlined ditch/canal, pipeline, lined ditch/canal, etc.), age of the infrastructure, and maintenance history to name a few. Conveyance loss is the water that is diverted that never reaches the crops. Some of these losses result from evaporation, transpiration by plants adjacent to the canals/ditches and seepage that is recharging shallow or deep aquifers. In some cases, the seepage losses provide wildlife habitat and water lost from ditches/canals may return to streams as return flows. Water accrued to streams from irrigation return flows may be available for use by other owners of water rights. Some conveyance loss is permanent – lost to evaporation or deep percolation. Water lost to evaporation and deep percolation may have limited benefit to agriculture, wildlife, or other beneficial uses. Conveyance losses are greatest in systems operated by individuals or small privately owned operations using flood irrigation with unlined and poorly maintained canals.

Once the water reaches the field, it is either used by crops or becomes on-farm losses. Irrigation provides water to the crop's root zone to meet crop needs. Water consumptively used by the crop is incorporated in the biomass of the plant or is transpired by the plant into the atmosphere. On-farm losses include runoff to adjacent non-cropped areas or evaporation directly from the soil surface.

The WWDC has been proactive in reducing conveyance losses in canals/ditches and aging pipes and siphons. The program has assisted nearly every large irrigation district in the basin improve canals, laterals and diversions with more efficient infrastructure including replacement of open ditches with pipelines within the Goshen Irrigation District and canal lining and replacement of open ditches with pipelines within the WID. Improvements to irrigation reservoirs operated by the WID have reduced losses from embankments and outlet structures.

The City of Casper, Wyoming, financed canal lining on portions of the CAID to reduce conveyance losses resulting from seepage. The District is a USBR project that maintains a 59-mile long canal and 190-mile lateral system. In return for their assistance, the City of Casper obtained approximately 7,000 acre-feet of water for municipal use.

Where water law allows and there may be willing water right owners, conserved agricultural water may be re-directed to provide environmental enhancement to wildlife habitat and development of wetland banks. In conjunction with the SWPP, the opportunities for implementing this kind of cooperative project could be further explored. Recreational user fees or selling credits in wetland banks could be explored as potential revenue generating options. Further, irrigation water reuse, system wide and on-farm conservation practices may improve water quality by reducing irrigation return flows transporting sediments and agricultural chemicals.

### 5.5.4 Industrial Water Conservation Strategies

In the Platte Basin, the principal industrial uses of water include mining, oil and gas extraction and electric power generation. These activities have a water-energy nexus. Water and energy are inextricably linked. Water is needed to produce the mechanical components of energy generation and to cool fossil fuel-fired generation facilities. Energy is needed to produce water. Power is needed to drill wells, pump water, treat water to electric utility standards, and treat wastewater. Except for wind and solar power generation, water is needed to produce electricity. However, water is still needed in the manufacturing of wind turbines, solar equipment and the electrical components needed to move electricity from generation facilities to end users.

Market factors drive conservation in the industrial sector. Manufacturers and producers are constantly seeking ways to cut costs. If conservation measures are economical, the private sector will usually embrace them.

Economics and environmental constraints will likely shape the water conservation actions taken by industrial users. Coal fired electric generation is in decline nationwide and this trend is likely to continue as these plants age and environmental constraints increase operating costs. Electric generation will likely shift to more distributed systems relying on natural gas, wind, and solar. Research in the field of energy storage is rapidly moving forward at universities, national research facilities and private engineering firms. When economic and environmentally friendly storage systems are developed the paradigm of power generation may shift rapidly and radically depart from current technologies. Wyoming, with an abundance of wind and solar resources may likely be on the forefront of this change.

The possibility exists that as coal fired and gas fired electric generation is replaced by renewable energy sources, industrial water demands may decrease. This could result in re-purposing water resources to other beneficial uses.

### 5.5.5 Environmental/Recreational Water Conservation Strategies

The environmental benefits of conservation in other sectors can have either positive or negative effects on wetland, riparian and aquatic ecosystems. The benefits of conservation in the agricultural, municipal, or industrial sectors include greater availability to provide water to environmental uses such as instream flows, wetland development and maintenance and upland wildlife habitats. Water saved and stored can be better directed to critical habitat areas when and where it is needed resulting in better habitat and better water management.

A downside of water conservation on farms and within irrigation delivery systems is the loss of seepage wetlands and irrigation tailwater wildlife habitats. However, in many cases these are marginal, lower value and isolated habitats that may be mitigated by acreage that is managed to maximize wildlife and habitat values.

## 5.6 WATERSHED PLANNING STRATEGIES

### 5.6.1 Watershed Planning Goals and Objectives

As described in several completed watershed studies, the watershed plans inventory and describe physical and biological information including geology, hydrology, soils, climate, plant communities, wildlife habitat, and geomorphic characterization of the stream systems. The characterization of these resource areas is intended to identify water supply problems in the watershed. This information is incorporated into development, rehabilitation, and management plans along with cost estimates for potential future project activities. The watershed plans are useful tools for providing information which factors into the Basin Plans.

The watershed studies are initiated through application to the WWDC by a Conservation District or other appropriate entity. The watershed studies are planning tools to identify projects that may be eligible for funding under the SWPP. Once a Watershed Study is completed, any eligible project in the watershed can be funded through the SWPP. The WWDC's operating criteria for the SWPP describes the program:

> *"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."*

The SWPP of the WWDC is a key component of Wyoming's overall conservation strategy. An important output of the watershed planning process is identifying projects that are eligible for funding through the SWPP. The program results in collaborative projects with conservation districts and other political subdivisions to provide water supply and environmental benefits to agricultural uses and the public. The program is expanded with 30 to 50 applications being submitted to WWDC annually with a biennial budget of about $750,000.00. More information regarding the SWPP is available at: http://wwdc.state.wy.us/small_water_projects/SWPPopCriteria.html

By undertaking the Watershed Studies and the SWPP, WWDC has played an important role in fostering a statewide conservation ethic in water resources management. The agency has funded water supply efficiency improvements for nearly every public water provider and most of the irrigation districts in the Platte River Basin. In addition, Watershed Studies are underway or have been completed (and are being implemented) in the following North Platte Basin tributary drainages:

1. Sweetwater River Watershed Study (Basinwide Watershed Management Plan) 2012
2. Sweetwater River Watershed (Phase I, Long Creek Watershed Management Plan) 2012
3. Sweetwater River Watershed Study (Phase II, Muddy Creek and Horse Creek Watershed Management Plan) 2012

4. Sweetwater River Watershed Study (Phase III, Alkali Creek/Crooks Creek/Buffalo Creek Watershed Management Plan) 2012

5. Sweetwater River Watershed Study (Phase IV, Willow Creek/Sage Hen Creek/Dry Creek Watershed Management Plan) 2012

6. Middle North Platte Watershed Study Watershed Management Plan 2014

7. Upper North Platte River Watershed Plan 2015

8. Medicine Bow River Watershed Plan 2016

9. Upper Laramie Watershed Study 2016

10. Middle North Platte Watershed Management Plan 2016

11. South Platte Watershed Study (2017)

The watershed plans, basin plans and statewide plan are dynamic and interrelated documents that reflect snapshots in time. In a sense, some of the information provided in this basin plan and other WWDC planning documents may constitute forward thinking projections based on past history that may, or may not, reflect actual future conditions. Perhaps the greatest good that these documents can provide is a reasonable estimation of future conditions with high and low scenarios provided to address unforeseen contingencies.

Because of the legal and institutional constraints affecting water development in the Platte Basin, the SWPP may provide the most cost effective and environmentally acceptable means of developing water supplies in the basin.

## 5.7 WATER SUPPLY AND WATER MANAGEMENT STRATEGIES

***"Sound strategy starts with having the right goal."***
- Michael Porter

### 5.7.1 Introduction

This section summarizes the strategies or opportunities for meeting the future water needs of the Basin. The lists of opportunities previously identified in the 2006 plan have been expanded to capture the strategies identified during the past 10 years. New information has become available regarding water use, conservation, and storage options.

The Platte River Basin has a varied history of water development and water conflicts. The Basin contains a system of federal reservoirs that primarily supply water for agricultural water use and provide flood control benefits. In addition, these reservoirs provide water for hydropower generation, municipal and industrial use. Finally, they provide environmental recreational benefits within the region. The Platte River Basin is the largest of Wyoming's seven river basins and is known for its economic diversity. Litigation and court decrees have affected the apportionment and future management of water supplies within the Basin. The key apportionment and entitlements within the Basin were originally defined within the 1945 North Platte Decree and amended within the 2001 Modified North Platte Decree (2001 Decree).

In the more recent history, the ESA, CWA and other environmental legislation has affected existing water uses and continues to significantly influence future water development and water use opportunities. Based on allocations and apportionment within interstate decrees and the State's participation within an ESA recovery program, any new major water developments within the Basin is unlikely without mitigation to offset the proposed new depletions. Water supplies from the development of non-hydrologically connected water or the importing of non-native sources would not be considered depletive.

The PRRIP is the ESA recovery program initiated in 2007 which allows for the continued use of existing water uses in Wyoming for irrigation, municipal, industrial and other water uses in place on, or before, July 1, 1997. Each State completed a depletion plan to address and manage existing and future water depletions. The Wyoming Depletions Plan (referred to as the "Depletion Plan") identifies existing and new water related activities that are covered by the Program. The Depletion Plan presently provides coverage for depletions authorized by existing uses and for water activities with valid Wyoming water rights with priority dates prior to July 1, 1997; the date negotiations began to formulate the Program.

For the future development of small water uses serving domestic, stock, recreation, fish and wildlife, environmental, and other deminimus uses; the Depletion Plan addresses new depletions in the North Platte River basin if the proposed water project does not exceed 20 acre-feet per year in net water depletions.

It is the State of Wyoming's goal to provide any necessary offset or mitigation to any permitted water use activity with a pre-July 1, 1997 priority water right and for any new water projects in the Basin that do not exceed 20 acre-feet of net depletion a year. If Wyoming is unable to provide the necessary offset and all the state sponsored mitigation that is required in the future, the State may require water users to provide their own mitigation. Wyoming's future of limited water development opportunities, and the tracking and reporting requirements within the Depletion Plan will likely continue during the anticipated extension of the Program beginning in 2020.

### 5.7.2 Water Supply Opportunities/Strategies

At the onset of this project, the Basin Plan team members reviewed the list of opportunities developed during the previous Basin Plan. The purpose of this review effort was to evaluate any changes or updates, and gather any new information that became available since the previous Basin Plan was published.

During the previous Basin Plan, a long list of water use opportunities was developed. The list was based on a summary of water use opportunities discussed in technical memoranda as well as capturing opportunities listed in other basin plans that could be applicable to the Platte River Basin. Other sources of information were input from WWDC staff and the Commission, a literature review, and specific recommendations from Basin Advisory Group members and stakeholders. The long list was refined into a short list of structural and non-structural opportunities for the Basin. A short list of opportunities were identified in the previous basin plan:

**Non-Structural Future Use Opportunities**

- Drought response planning
- Weather modification
- Water conservation
- Water right transfers
- Enhancing recreational use of water resources
- Increasing runoff from national forests based on USFS policies and practices
- Water exchange/banking
- Multi-purpose flood control program
- Utilization of WWDC's SWPP

**Structural Future Use Opportunities**

- Groundwater augmentation – non-hydrologically connected to North Platte River surface water
- Upper Laramie River storage opportunities
- Transbasin diversions
- Snow fences
- Stormwater capture, storage, treatment, and management; irrigation with treated municipal wastewater, grey water irrigation; and municipal irrigation using untreated water
- Modification of the Pathfinder Dam and Reservoir
- Conversion of coal bed natural gas (methane) wells
- Regionalization of public water supply systems
- Improving agricultural irrigation system efficiencies

### 5.7.3 Completed and On-Going Non-Structural Opportunities/Strategies

The Wenck Team evaluated changes or updates and gathered new information that became available since the 2006 Basin Plan. The short list from the previous Basin Plan was further refined and the top priority strategies were identified. The strategies were evaluated to develop and define other opportunities and to align the strategies with the anticipated growth and demands and water use changes over the 10 to 30-year planning horizon.

**Potential Operational Enhancements – Existing Storage and Conservation**

Water supply shortages coupled with legal and institutional constraints affect water development and water management in the Platte River Basin. The North Platte Basin has been considered as fully appropriated since the 1950's. Interstate decrees and an ESA recovery implementation program affect the development of water supplies. The highest priority strategies for maximizing the available water supplies are operational enhancements of existing storage and water conservation

The first two potential opportunities under operational enhancement category of operational enhancements uses (Re-Operation of Glendo Reservoir and Above Pathfinder Irrigation Reservoir Storage) could be achievable in the near-term planning horizon over the next 10 years and the implementation of some of the operational enhancements could occur over a longer planning period up to 30 years into the future.

**Re-operation of Glendo Reservoir***.* The State of Wyoming, through WWDC, is moving forward with a storage feasibility study with the objective of more efficient use of a portion of Glendo Reservoir's flood pool to meet downstream beneficial uses. Of the total dam storage capacity of 1,092,290 acre-feet, approximately half is reserved for flood control and surcharge. The USACE oversees flood control operations when the reservoir elevation reaches elevation 4,635 feet, and ceases at elevation 4,653 feet. A total of 271,017 acre-feet of flood pool storage is managed by the USACE to the flood pool. The flood pool operating rules prescribe evacuating water from the flood pool as quickly as possible without any consideration of downstream beneficial water needs. The initial estimates indicate that up to 20,000 to 40,000 acre-feet of flood pool storage may be available under this Glendo re-operation project.

The proposed project meets the goal of enhancing existing water storage in Wyoming, a high priority initiative within the Wyoming Water Strategy issued by Governor Mathew Mead. There are complex issues confronting this project but interagency coordination is planned at the onset of the project and the feedback received will affect the entire study. WWDC is aware that mitigation will be required; particularly due to the anticipated effects of high water levels on Glendo State Park's recreation and infrastructure facilities.

When the USACE-authorized flood pool releases occur before large irrigation demands become active downstream, no benefits to storage water supplies are achieved. The project proposes the retiming of released water to assist in meeting downstream irrigation demands and to conserve overall storage supplies. Contractors of federal storage supplies and natural flow diverters both downstream and upstream of Glendo Reservoir would realize benefits of storage water conservation because the additional storage water can be used in lieu of normal water supplies throughout the entire North Platte River system.

**Above Pathfinder - Irrigation Reservoir Storage***. **Note: This strategy has both a non-structural and a structural component.*** Volume 3, Section 3.6 of this updated Platte Basin Plan evaluated potential storage opportunities in irrigation reservoirs located in the basin above Pathfinder Reservoir exclusive of the Kendrick Project and Seminoe Reservoir. Specifically, Section 3.6.7 discussed both structural and non-structural alternatives for optimizing water storage for irrigation purposes above Pathfinder. One of the non-structural alternatives is to implement reservoir owner operating strategies.

In accordance with interstate Decree requirements, Wyoming is only able to accrue up to 18,000 acre-feet of water from the North Platte River and its tributaries above Pathfinder Reservoir for irrigation purposes during any one year. Wyoming's annual accrual amount has averaged 12,038 acre-feet since reporting began in 1951. The estimated overall total storage capacity of all the reservoirs (active and inactive combined) is 27,525 acre-feet so there is a possibility of exceeding the cap in any one year; although Wyoming has never exceeded the accrual cap. A potential non-structural recommendation is to facilitate coordination of storage accruals amongst the reservoir owners. Reservoir operational plans that address targeted accrual quantities based on carryover amounts and anticipated runoff would be developed for the largest reservoirs. The new measuring device equipment installed on the largest 11 reservoirs allows for near real-time monitoring of accruals and maximum storage amounts. The objective of this operational strategy would be to maximize Wyoming's storage quantities up to the Decree allowance of 18,000 acre-feet in as many Water Years as possible.

**Agricultural Water Use Conservation*.*** Irrigated crop production within the agricultural sector represents the largest water use within the Basin and presents the largest opportunity for water savings through water conservation. Two potential objectives of water conservation are to reduce the non-beneficial water consumption or to reduce diversion. The proposed changes in methods and practices are opportunities to stretch existing water supplies to effectively meet existing water needs and to help meet future water needs. The conservation plans need to be evaluated individually to determine their potential effects on water rights, crop production, other existing water uses, and the environment.

It is important to understand the terminology of irrigation methods when reviewing potential conservation methods. Irrigation efficiency is considered as the ratio of the total amount of water diverted for an irrigation use to the amount of water needed by the crop, which is considered the consumptive use supplied by irrigation. Natural precipitation provides a portion of the water consumption needed by the plants. Irrigation efficiency can be further refined into water conveyance or delivery efficiency and on-farm efficiency. The conveyance losses occur between the point of diversion and the delivery of water to the field turnouts. The losses can occur through evaporation, consumptive use (evapo-transpiration) by non-crop vegetation or phreatophytes, and seepage. The on-farm water losses primarily include deep percolation, evaporation, and runoff from the fields.

Wyoming's primary land uses and history supports a ranching lifestyle that is complementary to other water uses. The primary crop in the Basin is native hay and most ranchers only perform one harvest cutting per year. Portions of the irrigated lands are not cultivated and only serve as pasture for livestock. Most ranchers within the above Pathfinder Reservoir and Upper Laramie River subbasins rely on flood irrigation practices although some center pivots and siderolls are present. The diversion locations can be a significant distance from the irrigated fields with earthen ditches cut along ground contours conveying water supplies. The overall runoff and active irrigation period can be relatively short for the tributary areas within the Basin due to the short period of high runoff, which primarily occurs in the spring and early summer months. The return flows from the flood operations often occur gradually following the flood irrigation providing for wetlands, recreation, and instream benefits.

The agricultural production below Pathfinder Reservoir, in the Lower Laramie, and within the South Platte and Horse Creek subbasins have varying amounts of row crop production and many producers have installed efficient conveyance and application facilities; which include pipeline conveyances, and center pivot or sideroll irrigation systems. The agricultural production methods within these subbasins are more amenable to water conservation and are more likely to be impacted by pressures by other water users; particularly for enhancing recreation and environmental water needs.

Wyoming water laws allow for the historic crop consumptive use by irrigation to be marketed and transferred to other types of beneficial use. The current water laws allow for the determining consumptive use as the amount of irrigation water the crop needs for growth. Within the Basin, crop irrigation deficiencies occur due to many factors. Primary deficiencies include inadequate water supplies, and losses associated with conveyances, and on-farm practices. Because of these deficiencies, natural precipitation combined with the actual water delivered to the crop is not sufficient to meet the full supply requirement of the crop consumptive use during the crop's growing season for most of the time.

Throughout the Basin, where feasible and appropriate, open-ditch delivery systems have, and are being converted to closed pipelines virtually eliminating all conveyance losses. Flood and furrow irrigation is being replaced with more efficient application practices involving sprinklers, side rolls and drip systems where these practices are feasible. Many of the projects are state or federally funded with public entities and sponsors contributing much of the expense and labor. When funding is inadequate from the government and local and private entities, partnerships with other water users, foundations, or local organizations benefiting from the improvements should be considered. Agricultural water savings can provide significant benefits to recreation and instream flow. The foundations and non-profit organizations benefiting from the improved conservation methods may be willing to provide monetary and volunteer labor support.

**Buy and Dry Transfers*.*** The typical agricultural transactions in western states involve "buy and dry" transactions. The land sales and accompanying water rights transfers are completely market driven. For Wyoming, the agricultural developments in the Basin lost to municipal development are primarily limited to residential and commercial developments near larger communities; such as, Casper, Cheyenne, and Torrington. In Wyoming, as in other western states, an aging population of agricultural producers and a lack of younger people available for farming and ranching are affecting the trends of land use changes. The projected population growth effects in other western states have already removed large agricultural areas from production. As population grows these land use changes from agricultural to urban and residential developments is expected to continue if alternative water transfers are not implemented. Alternative water right transfer agreements are beginning to occur that prevent the complete demise of agriculturally based communities. A number of alternative water right transfer agreements have been executed in the State of Colorado. The Morgan Ditch Company formed a voluntary lease agreement with Xcel Energy. The agreement has allowed for Xcel Energy's Pawnee power station to receive a firm water supply within the eastern plains near Brush, Colorado. During dry years, a small portion of the water supply is provided to the power station since it is located in the vicinity of the main canal. Water is delivered to the power station but most of the ditch farmland remains fully irrigated with senior direct flow and senior reservoir rights. Other examples include the City of Thornton forming a short-term lease supply plan to provide for emergency water from the Platte River Power Authority and the Lower Arkansas Valley Super Ditch Company which allows irrigators to temporarily lease water to cities, towns, water districts but the ownership of the water is retained with the farms (Colorado's Water Plan, 2015). An alternative water right transfer agreement could allow for certainty of water availability to serve water needs of municipalities or other high value markets periodically when the demand occurs but the water right appropriation's primary purpose is to serve and maintain agricultural production in the future.

**Legislative Strategies*.*** In many water law settings, there is a "use it or lose it" policy which requires that water users exercise their individual water rights to protect them. However, in specific situations, Wyoming water laws can be a barrier to conservation improvements.

Wyoming's water users may consider the need for legislative reform to address the concerns with existing water laws being a disincentive to improving agricultural conservation and efficiency. Other western states have enacted bills and legislation that protect appropriators from abandonments if the appropriator has agreed to participate in a state or federal water conservation program that is approved by a state agency. The primary types of water sharing transactions being evaluated or implemented in other western states to prevent further reductions in irrigated lands include the following agreements:

- Purchase and lease-back
- Rotational fallowing (short and long term)
- Water banks
- Reduced crop consumptive use
- Interruptible water supply agreement

Rotational fallowing and raising crops with lower consumptive use are techniques for reduced consumptive use of the irrigated crop. The accounting of water depletions under Wyoming's Depletion Plan for the Program allows for the accounting of underrun depletions of various water uses to offset the overruns by the other water uses when the depletions are summed and translated to the Wyoming Stateline with Nebraska. The accounting system can be considered as a de facto water bank that is accounted for and tracked by the State of Wyoming. This water bank accounting provides flexibility to water users under the Depletion Plan. In addition, the replacement of abandoned or active irrigation wells in the "Triangle Area" in Goshen County allows for Wyoming to maintain the "water bank" of wells allowed under the 2001 Modified North Platte Decree.

An interruptible water supply agreement (IWSA) protects an appropriator with an agreement with another water user. An IWSA allows an agricultural appropriator to temporarily lease their historic consumptive use without requiring a permanent change in their water rights. The IWSA's in Colorado allow for leasing periods with terms up to 10 years and can be renewed up to two times. The Colorado agreements allow the agricultural producers to rely on active use of the water right up to 3 years during the 10-year period. The agreements allow for flexible water use based on water supply conditions and the water needs of the two parties.

The SEO would need to be involved in reviewing and approving any long-term water leasing agreements to ensure that the physical water supply exchange process is manageable and practical and that other appropriators are not injured. Without similar legislation in Wyoming, there remains less flexibility and a disincentive for Wyoming's appropriators to lease or to conserve water supplies for the benefit of other water users or to provide for recreation or instream benefits. The attempts in Wyoming to address flexible water use transactions under existing Wyoming Statutes §41-3-110 providing for recreation or instream benefits have not been successful. This Statute allows for the temporary change of water rights acquired through purchase, gift, or lease for up to a 2-year term. These temporary water right transfers are subordinate to all other permanent water rights. When the 2-year term ends, the appropriation automatically reinvests back to the original water right unless the agreement is renewed.

**Imported, Exchanged and Transferred Water Supplies.** Because of water supply limitations along with significant regulatory and legal obstacles to the development and use of in-basin water resources, another strategy for meeting future demands is importation of out of basin water supplies. The City of Cheyenne has successfully implemented this strategy in their development of the Stage I and Stage II water supply projects. Further, transferring existing water supplies with adjudicated rights to other users is an option that may be feasible to better use existing water rights. The existing water rights may be retired or abandoned entirely or just portions of the water rights may be retired or transferred temporarily. This action requires SEO approval.

The endangered species recovery program for the Central Platte River in Nebraska allows for project proponents in Wyoming to rely on non-native water supplies imported into the Basin to meet proposed water projects with new depletions. In addition, the Program covers any existing water uses in place in Wyoming as of July 1, 1997, water rights transfers approved by the Wyoming Board of Control are not considered new depletions.

Public and private entities in Wyoming have existing infrastructure in-place for importing non-native water supplies into the Basin. For example, the City of Cheyenne BOPU provides imported water from the Little Snake River Basin that is released in the North Platte River drainage in exchange for the water imported to Cheyenne from the North Platte Basin under Wyoming's Stage II Project. Cheyenne BOPU's existing reuse system relies on the non-native imported water that is available at the wastewater plants and can be used to extinction. As the population of Cheyenne increases and the reuse system is expanded, the water supplies imported through this Stage II project will also increase. If the City of Cheyenne has surplus water supplies available in any one Water Year, municipal, industrial, and other water users may purchase water from the Cheyenne BOPU and the State of Wyoming.

The State of Wyoming and appropriators within Laramie County have been engaged in evaluating remedial measures to address depleted groundwater resources. The non-native water supplies available through the Stage II Project could assist with recharge of the depleted groundwater areas within the Laramie County Control Area near the Crow Creek drainage.

Transbasin diversion projects have been investigated for importing water supplies from other Wyoming basins into the North Platte River Basin. These projects can be very complex and difficult to obtain permits and authorizations because of significant environmental mitigation requirements and opposition by the affected water basin. The extent of public support or opposition to the project can affect the development of the project. The water supplies must be physically and legally available within the basin of origin. No large water development project is anticipated within the 10-year planning period. Other feasible water supply options described in this volume can meet water needs anticipated within the 10-year period. The studies completed within the Basin include the following.

- A joint collaborative effort is underway between Colorado and Wyoming entities to investigate the feasibility of an interstate water project to bring water from the Green River Basin in Wyoming to the Platte River Basin and Colorado front range communities. The Flaming Gorge Pipeline Project as it is known, involves a coalition of Wyoming communities including the City of Cheyenne, City of Torrington and Laramie County. The Colorado entities engaged in the project are Douglas County, the 13 members of the South Metro Water Supply Authority, Donala Water and Sanitation District, and Cherokee Metro District in the Pikes Peak Region. The project would take unappropriated water from the Flaming Gorge Reservoir in Wyoming and deliver it to project participants in Wyoming and Colorado through existing channels and new pipeline and storage infrastructure.

- A Wind River Export study to import water from the Wind River Basin with yields up to 36,000 acre-feet in dry years (Level 1, ECI, 2002). The water was delivered to the North Platte River through the Sweetwater River conveyance. Current WWDC storage feasibility studies are evaluating tribal and district water rights and Wind River Basin water supply irrigation shortages.

**Industrial Water Use Changes*.*** The economic demand projections within the high scenario of this Basin Plan predict the possibility of a new gas-fired power plant and a new coal conversion facility within the next 30-year planning period. The water demands for oil and gas development affected by the cyclical boom and bust conditions are expected to increase in the next 10 to 20 years under the High (growth) Scenario. In subbasins where water supplies are limited, oil and gas producers have executed water leasing agreements with existing water users that require the user to temporarily forgo the use of a portion of their water right. Expansions and development of mines serving the uranium extraction industry are anticipated to occur under both mid-range and high-growth scenarios in this Basin Plan.

In addition, new wind turbine farms are in various planning stages with some larger-scale projects built and active within the Basin. The water needs and demands for construction and operation of windfarms is small in comparison to other industrial water uses. A couple of former oil refineries within the City of Casper have been shut down for many years and are in different phases of remediation and re-development of the refinery properties. In the recent past, an ethanol facility in Torrington has ceased operations and a sugar processing plant in Torrington is anticipated to close within the next few years. An existing coal-fired power plant that diverts and relies on significant water supplies from the North Platte River is located near Glenrock. A second coal-fired power plant near Wheatland relies on water supplies from the Laramie River and Grayrocks Reservoir. Both plants are not planning any expansions and reductions in water use could occur due to market and environmental regulation conditions over the short and long-term planning period. Other coal-fired power plants within the State have converted their plants into gas-fired operations.

With the potential water use changes expected by various industrial water users, water supplies made available by the retiring or the leasing of pre-1997 water rights may likely be adequate to satisfy new water right demands. The temporary leasing of water rights is allowed under Wyoming's Temporary Water Use Agreement Statute and permanent water right transfers would be reviewed and approved by the Wyoming Board of Control. Water rights of industrial users that are reducing or closing operations and not transferring their consumptive use to other water uses either temporarily, or permanently, could be subject to involuntary water right abandonment actions.

**Laramie County Regulatory Controls***.* The South Platte subbasin water uses, particularly irrigated agriculture, are very dependent upon groundwater supplies with little surface water supplies available in the subbasin. Due to declining groundwater levels and water use pressures in the High Plains Aquifer, the State Engineer issued a corrective control Order on April 1, 2015 guiding development for the next five years within the Laramie County Groundwater Control Area. Within the LCCA, the SEO requires documentation of water use in the past 5 years through inspection of aerial photography or other documentation such as well pumping power records or water meter readings.

These recent actions occurring within the South Platte subbasin within Laramie County are an example of regulatory controls taken to protect and enhance an existing groundwater resource within the Basin. The State of Wyoming established Groundwater Control Areas to address concerns with groundwater resources within the State when demands exceed available supplies. The Laramie County Groundwater Control Area (LCCA) is contained within the eastern two-thirds of Laramie County within the South Platte subbasin. Since the 1970's, much of the High Plains aquifer system has been heavily appropriated and the LCCA was formed in 1981 to address groundwater depletion concerns.

Due to declining groundwater levels and water use pressures in the High Plains Aquifer, the State Engineer issued a corrective control Order on April 1, 2015 for the LCCA that affects groundwater development for the next five years. A groundwater model had been developed for Laramie County to evaluate the effects of current and proposed groundwater withdrawals. The model was relied upon to evaluate various control options. One requirement of the Order is that all large capacity wells shall be metered within the LCCA prior to water year 2017. The Order stops the drilling of new large capacity wells in specific heavy use irrigation areas and requires spacing, water use and monitoring in the "Conservation Area" defined within central and western parts of the LCCA. Wells completed in formations deeper than the High Plains Aquifer also have metering, spacing, and monitoring requirements.

In southeast Wyoming, the oil and gas development in Laramie County has primarily occurred within the LCCA. The SEO has encouraged water leasing of existing water rights, primarily leading to agreements with existing groundwater appropriators willing to forgo the use of a portion of their irrigation water rights. During water years 2011 and 2012, approximately 117 water leasing agreements for meeting oil and gas water needs were reviewed and approved by SEO. An important requirement of the Temporary Water Use Agreement Statute (W.S. 41-3-110) is that "*Only that portion of the water right so acquired which has been consumptively used under the historic use made of the water right, may be diverted by the temporary user*."

**Aquifer Storage and Recovery.** Aquifer recharge and aquifer storage and recovery (ASR) wells is a method proposed to replenish or store water in an aquifer. The purpose of the recharge is to store water underground and to recover groundwater from a well for beneficial uses. The water can be injected with a well or by surface water infiltration from riverbeds of recharge basins. The water injected is typically treated to meet primary and secondary drinking water standards. The viability and feasibility of potential artificial recharge sites in the Basin needs to be assessed. Potential problems that can occur with artificially recharged water are geochemical reactions that occur in the subsurface that adversely affect aquifer water quality. The project design needs to control the water supply stored within the aquifer space without allowing water to escape within the aquifer system. The proposed construction, operation, and maintenance of the artificial recharge project needs to be technically feasible. A project can be tested through pilot scale studies.

When compared to alternative surface water reservoirs, ASR can provide economic savings. The technology has been found to be good for the environment, aquatic, and terrestrial ecosystem as compared with new surface water storage. The ASR typically store water during times of flood or overly wet conditions when water quality is good, and recover water during times of drought or dry conditions when water quality from surface water sources may be degraded. The suitable aquifers can be aquifers that have experienced long-term declines in water levels due to heavy pumping to meet municipal, industrial, or agricultural water needs. ASR can provide water supply during emergencies; as a back-up supply, such as severe floods, earthquakes, contamination incidents, pipeline breaks, or damage due to warfare or sabotage.

One method of recharge is from recharge basins or spreader dikes to provide infiltration with surface water supplies. The recharge can also occur through increasing or enhancing the flow of water in natural drainages and channels within reaches that lose flow to the subsurface. A potential application for the Basin is the recharge of surface water supplies within the South Platte subbasin in Laramie County. Previous studies have reviewed the acceptability of recharging the High Plains Aquifer with surface water supplies of the City of Cheyenne water collection and distribution systems in the Crow Creek drainage. Another alternative is the supply of recharge water from discharge at the wastewater treatment plants or treated reuse water supplies. An aquifer recharge project in the Basin will face permitting and technical challenges so feasibility and planning studies are needed to evaluate potential projects and screen for fatal flaws.

### 5.7.4 Completed and On-Going Structural Opportunities and Strategies

Many of the water use opportunities and strategies are in different phases of being implemented with more details of the status of various implementation efforts below. Many of the successful water supply projects are completing or planning expansions or enhancement to the existing systems.

**Wyoming Water Development Commission Projects.** The WWDC has been actively engaged in assisting municipalities, domestic water districts and irrigation districts improve the efficiency of their systems and develop new water supplies. Since 2006, the WWDC has committed more than $111M to construct 78 projects in the Platte River Basin. As shown in **Table 5.7.1** there are currently 45 projects underway with appropriations totaling nearly $70M. Thirty-three completed projects are shown in **Table 5.7.2** and total more than $41M.

**Table 5.7.1: WWDC Construction Projects in Process in the Platte River Basin Since 2006**

| Project | Program | Session | Account | Appropriation | Due Date |
|---|---|---|---|---|---|
| Casper Poplar Transmission Pipeline | New Development | 2007 | I | $3,200,000 | 2012 |
| Casper Zone II 2015 | New Development | 2007 | I | $3,200,000 | 2012 |
| Laramie Transmission Pipeline | New Development | 2008 | I | $880,000 | 2013 |
| Goshen Irrigation District Rehabilitation 2013 | Rehabilitation | 2009 | II | $1,200,000 | 2014 |
| Laramie Transmission Pipeline | New Development | 2009 | I | $6,850,000 | 2014 |
| Casper Alcova Rehabilitation 2010 | Rehabilitation | 2010 | II | $477,040 | 2015 |
| Casper Poplar Transmission Line | New Development | 2010 | I | $663,300 | 2015 |
| Casper Zone II 2015 | New Development | 2010 | I | $663,300 | 2015 |
| South Laramie Water Supply | New Development | 2010 | I | $3,100,000 | 2015 |
| Central Wyoming Regional Zone IIB | New Development | 2011 | I | $1,959,750 | 2016 |
| Cheyenne Southern Pipeline | New Development | 2011 | I | $14,029,800 | 2016 |
| Douglas Box Elder Spring-Phase 1 | New Development | 2011 | I | $1,487,400 | 2016 |
| Goshen Irrigation District Rehabilitation 2013 | Rehabilitation | 2011 | II | $1,100,000 | 2016 |
| Wheatland Irrigation District Rehabilitation 2015 | Rehabilitation | 2011 | II | $723,600 | 2016 |
| Wheatland Rehabilitation 2011 | Rehabilitation | 2011 | II | $723,600 | 2016 |
| Casper Poplar Transmission Pipeline | New Development | 2012 | I | $1,541,000 | 2017 |
| Casper Zone 3 Improvements | New Development | 2012 | I | $1,541,000 | 2017 |
| Casper Zone II 2015 | New Development | 2012 | I | $1,541,000 | 2017 |
| Fort Laramie Storage Tank | Rehabilitation | 2012 | I | $53,600 | 2017 |
| Lake Hattie Dam | Rehabilitation | 2012 | II | $840,000 | 2017 |
| Lake Hattie Dam | Rehabilitation | 2008/2012 | II | $282,000 | 2017 |
| Laramie Transmission Pipeline | New Development | 2012 | I | $3,120,000 | 2017 |
| Rolling Hills Water Supply | New Development | 2012 | I | $160,000 | 2017 |
| Rolling Hills Water Supply | New Development | 2014 | I | $1,184,000 | 2017 |
| South Laramie Water Supply | New Development | 2012 | I | $2,638,170 | 2017 |
| Casper Raw Water Supply II | New Development | 2013 | I | $487,600 | 2018 |
| Cheyenne Southern Pipeline | New Development | 2013 | I | $4,261,200 | 2018 |
| Cheyenne Southern Pipeline | New Development | 2014 | I | $0 | 2018 |
| Evansville Emergency Connection | New Development | 2013 | I | $141,370 | 2018 |
| Fort Laramie Storage Tank | Rehabilitation | 2013 | I | $1,085,500 | 2018 |
| Goshen Irrigation District Rehabilitation 2013 | Rehabilitation | 2013 | II | $1,400,000 | 2018 |
| Jeffrey City Water System Improvements | New Development | 2013 | I | $418,750 | 2018 |
| Savery Creek Diversions Phase II | Rehabilitation | 2013 | II | $1,900,000 | 2018 |
| Casper Zone 3 Improvements | New Development | 2014 | I | $3,685,000 | 2019 |
| Central Wyoming Regional Elevated Tank | Rehabilitation | 2014 | I | $1,648,200 | 2019 |
| Cheyenne Southern Pipeline Phase III | New Development | 2014 | I | $1,206,000 | 2019 |
| Glenrock Transmission Pipeline | New Development | 2014 | I | $381,900 | 2019 |
| Laramie North Side Tank | New Development | 2014 | I | $1,200,000 | 2019 |
| Medicine Bow Transmission Pipeline | Rehabilitation | 2014 | II | $1,052,000 | 2019 |
| Pine Bluffs North Well Field | New Development | 2014 | I | $1,811,000 | 2019 |
| Rock River Transmission Line Replacement | Rehabilitation | 2014 | II | $1,159,100 | 2019 |
| Goshen Irrigation District-Guernsey Spillway Rehabilitation | Rehabilitation | NA | NA | NA | NA |
| Hill Irrigation District-Guernsey Spillway Rehabilitation | Rehabilitation | NA | NA | NA | NA |
| Savery-Little Snake-Battle Creek Diversion | Rehabilitation | NA | NA | NA | NA |
| Wheatland No. 7 Well | New Development | NA | NA | NA | NA |
| | | | | **$74,996,180** | |



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### Table 5.7.2: WWDC Projects Completed in the Platte River Basin Since 2006

| Project | Year Completed | Category | Source | Program | Actual Expenditures |
|---|---|---|---|---|---|
| 33 Mile Pump Station | 2013 | MUN | GW | New Development | $129,827.53 |
| Albin 2005 Well | 2008 | MUN | GW | New Development | $155,274.35 |
| Burns Storage Tank | 2013 | MUN | | New Development | $889,581.00 |
| Casper Alcova Ditch Rehabilitation | 2009 | IRR | SW | Rehabilitation | $742,261.00 |
| Casper Alcova Rehabilitation 2009 | 2010 | IRR | SW | Rehabilitation | $83,855.00 |
| Casper Paradise Valley Pipeline | 2011 | MUN | SW | New Development | $595,993.60 |
| Casper Rock Creek Dam Rehabilitation | 2011 | MUN | RES | Rehabilitation | $834,150.00 |
| Casper Zone III | 2012 | MUN | SW | New Construction | $1,873,847.71 |
| Casper Zone IV Improvements | 2012 | MUN | GW | New Development | $475,538.10 |
| Cheyenne's Granite Dam Spillway Improvements | 2009 | MUN | RES | Rehabilitation | $473,730.23 |
| Chugwater Water Supply | 2007 | MUN | GW | New Development | $1,302,436.00 |
| Glendo Well | 2011 | MUN | GW | New Development | $292,404.37 |
| Glenrock Tank Rehabilitation | 2008 | MUN | GW | New Development | $846,617.26 |
| Glenrock Well | 2011 | MUN | GW | New Development | $614,137.00 |
| Goshen Rehabilitation 2009 | 2012 | IRR/MUN | SW/R | Rehabilitation | $1,126,138.93 |
| Goshen Rehabilitation 2011 Project | 2013 | IRR/MUN | SW/R | Rehabilitation | $1,100,000.00 |
| Laramie County Archer Water Supply | 2012 | MUN | GW | New Development | $115,153,31 |
| Laramie Water Management Project (meters) | 2008 | MUN | GW | Rehabilitation | $70,421,76 |
| Mile-Hi Water Supply Project | 2011 | MUN | GW | New Development | $595,593.42 |
| Pathfinder Modification Project | 2013 | MUN | RES | Dams/Reservoirs | $5,997,076.07 |
| Pine Bluffs Deep Well 2009 | 2012 | MUN | GW | New Development | $319,343.69 |
| Pine Bluffs Lance, Fox Hills Well | 2011 | MUN | GW | New Development | $318,889.90 |
| Poison Spider Pipelines | 2013 | MUN | GW/SW | New Development | $1,027,859.00 |
| Rawlins Atlantic Rim Pipeline | 2011 | MUN | RES | Rehabilitation | $2,621,202.45 |
| Rawlins Pipeline & Atlantic Rim Reservoir | 2013 | MUN | RES | Rehabilitation | $5,972,112.36 |
| Rawlins Treated Water Tank Rehabilitation | 2009 | MUN | GW/SW | Rehabilitation | $1,154,298.00 |
| Saratoga Well field | 2010 | MUN | GW | Rehabilitation | $3,079,680.00 |
| Sundance Meadows Water Supply | 2011 | MUN | SW | New Development | $280,923.99 |
| Torrington Water Supply | 2008 | MUN | GW | New Development | $3,391,795.00 |
| Wardell Water Supply Improvements | 2013 | MUN | | New Development | $4,206,458.93 |
| Wheatland Black Mountain II Water Supply | 2009 | MUN | GW | New Development | $222,440.00 |
| Wheatland Re-regulating Reservoirs | 2010 | IRR | SW | Rehabilitation | $74,591.00 |
| Yoder Water Supply | 2013 | MUN | GW | New Development | $179,232.00 |
| | | | | | **$41,162,862,06** |

**Weather Modification.** In addition to the structural projects noted above that are completed or underway, the WWDC has also sponsored cloud seeding studies since 2005. Pilot programs were undertaken for six winters in Sierra Madre and Snowy Range Mountains and the researchers concluded the following (WWDC, 2014):

> *"A pilot program for the accumulation of evidence from statistical, physical, and modeling analysis suggests that cloud seeding is a viable technology to augment existing water supplies, for the Medicine Bow and Sierra Madre Ranges. While the primary statistical analysis did not show a significant impact of seeding, statistical analysis stratified by generator hours showed increases of 3-17% for seeded storms (Figure 3). A climatology study based on high-resolution model data showed that ~30% of the winter time precipitation over the Medicine Bow and Sierra Madre Ranges fell from storms that met the WWMPP seeding criteria. Ground-based silver iodide measurements indicated that ground-based seeding reached the intended target, and in some cases well downwind of the target. High-resolution modeling studies by NCAR that simulated half of the total number of seeding cases showed positive seeding effects between 10-15% (Figure 3).*
>
> *In spite of the result of no seeding effect from the primary randomized statistical experiment, ancillary studies, using physical considerations to stratify the RSE* (Relative Standard Error) *data, and modeling studies over full winter seasons, led to an accumulation of evidence from the statistical, modeling, and physical analysis which suggest a positive seeding effect on the order of 5 to 15%.*

*Based on a potential increase in precipitation from seeded storms of 5 to 15%, affecting 30 to 80% of the cloud seeding impact area, the VIC hydrological model indicated an increased streamflow for Wyoming water in the NPRB ranging from 0.4 to 3.7%. Using the lower cost estimate for an operational cloud seeding program, along with the range of seeding effects and cloud seeding impact areas, the cost of the water ranges from $27 to $214 per acre-foot. Applying the higher cost operational program option with evaluation, the costs range from $53 to $427 per acre-foot."*

**Groundwater Supplies – Non-hydrologically Connected to North Platte River Surface Water.** Examples of municipal wells that have been deemed to be non-hydrologically connected are the City of Rawlins's Nugget Wellfield and Town of Elk Mountain's well producing from the Cloverly Formation. In addition, the Town of Saratoga completed a new wellfield to serve as their primary municipal water supply, replacing a surface water supply from the North Platte River. A portion of the new wellfield is not hydrologically connected, but it has not been deemed to be entirely non-hydrologically connected in accordance with the 2001 Modified Decree methodology. Return flows that are not connected are considered accretions to the North Platte River in accordance with the PRRIP.

As future municipal water supplies are developed in the Basin, the state-funded feasibility studies consider and evaluate whether developing non-hydrologically connected groundwater sources is practical.

Non-hydrologically connected wells known as, "the Split Rock Wells" were further evaluated for meeting the Wyoming's Decree replacement water requirements in a WWDC-funded 2007 study. In addition, a screening process prioritized a long list of prospective sites throughout the Basin into the top ten locations for development of non-hydrologically connected groundwater supplies. The use of the wells for Decree replacement was not found to be cost effective; primarily due to prohibitively high electrical costs to pump water from the significant depth of the groundwater source at the best-selected site, which was the Split Rock Wells location west of Pathfinder Reservoir.

**Municipal Irrigation Using Untreated Water.** An example of municipal irrigation of untreated water is the new raw water wellfield developed by funding from WWDC and the City of Casper. The new wells serve the North Casper Athletic Complex and replace a surface water supply, which has had maintenance problems. The new wells also address expansions of new baseball fields at the Complex. Another raw water project is in the works for the University of Wyoming Golf Course in Laramie. Other municipalities and public entities within the Basin are evaluating the feasibility of developing new raw water supplies to meet irrigation needs.

**Irrigation with Treated Municipal Wastewater.** An example of municipal irrigation with treated water is the City of Cheyenne's BOPU non-potable reuse system that provides irrigation to green areas in the City. The first phase was completed in 2007 and the second phase was completed in 2009. In future phases, the City is planning to further expand the distribution system to serve additional customers. The wastewater is treated to WDEQ Class A standards. As defined by WDEQ Water Quality Chapter 12 Rules and Regulations, the Class A treated wastewater is allowed for irrigation of land with a potential for public exposure. Existing customers include parks, cemeteries, golf courses, and schools. With the anticipated growth in the customer base, Cheyenne BOPU anticipates doubling the size of the system to serve approximately 130 acres of green areas in the next 50 years. The system relies on non-native imported water that is available at the wastewater plants and can be used to extinction. Other municipalities in the Basin are evaluating the feasibility of providing non-potable reuse water to irrigate green areas within their municipal boundaries.

**Modification of Pathfinder Dam and Reservoir.** The Pathfinder Modification Project has been completed. The 2.4 feet of spillway raise to Pathfinder Dam has recaptured 53,493 acre-feet of storage space in the reservoir that was lost to accumulated sediment. The Program administered through Reclamation operates a 33,493 acre-foot Environmental Account for the benefit of endangered species and their habitat in Central Nebraska. The State of Wyoming has the exclusive right to the remaining 20,000 acre-feet of storage space within the Wyoming Account that provides a firm yield of 9,600 acre-feet which is considered the last large water development opportunity developed to serve future municipal growth in the Basin. The State of Wyoming, through WWDC, has contracted with Casper, Rawlins, Mills, Evansville, and Glenrock for providing replacing water during periods of water rights administration. The Wyoming account also provides water for meeting Wyoming's replacement obligation for groundwater irrigation depletions in Goshen County under the 2001 Modified Decree.

**Improving Agricultural Irrigation System Efficiencies.** The Casper-Alcova Irrigation District provides irrigation water to approximately 23,500 acres with over 300 miles of canal and lateral infrastructure. The water supplies for CAID were authorized under the Kendrick Project with storage held within Seminoe Reservoir. CAID is located west of Casper and its water supply is diverted from the North Platte River. In 1982, the USBR, the City of Casper, and CAID executed a 40-year agreement concerning municipal water made available from an agricultural water conservation project. The City of Casper had agreed to pay for canal lining of portions of CAID's canal and lateral system. The benefits of this agricultural water conservation project accrue to storage within Seminoe Reservoir, so the City acquired up to 7,000 acre-feet of storage in Seminoe Reservoir based on the estimated annual water savings.

Other potential partnerships between agricultural entities and local governmental, industrial or environmental organizations could plan, design and implement successful water conservation projects that benefit the agricultural water users and provide for water supplies to meet existing and future water for municipal and industrial uses and/or recreation and environmental benefits.

## 5.8 PUBLIC INVOLVEMENT AND COMMUNICATION STRATEGY

### 5.8.1 Introduction

> ***"If people work together in an open way with porous boundaries - that is, if they listen to each other and really talk to each other - then they are bound to trade ideas that are mutual to each other and be influenced by each other. That mutual influence and open system of working creates collaboration."***
>
> - Richard Thomas

This section presents an assessment of water related issues and opportunities within the basin from conversations held with interested parties. The content of this section has been prepared from information gathered from meetings held during the plan update period in various locations, and from an interest poll that was distributed in January 2016 to 260 residents of the Basin by WWDC staff.

### 5.8.2 Public Meetings

As a means of gathering concerns and relaying information, the WWDC advertised and arranged three meetings for stakeholders and interested parties in the basin including members of the original Basin Advisory Group. The meetings were held open house style and conducted in Saratoga, Casper, and Wheatland between January 27 and 29, 2015. Representatives from the WWDC, Wenck, SEO, and Water Resource Data System were present to meet attendees, receive input, and answer questions. Wenck displayed numerous aspects of the Basin Plan update to the various attendees at the meetings. However, attendance at the meetings was generally limited with the Saratoga meeting having the largest turnout. No specific issues were identified through these meetings. In addition, a project update was given at a public meeting on May 11, 2015.

### 5.8.3 Water Development Commission Poll

To develop additional perspective on water related concerns in the Basin, the WWDC (2016) coordinated a Google poll that asked numerous questions of the surveyed individuals. The distribution list for the poll originated from the Basin Advisory Group contact list database and Water Resource Data System Platte River local agency list. Of the 260 that were surveyed, 56 responded, but not necessarily to all the questions. The intent of the survey was to understand the water resource issues of current interest.

The results of the survey indicated a wide range of concern related to the top water resource issues, and indicated a majority believe there is insufficient water supply to provide for additional development. The top five issues included groundwater resources, water quality, effects of growth and development, agriculture, and water supply and scarcity. Groundwater resources were listed by 50% of the respondents, and water supply and scarcity was listed by 41% of the respondents. The next tier of concerns included fish and wildlife, conservation, and drought preparation. Drought was listed by only 34% of the respondents, despite the hydrologic droughts of 2002 and 2012. Approximately 58% of the respondents indicated they believed there was insufficient water in the Basin to provide for additional development, population growth, industry, and agricultural demand.

With respect to water resource data, the respondents varied in the data they use and what additional data they'd like to see collected. Sixty-two percent indicated they use available water resource data, and many indicated they would like to see additional hydrologic data collected. Their responses for additional hydrologic data included everything from precipitation data to groundwater levels to water quality and water usage in order to better understand and utilize the available resource. When asked whether water usage and hydrologic data should be developed to improve planning in the basin, 60% of the respondents indicated they would like to see it happen.

The survey also assessed how frequently water providers or irrigators experience insufficient supplies. Most of the surveyed respondents (73%) indicated the question did not apply to them. Of the remainder, more than half indicated they experienced supply deficits at least 2 of every 10 years. The rest experienced a supply deficit only once every 10 years.

### 5.8.4 Public Meetings Conducted After Release of the Draft Platte River Basin Plan 2016 Update

Public meetings were conducted in Casper on February 13, 2017 and Laramie on February 16, 2017. Peter Gill, WWDC Project Manager; Mike Carnevale, Wenck Associates Project Manager; and Brandon Gebhart, HDR Project Manager presented the findings of the study. A slide show as shown in **Appendix 5-C** was presented to the attendees. Two comment letters were submitted from the public and are also presented in **Appendix 5-C**. Verbal feedback from the audience was also received and noted. Generally, regarding the administration of Wyoming water law in the Upper Laramie Subbasin, there was sentiment expressed to maintain the status quo.

### 5.8.5 Potential Public Information and Public Involvement Strategies

Communication is an exchange of ideas. The stakeholder groups and public may have good ideas that the WWDC staff and their contractors missed. Therefore, timely dissemination of information to the public is essential to keep effective lines of communication open. To facilitate public understanding and successful implementation of water resource development and enhancement projects, the following actions are being considered by the WWDC:

1. Twice annual or quarterly newsletters e-mailed to local governmental organizations, non-government organizations and interested parties with updates on projects underway in the basin, status of watershed plans, projects being considered for funding, regulatory/environmental issues and notices for meetings that are of interest to water users.

2. A WWDC booth at the Wyoming Water Development Association, county fairs in the basin and the Wyoming State Fair with reports, brochures and water related swag that brings attention to the basin planning, watershed planning and funding programs of the WWDC.

3. WWDC sponsored seminars and activities addressing basin, sub-basin or watershed water supply needs, planning efforts and funding opportunities for rehabilitation and new development projects (large and small).

4. Annual or bi-annual economic updates in each basin using data compiled by the Wyoming Department of Administration and Information.

5. WWDC is working with Conservation Districts to encourage development of small storage projects under the SWPP. These projects benefit agriculture, wildlife, and public recreation.

### 5.8.6 References

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**Water Law and Water Administration - Summary of the Settlement of the <u>Nebraska v. Wyoming</u> Law Suit Filed in 1986 and Resolved in 2001**

**Prepared by:**
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**Reviewed by the Wyoming Attorney General**
**and**
**the Wyoming State Engineers Office**

## 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 <u>Nebraska v. Wyoming</u> law suit filed in 1986 and resolved in 2001 (Settlement).

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, Wyoming administered its water rights in a manner that recognized that each of the three North Platte River segments (above Pathfinder Dam, Pathfinder Dam to Guernsey Dam, and Guernsey Dam to the Wyoming/Nebraska state line) have their respective entitlements under the North Platte Decree. Therefore, during the irrigation season, each section is independently administered under Wyoming 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 calling the senior water right. This practice was preserved in the settlement.

**Key Dates and Corresponding Important Events Related to the Settlement**

A time line of the events that impacted the settlement is presented below. 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 filed its complaint against the State of Wyoming in the U.S. Supreme Court (Court). The complaint alleged Wyoming 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 Nebraska.).*

The issues in the original complaint were straight forward. However, the case became more complex as it was expanded based on requests by Nebraska and approvals by the Special Master and Court.

**1988:** Nebraska 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 Nebraska. The Supreme Court summarily denied Nebraska's motion without opinion. This issue surfaces later in the litigation and negotiations.

**1991:** Nebraska 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 Nebraska during both the law suit and settlement negotiations.
2. Allege that Wyoming 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 U.S. be enjoined from increasing its 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 Wyoming that were not authorized by the Decree. The Court referred this matter to the Special Master.

**1993:** In response to Wyoming'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 Wyoming that the waters of the Laramie River were completely apportioned between Wyoming 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, Wyoming could not freely dewater the Laramie River.

**1994:** Nebraska filed a motion to:

1. Add allegations that Wyoming'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 Nebraska's apportionment under the Decree.
3. Again allege the U.S. was violating the Decree by contracting for uses of water from Glendo Reservoir that were not authorized by the Decree.
4. Allege Wyoming 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 Wyoming's and Nebraska'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 Nebraska 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 Nebraska, Colorado, Wyoming, 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:** Wyoming, Nebraska, Colorado, and the U.S. 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, Nebraska would not agree to the Wyoming and USBR proposal to resolve the groundwater issues.

**May 10, 2000:** The settlement teams completed the Principles of Settlement, which were approved by the Governors the evening before trial was to begin in Pasadena, California. 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 Owen Olpin.

**October, 2001:** Special Master Owen 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 Nebraska 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

Nebraska alleged that the U.S. 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 the allocated use of Wyoming's Glendo storage water to irrigation purposes in southeastern Wyoming below Guernsey Reservoir. The U.S., 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. Wyoming approved these transactions through provisions of Wyoming water law. Interestingly, Nebraska was also bending the restrictions within the Decree in the use of its allocation of Glendo storage water. Nebraska's use of Glendo storage water was limited to irrigation purposes in the North Platte River basin in western Nebraska. A portion of Nebraska's storage water allocation was being contracted for, delivered to, and stored in Lake McConaughy for hydropower and irrigation uses downstream of western Nebraska in the Platte River Basin, below the confluence of the North and South Platte Rivers.

It was apparent that the DOI, Nebraska, and Wyoming wanted additional flexibility in the use of Glendo storage water. The settlement, as documented in Appendix C, gives unrestricted use to Nebraska and Wyoming for its respective share of storage in Glendo Reservoir below Guernsey Reservoir and in the Platte River Basin, subject to contracts with the USBR, ESA, and NEPA compliance.

Appendix C also provides provisions whereby Wyoming'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 Wyoming.

In addition, Appendix C allows for the use of 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 Wyoming to annually store a total 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, Wyoming was sure that it was logistically unlikely that the limitation was being exceeded.

Nebraska alleged that the annual storage accounting completed by Wyoming was inadequate and incomplete. While it was probably not admitted, this was an easy matter to resolve as Wyoming officials wanted a less cumbersome and more accurate means to measure the annual storage in the reservoirs. Therefore, Wyoming agreed to install and monitor measuring devices on the eight largest reservoirs in the specified area, which stored over 60% of the allowed 18,000 acre-feet 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, Wyoming decided to ultimately invest more into measuring devices for the largest eleven reservoirs to more closely monitor Wyoming'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 Wyoming and the Inland Lakes in Nebraska. The project provides storage water for irrigators in eastern Wyoming and western Nebraska. The irrigators in Nebraska enjoy approximately 80% of the benefits of the North Platte Project, while the major storage facilities are located in Wyoming and are administered under Wyoming water law and the Decree. Nebraska was concerned that Wyoming would allow its appropriators to operate in a manner that would impact the inflow entitlements of the North Platte Project.

Wyoming alleged that the U.S. was violating the Decree in its allocation of storage water. Wyoming believed that the U.S. 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. Wyoming'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 their respective positions on the matter.

The parties reviewed historic information provided by the USBR regarding the water usage of the North Platte Project in Wyoming and Nebraska. 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 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 Wyoming.

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 Wyoming, and 6,400 acre-feet per year if, in addition, the reservoir was regulated in April for the Inland Lakes in Nebraska. 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, Nebraska 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 Nebraska, 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 Nebraska's complaint. As the negotiations progressed, it became apparent that Nebraska was not necessarily concerned about the development of a new water supply for the Wyoming municipalities. However, Nebraska 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. Wyoming achieved this requirement through the purchase of 470 acres near Kearney, Nebraska. However, there were no conditions within the permit requiring Wyoming to provide water to offset depletions resulting from the operation of the Deer Creek Project. Wyoming convinced the USACE that any water provided to offset depletions would not arrive at the critical habitat because Nebraska would not or could not protect the water from the state line to the habitat. Therefore, Nebraska was very concerned that Wyoming was permitted to build a storage project by simply buying and retiring Nebraska land without providing mitigation for water depletions. Ultimately, Nebraska filed suit against the USACE 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 of the Omaha District of the USACE. There was another underlying concern shared by Nebraska and the USBR. Nebraska and the USBR were concerned about Wyoming's administration of the Deer Creek Dam, given the initial position of Wyoming 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 Wyoming 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 the 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 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 Wyoming 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 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, <u>in order of priority</u>:

1. A supplemental water supply for Wyoming'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 Wyoming'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 Nebraska and Wyoming was limited to focusing on the annual "Natural Flow and Ownership" 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 Wyoming and Basin Electric Power Cooperative (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 Control decisions and the Final Settlement Stipulation. The following background information is offered.

The Grayrocks Reservoir is owned by the 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 Nebraska. 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 Nebraska 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. Nebraska 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. Nebraska'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. 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 Nebraska filed its complaint, the project was on "hold" status within the Wyoming Water Development Program as it did not appear to be economically feasible. The CCID had contacted the USBR in Mills, Wyoming and reserved Wyoming'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 Nebraska's desire to protect inflows into Grayrocks Reservoir and the concern that the Corn Creek Project would reduce the storage in the reservoir.

Nebraska's concerns about the protection of the flows below Grayrocks Reservoir were based on the potential implementation of the Corn Creek Project. However, Nebraska 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 WWDC 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 Nebraska 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 Wyoming to protect the minimum flow releases to the mouth of the Laramie River and, certainly, not to the Nebraska/Wyoming state line.

Nebraska's Laramie River claim that Wyoming had consistently refused to administer the releases provided by the BEPC and Nebraska 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 Nebraska had previously agreed to the Corn Creek Project in its settlement with BEPC, resulted in the dismissal of Nebraska's claims in the Nebraska v. Wyoming law suit relating to Corn Creek on March 26, 1999.

Nonetheless, as part of the settlement, Wyoming 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 Wyoming wanted to secure the remaining 10,600 acre-feet of Glendo storage water, which was being reserved by the USBR for the CCID. Wyoming 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 CCID have been completed by Wyoming 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, Wyoming, 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.)* Wyoming 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, Nebraska alleged that Wyoming 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, Wyoming 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. Nebraska was interested in extending the acreage limitation to include these tributaries. Wyoming was interested in improving its position under the acreage limitation. The issue was resolved by the agreement that Wyoming may irrigate no more than 226,000 acres between the Colorado/Wyoming state line and Guernsey Reservoir, exclusive of the Kendrick Project. Basics of the agreement included:

1. Wyoming agreed to provide a base map on the irrigated acres to Nebraska for review. Further, Nebraska officials were allowed to review Wyoming'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 Wyoming'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. Nebraska was adamant that the acreage limitation should be divided between the area from the Colorado/Wyoming state line to Pathfinder Reservoir and from Pathfinder Reservoir to Guernsey Dam, including the tributaries in this lower reach. Nebraska cited that the irrigation efficiency and consumptive use per acre was higher in the lower basin and they feared Wyoming 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, Wyoming 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, Wyoming 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 Wyoming 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 Wyoming 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 of 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. Wyoming 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 Wyoming's position regarding sectionalized administration of the North Platte Basin in Wyoming.
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.

Nebraska 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**

Nebraska wanted to add limitations to Wyoming's consumptive use of water throughout the settlement. Wyoming balked because such limitations seemed unwarranted and Nebraska'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 Wyoming on this matter. Ultimately, a solution was reached which would provide some certainty to Nebraska, while maintaining flexibility for Wyoming. Information from the Wyoming and Nebraska 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 10 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 10 consecutive years. The 10 consecutive years include the year of the annual report and the preceding 9 years, plus the annual amount of water consumed in each of the same 10 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 Wyoming 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 SEO 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 Wyoming 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 Wyoming. 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 Wyoming and Nebraska. 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 Wyoming/Nebraska 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 Nebraska, as measured at the Lewellan gage. The increased duty on storage deliveries basically increased the amount of natural flow available for use in Wyoming and Nebraska 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 Wyoming and Nebraska 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 Nebraska's submittal of amended pleadings. Count I of Nebraska's amended pleadings alleged Wyoming 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 Wyoming's use of groundwater while Nebraska 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 Nebraska, he also derided Wyoming'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 Wyoming'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, 1 mile north of the Interstate Canal on the north and extending downstream to the Wyoming/Nebraska 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 Nebraska and Wyoming 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 groundwater right priority dates prior to October 8, 1945 (date of the original North Platte Decree) are not affected by Exhibit 10.

2. Wyoming 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 10 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, Wyoming 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. Wyoming 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, Wyoming 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, Wyoming's allocation of storage water from Glendo Reservoir, the Wyoming Account in the PMP, other storage releases, replacement from other surface and groundwater 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 Wyoming and Nebraska 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 Nebraska and 25% to Wyoming.

The settlement teams wrestled with the scenario wherein Wyoming would not be able to provide the necessary replacement water. The parties were aware that Wyoming'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 Wyoming or Nebraska 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 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 Wyoming "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 Wyoming'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**

Nebraska contended that Wyoming diversions from the tributaries, such as Rawhide Creek and other small streams should be counted against Wyoming's 25% share of the natural flow in the reach. Originally, Nebraska 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. Wyoming convinced Nebraska that the Horse Creek Drainage upstream of the Gering-Fort 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.

Nebraska argued that Wyoming 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 Nebraska's 75% share of the natural flow. Wyoming did not administer these tributaries and drains for shortages on the mainstem.

Ultimately, Wyoming agreed to replace 50% of the diversions or administer the tributaries and drains in times of mainstem regulation. Wyoming 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. Wyoming 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 Nebraska's concerns regarding inflows into Grayrocks Reservoir, Wyoming agreed to limit irrigated acreage in the Lower Laramie River basin, exclusive of the area within the 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 Wyoming made it clear that lands within the District were irrigated from Wyoming'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 Colorado and Wyoming.

These procedures were primarily adopted to improve communications between Nebraska and Wyoming:

**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**

#### 3.7.4. 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 Wyoming's concern about endangered species issues being addressed by the law suit. Nebraska, Colorado, and Wyoming 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 PRRIP. However, the Modified Decree and Final Settlement Stipulation left the resolution of endangered species issues to the PRRIP.

***Background***

Endangered species issues began affecting water development and management in the North Platte River in Wyoming 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 ESA provided the 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 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 Wyoming 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 to 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. Wyoming's water contribution on behalf of its water users is the Environmental Account in the PMP. Nebraska contributed water from Lake McConaughy and Colorado 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 Wyoming's demands. This is likely the only PRRIP water that will come from Wyoming.

The land goal is to acquire, protect, and maintain 10,000 acres of habitat in the Central Platte. Wyoming'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 Wyoming 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. Wyoming 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 Wyoming water users (including Nebraska water users that use federal storage water from Wyoming reservoirs) have individual members. The Committee operates on a consensus basis, which provides Wyoming 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. Wyoming'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 Wyoming users without a Program and came to the following conclusions:

The 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 to 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.

Prolonged and costly lawsuits would likely be initiated by each state or by the states 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.

Issues in the Nebraska vs. Wyoming 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.

### *Wyoming's Depletion Plan*

In addition to providing money and water, the states of Wyoming, Nebraska, and Colorado 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 Nebraska v. Wyoming settlement will provide confirmation that Wyoming 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.

## References


"Depletions Plan, Platte River Basin, Wyoming, (Wyoming's Depletions Plan)," October 24, 2006.

Owen Olpin, "Final Report of the Special Master," October 12, 2001.

Owen Olpin, "Third Interim Report on Motions to Amend the Pleadings," September 9, 1994.

"Proposed Joint Settlement (Brown Book)," October 12, 2001.

Purcell, Mike, "Level I Feasibility Study-Mitigation North Platte Drainage System," November 1, 2007.

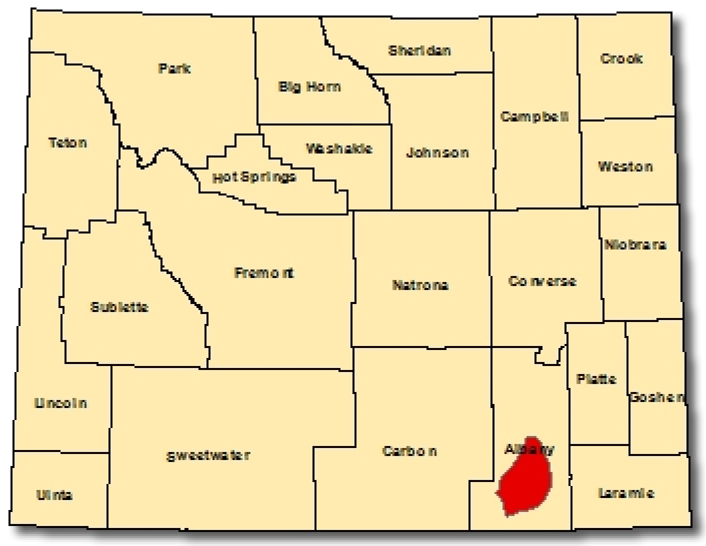
Wyoming Attorney General's Office, "Briefing-North Platte River Basin," November 25, 2003.

**Federally Listed Threatened and Endangered Species Associated with Aquatic, Wetland and Riparian Habitats in the Platte River Basin of Wyoming**

# Wyoming Toad (*Anaxyrus baxteri*)

Status: Endangered

Photo Credit: WY Toad SSP - Armstrong




Potential Distribution in Wyoming

Area of Influence for Wyoming Toad in Wyoming

Areas of Influence (AOI) identify areas where any project located within should consider potential effects to the Threatened, Endangered, Proposed, and Candidate species and designated and proposed Critical Habitat in reference to Section 7 of the Endangered Species Act of 1973, as amended. AOI typically encompass larger areas than simply where the species is known to exist because of direct and indirect effects to the species and their habitat. It is important to consider potential effects to the species and their habitat within these larger areas. Action agencies are encouraged to refer to the Service's **Information, Planning, and Conservation System (IPAC)** or contact the **FWS Wyoming Ecological Services Office** for additional information. The AOI boundaries are based on the best available data at time of development. The AOI will be updated as new information becomes available.

Species Information

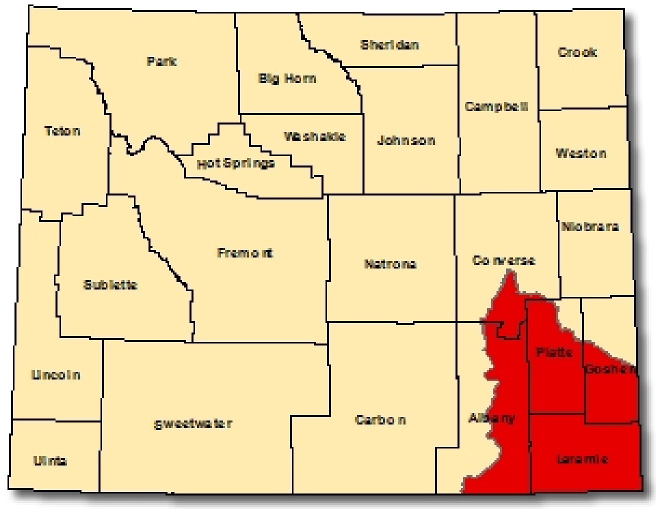
The Wyoming toad (*Anaxyrus (Bufo) baxteri*) historically occupied flood plains, ponds, and seepage lakes associated with shortgrass communities occurring between 7,000 and 7,500 feet in elevation in the Laramie Basin. The toad was associated with both the Big and Little Laramie Rivers. Populations of the Wyoming toad suffered a dramatic decline in the 1970s and the current distribution is limited to Mortenson Lake National Wildlife Refuge and possibly Hutton Lake National Wildlife Refuge. The Service recommends surveys when a proposed project will occur within 1-mile of Mortenson Lake or Hutton Lake National Wildlife

Refuges. These guidelines may change as new sites for Wyoming toad populations are established.

# Preble's Meadow Jumping Mouse (*Zapus hudsonius preblei*)

Status: Threatened

Photo Credit: FWS




Potential Distribution in Wyoming. The Area of Influence (AOI) for Preble's Meadow Jumping Mouse in Wyoming is shown in the figure above.

Areas of Influence (AOI) identify areas where any project located within should consider potential effects to the Threatened, Endangered, Proposed, and Candidate species and designated and proposed Critical Habitat, in reference to Section 7 of the Endangered Species Act of 1973, as amended. AOI typically encompass larger areas than simply where the species is known to exist because of direct and indirect effects to the species and their habitat. It is important to consider potential effects to the species and their habitat within these larger areas. Action agencies are encouraged to refer to the Service's **Information, Planning, and Conservation System (IPAC)** or contact the **FWS Wyoming Ecological Services Office** for additional information. The AOI boundaries are based on the best available data at time of development and the AOI will be updated as new information becomes available.

Species Information

Federal listing status under the ESA for Preble's meadow jumping mouse (*Zapus hudsonius preblei*) as a threatened species in Wyoming was reinstated on August 6, 2011 (76 FR 47490). Preble's meadow jumping mouse is a small rodent in the Zapodidae family and is one of 12 recognized subspecies of *Z. hudsonius*, the meadow jumping mouse. This species has a body length of 3 to 4 inches, a bicolored tail 4 to 6 inches in length, large hind feet adapted for jumping, and a distinct dark stripe down the middle of its back bordered on either side by gray to orange-brown fur. Their diet consists of seeds, fruits, fungi, and insects. Preble's meadow jumping mouse is primarily nocturnal or crepuscular, but has been observed during daylight. Hibernation occurs from October to May in small burrows the mouse excavates several centimeters underground.

Preble's meadow jumping mouse exhibits a preference for lush vegetation along watercourses or herbaceous understories in wooded areas near water. The mouse occurs in low undergrowth consisting of grasses or forbs; in wet meadows and riparian corridors; or areas where tall shrubs and low trees provide adequate cover. The species uses upland habitats as far as 330 feet beyond the 100-year floodplain. In Wyoming, Preble's meadow jumping mouse has been documented in Albany, Laramie, Platte and Converse counties, and may occur in Goshen County. If a proposed project will disturb suitable habitat within any of these five counties, surveys should be conducted prior to any action. Due to the difficulty in identifying the Preble's meadow jumping mouse, surveys should be conducted by knowledgeable biologists trained in conducting these surveys.

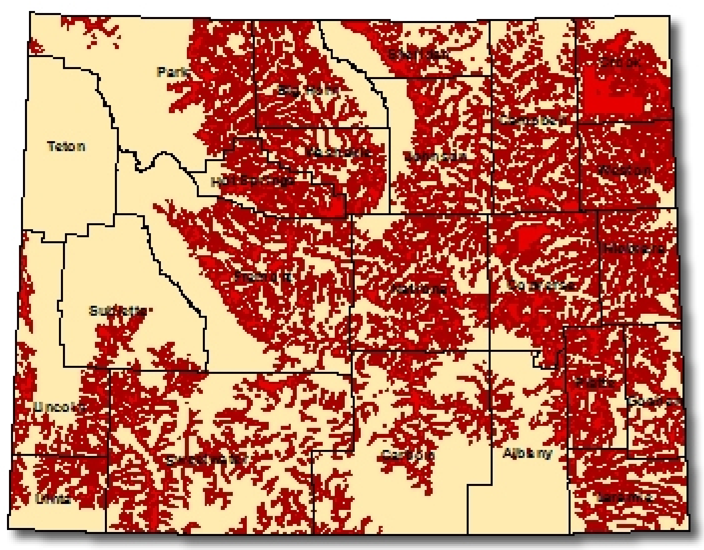
Additional Information and Recent Actions

- **U.S. FWS Region 6 Preble's Meadow Jumping Mouse information**
- May 23, 2013 Federal Register: **12-Month Finding on Two Petitions to Delist the Preble's Meadow Jumping Mouse**
- May 2013 Press Release: **Preble's Meadow Jumping Mouse Retains Protections Under the ESA**

# Ute Ladies'-tresses (*Spiranthes diluvialis*)

Status: Threatened

Photo Credit: FWS/Lindstrom




Potential Distribution in Wyoming

Area of Influence for Ute Ladies'-tresses in Wyoming

Areas of Influence (AOI) identify areas where any project located within should consider potential effects to the Threatened, Endangered, Proposed, and Candidate species and designated and proposed Critical Habitat, in reference to Section 7 of the Endangered Species Act of 1973, as amended. AOI typically encompass larger areas than simply where the species is known to exist because of direct and indirect effects to the species and their habitat. It is important to consider potential effects to the species and their habitat within these larger areas. Action agencies are encouraged to refer to the Service's **Information, Planning, and Conservation System (IPAC)** or contact the **FWS Wyoming Ecological Services Office** for additional information. The AOI boundaries are based on the best available data at time of development. The AOI will be updated as new information becomes available.

Species Information

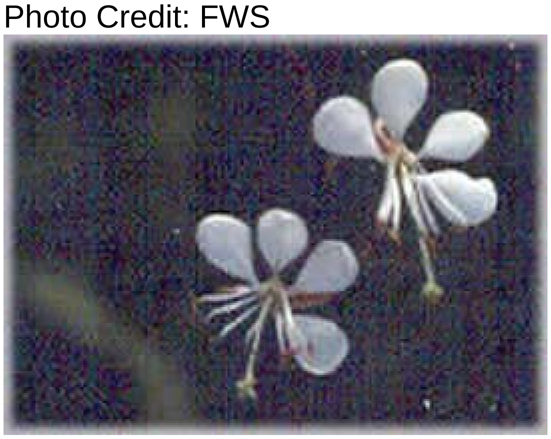
Ute ladies'-tresses (*Spiranthes diluvialis*) is a perennial orchid, 8 to 20 inches tall, with white or ivory flowers clustered into a spike arrangement at the top of the stem. Ute ladies'-tresses typically blooms from late July through August. However, it may bloom in early July or still be in flower as late as early October, depending on location and climatic conditions. Ute ladies'-tresses is endemic to moist soils near wetland meadows, springs, lakes, and perennial streams where it colonizes early successional point bars or sandy edges. The elevation range of known occurrences is 4,200 to 7,000 feet (although no known populations in Wyoming occur above 5,500 feet). Soils where Ute ladies'-tresses have been found typically range from fine silt/sand, to gravels and cobbles, as well as to highly organic and peaty soil types. Ute ladies'-tresses is not found in heavy or tight clay soils or in extremely saline or alkaline soils. Ute ladies'-tresses typically occurs in small, scattered groups found primarily in areas where vegetation is relatively open.

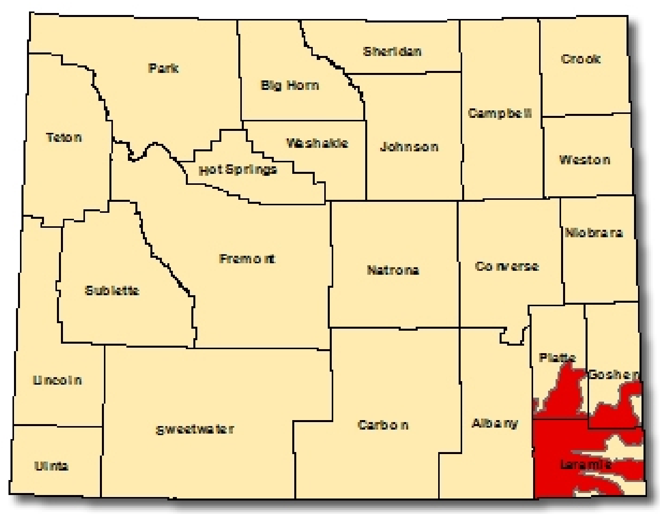
Many orchid species take 5 to 10 years to reach reproductive maturity; this appears to be true for Ute ladies'-tresses (FR 57 2048). Furthermore, reproductively mature plants do not flower every year. For these reasons, 2 to 3 years of surveys are necessary to determine presence or absence of Ute ladies'-tresses. Surveys should be conducted by knowledgeable botanists trained in conducting rare plant surveys.

# Colorado Butterfly Plant (*Gaura neomexicana coloradensis*)

Status: Threatened

Photo Credit: FWS






Potential Distribution in Wyoming

Area of Influence for Colorado Butterfly Plant in Wyoming

Areas of Influence (AOI) identify areas where any project located within should consider potential effects to the Threatened, Endangered, Proposed, and Candidate species and designated and proposed Critical Habitat, in reference to Section 7 of the Endangered Species Act of 1973, as amended. AOI typically encompass larger areas than simply where the species is known to exist because of direct and indirect effects to the species and their habitat. It is important to consider potential effects to the species and their habitat within these larger areas. Action agencies are encouraged to refer to the Service's **Information, Planning, and Conservation System (IPAC)** or contact the **FWS Wyoming Ecological Services Office** for additional information. (AOI boundaries based on the best available data at time of development. AOI will be updated as new information becomes available).

Species Information

The Colorado butterfly plant (*Gaura neomexicana coloradensis*) is a perennial herb endemic to moist soils in wet meadows of flood plain areas. This plant occurs in southeastern Wyoming, north-central Colorado, and extreme western Nebraska between elevations of 5,000 and 6,400 feet. These plants are often found in low depressions or along bends in wide meandering stream channels a short distance upslope of the actual channel. Threats to the plant include non-selective herbicide spraying, haying and mowing schedules that inhibit the setting of seed, land conversion for cultivation, and competition from noxious weeds. Low numbers and limited distribution contribute to the plant's vulnerability. Surveys should be conducted during flowering season, which normally occurs in July and August. Temporal variability in the flowering period exists from site to site and from year to year depending on annual climatic conditions. Surveys should be conducted by knowledgeable botanists trained in conducting rare plant surveys. The Service does not maintain a list of "qualified" surveyors but can refer those wishing to become familiar with the Colorado butterfly plant to experts who can provide training/services. Critical habitat is designated for Colorado butterfly plant in specific wet meadows and riparian areas within Laramie and Platte Counties of Wyoming (see 50 CFR 17.96(a)).

Colorado Butterfly Plant Critical Habitat

Critical habitat for this species is designated in Platte and Laramie Counties in Wyoming.

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# Appendix 5-C

**Public Involvement**

## Comment Letters

**Comment from Clay Thompson, NRCS, Laramie, WY <Clay.Thompson@wy.usda.gov>**

Date: Tue, Feb 21, 2017 at 3:06 PM
Subject: Comments on Platte River Basin Plan
To: "Peter.Gill@wyo.gov" <Peter.Gill@wyo.gov>

Peter,

I met you at the meeting last week. Thank you for the presentation.

I am a landowner and irrigator on the Big Laramie River above Laramie. I'm also a Civil Engineering Technician for the NRCS and work on irrigation systems, livestock water projects and other engineering projects in Albany and Carbon counties. A lot of my work is in the Platte River basin.

I have two main comments:

**1.) I do not trust or agree with the conclusion that irrigation has decreased 16% and will continue to decrease in the future based on two aerial photos.**

**2.) WE SHOULD NOT CHANGE WYOMING WATER LAWS, PERIOD!!**

My first comment is directed at the conclusion that irrigation has decreased 16% from 2005 to 2015. Using just two aerial photo flights ten years apart should not lead to any conclusions unless precip, drought, snowpack, reservoir levels, calls on the river, etc. that may have been happening those two years were factored in. Were the photos taken the same time of year? I work with aerial photos in my job and they can change drastically from year to year due to these factors. In our area the biggest factor leading to reduction of irrigated acres is lack of enough irrigation water. I think the conclusions that irrigated acres have decreased could be very misleading. Especially when it is used to project further decreases in the future. With more data analysis it may be proved correct, but there is a good chance it won't be. There should be more research on this before any conclusions should be made that could affect the future of irrigation on the Platte River system.

The second item I wanted to comment on is the report's strategies for the future. In the report there are several references to making changes to Wyoming water law so landowners would have more flexibility to sell off their water. **I CANNOT STRESS ENOUGH MY OPPOSITION TO MAKING CHANGES TO WYOMING WATER LAWS!!** Wyoming has the best water laws of any western state and changing them will lead to people selling off the water to the Front Range of Colorado. We need to do everything we can to keep our water in Wyoming to benefit our state. The notion that someone could 'lease' the water for a few years and then it would come back to the land is a dream. Once it is gone it will never come back!

The total value of flood irrigation needs to be studied better. We need to put a dollar value on our migratory bird habitat, wetlands, flood control, storage of water in our underground aquifers, and wildlife values to really understand the importance of how we use the water. We can be more efficient in how we irrigate to save water, but at what cost to the environment and wildlife that use these areas.

Lastly, I just want to say **DON'T CHANGE WYOMING WATER LAWS!!**

Sincerely,

Clay Thompson

**Comment received from Carol Price, Rancher, Rock River, WY**

Fri, Feb 24, 2017 at 7:05 AM, Carol P <cprice19@gmail.com> wrote:

To the Wyoming Water Development Office

As you requested at the February 16, 2017 meeting in Laramie, WY, here are some comments concerning the Platte River Basin Plan Update 2017.

Is the Wyoming Water Development Office interested in having a resilient sub-basin? If resiliency is the main objective, future updates need to address how to make the sub-basin more resilient. While smaller reservoirs are an answer, what is the proportion of evaporative loss compared with a larger reservoir? The water in the Above Pathfinder and Upper Laramie River is seasonal. How does the Wyoming Water Development Office propose encouraging recreation when there is limited water, if any, in the streams? Without a way to store the water to have late season in-stream flow, the plan ideas for increased recreation are not going to come to fruition.

From page 19, how are return flows and inefficiencies in a sub-basin a bad thing? The water is being recycled and is benefitting users down stream.

Forest health plays a role in slowing down the snowmelt.

A reevaluation of "crop" consumptive use needs to be accomplished for native and Garrison hay meadows. If the private landowners data and information would remain private there may be more cooperation but they do not want to have their competition (their neighbor) to know their exact numbers (trade secret).

Photo comparisons need to be done at the same time each year and preferably four times a year so the differences can be attributed to weather, grazing, and other factors. The photos for 2005 should have limited residual plant life due to the drought in 2002. In 2015, there was old grass standing and the reduction in cattle numbers had already occurred. It would make it harder to see where the water covered the landscape in 2015 compared with 2005.

Precise quantities are nice for the researchers but what is the data going to be used for? This is not a black or white question. There is an ulterior motive.

Wyoming Water Law is very protective of our water and it should remain that way. It is one of the few things still in place that can protect agriculture.

Thank you for your time.

Sincerely,

Carol Price
Rancher
PO Box 202
Rock River, WY 82083
cprice19@gmail.com

### Response from Peter Gill, GISP, River Basin Planning Project Manager

Thank you Carol. Your comments will be appended to the final report.

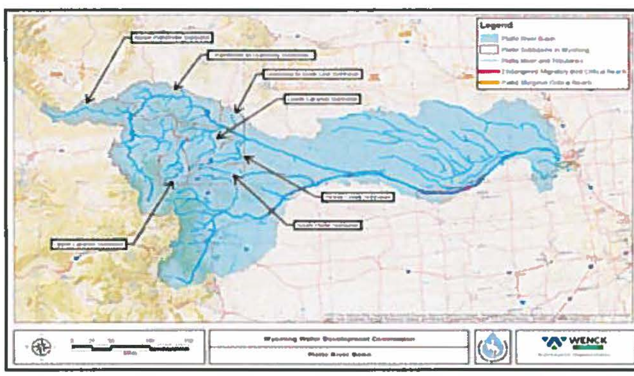
Regarding your questions, resiliency and dependable water supplies are important. One of our recommendations to the Commission is to encourage more small reservoirs and maximize the use of existing large reservoirs. The reference to inefficiently irrigation water use was not intended to reflect good or bad, simply to note that small amount of the diverted water is used by the crops. Yes, particular crop information would have to be aggregated to protect business interests. More precise water availability numbers would help the State bring in new water dependent enterprises. Labeling the entire basin "fully appropriated" prevents investment in the area.

We appreciate your feedback.

**Slide Show**


## Introduction and Background

- History of the Wyoming Water Development Program
  - Governor Ed Herschler's Vision
    - ✓WWDC established in 1975 to promote the optimal development of the state's human, industrial, mineral, agricultural, water and recreational resources
- History of Wyoming Water Planning
  - Driving Factors:
    - ✓Water Shortages
    - ✓Interstate Allocation Issues
    - ✓Changing Societal And Environmental Needs
  - WWDC Basin Planning began in 1997
    - ✓Purpose: Quantify existing water uses and project future needs of this important resource



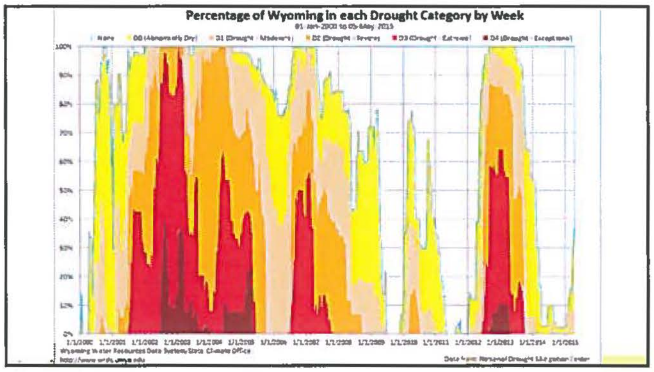
## Location and Geographic Setting

- **Location: Southeast quarter of Wyoming - 24% of Wyoming land mass - about 24,000 square miles - Elevations range from over 12,000' msl to about 4,025' msl – mountains and mountain valleys to short grass prairie**
  - Two Major Subbasins: North Platte 22,000 square miles; South Platte 2,000 square miles
  - There are seven subbasins that comprise the Platte River Basin
  - Mountains provide the major water supplies to the valleys and plains where the cities, farms / ranches, and industrial facilities are located
- **Major Tributaries**
  - North Platte River, Sweetwater River, Laramie River
- **Numerous Smaller Tributaries**
  - Casper Creek, LaPrele Creek, Deer Creek, Horse Creek, Crow Creek

*"Although mountains may guide migrations, the plains are the regions where people dwell in greatest numbers"*
- Elsworth Huntington

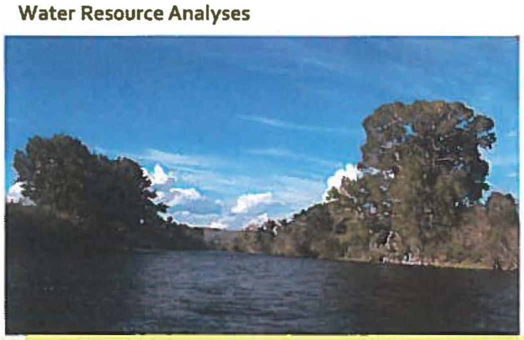

## Weather and Climate

- **Highly Variable: Large Temperature / Precipitation Variances**
- **Typical Continental Climate**
- **Winters: Cold - *Windy* – Dry – Low Humidity**
- **Summers: Warm - Hot - Dry - Low Humidity**
- ***Wind***
  - Rawlins, Laramie, Casper and Cheyenne are the windiest cities in the Cowboy State
- **Drought is a constant threat! Wyoming is the Fifth Driest State in the United States *(Wyoming State Climate Atlas)***
- **A portion of Wyoming is almost always in drought - According to paleoclimatic records dating back thousands of years, drought is a defining feature of Wyoming's climate.**

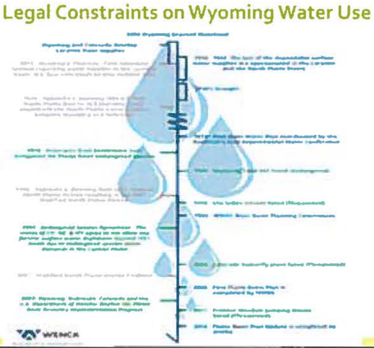


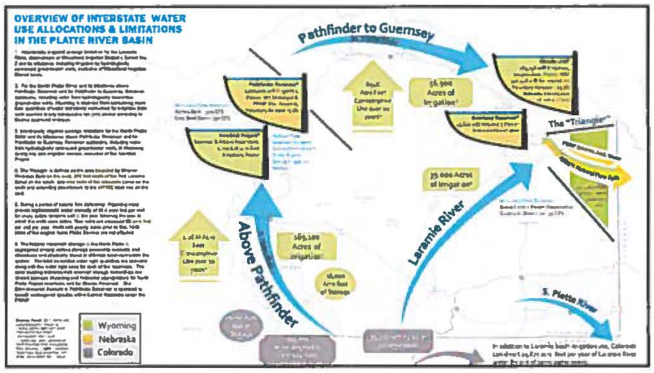

| City | Average Annual Temp(F°) | Average Annual Precip (in) |
|---|---|---|
| Rawlins, WY | 42.35 | 9.24 |
| Laramie, WY | 41.15 | 11.45 |
| Casper, WY | 45.25 | 12.48 |
| Douglas, WY | 45.65 | 12.63 |
| Wheatland, WY | 49.55 | 13.7 |
| Torrington, WY | 44.55 | 13.8 |
| Denver, CO | 50.7 | 14.16 |
| Cheyenne, WY | 46.4 | 15.92 |
| Fort Collins, CO | 50.25 | 16.05 |
| North Platte, NE | 49 | 20.77 |
| Grand Island, NE | 50.75 | 26.61 |

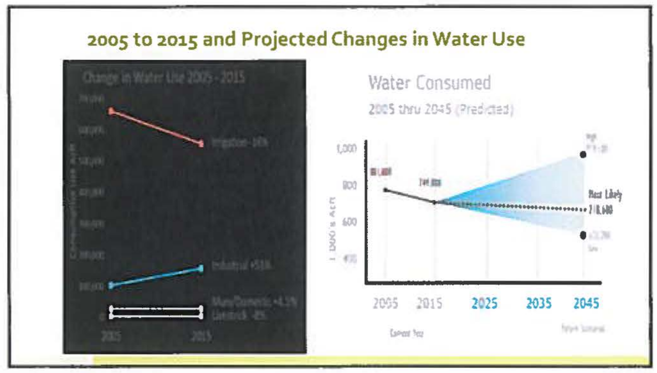
## Water Resource Analyses

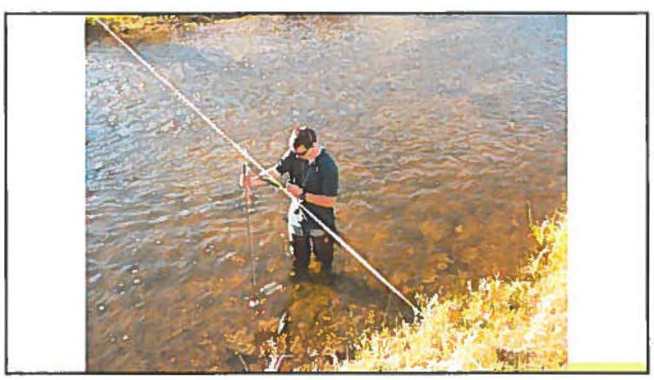


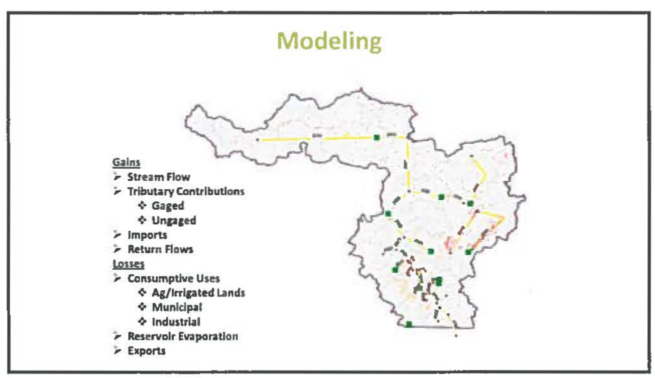
## Legal Constraints on Wyoming Water Use



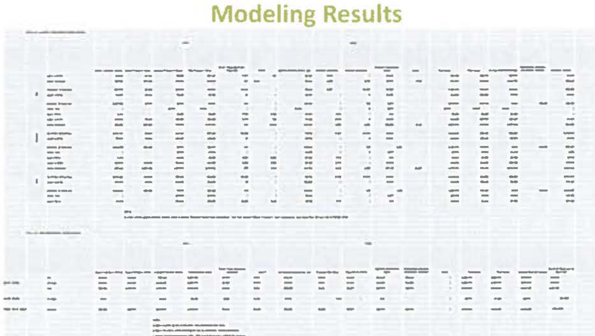

OVERVIEW OF INTERSTATE WATER USE ALLOCATIONS & LIMITATIONS IN THE PLATTE RIVER BASIN
Pathfinder to Guernsey
56,900 Acres of Irrigation
The "Triangle"
25,000 Acres of Irrigation
Laramie River
Above Pathfinder
165,100 Acres of Irrigation
S. Platte River
Wyoming
Nebraska
Colorado


2005 to 2015 and Projected Changes in Water Use
Water Consumed
2005 thru 2045 (Predicted)
1,000
800
600
400
2005
2015
2025
2035
2045
Most Likely




Modeling
Gains
Stream Flow
Tributary Contributions
Gaged
Ungaged
Imports
Return Flows
Losses
Consumptive Uses
Ag/Irrigated Lands
Municipal
Industrial
Reservoir Evaporation
Exports

## Modeling Results



## Benefits, Deficiencies and Recommendations

**Benefits**

- Initial Model
- Data
- Collected and housed
- Incorporate into future modeling
- Formatting and Manipulation

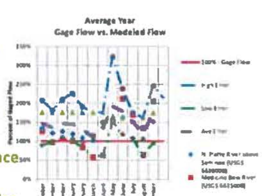
**Deficiencies**

- Actual CU vs. Depletion
- Accuracy of Non-gaged calculations
- Federal Reservoir Accounting
- Lack of Gaged Data
- Environmental water usage
- Does not account for priority

## Recommendations

**Future Needs**

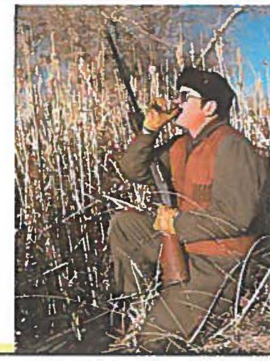
- Additional Gages - Yearly
- Environmental Losses
  - Vegetation
  - Aquifer/Groundwater
- Irrigation Accounting
  - Groundwater vs. Surface Water
  - Actual Consumptive Use Calculations
- Future Models i.e. StateMOD




## Socioeconomics

- 44% of Wyoming's population lives in the Platte Basin
- From 2000 – 2014 the population in the Basin increased by more than 36,000 to 220,860 (16.3%)
- Between 2002 and 2014, Basin employment increased by 27,200 to 172,800 (16.2%)
- 80% of the growth occurred in the South Platte and Pathfinder to Guernsey Subbasins
- In-migration contributed more to population growth than resident births; Household size decreased and the average resident is about one year older
- Government is the largest employment sector followed by retail trade, healthcare, lodging and food service, construction and mining, and agriculture

## Recreational Opportunities



## Recreation Opportunities

- The Platte Basin has some the most outstanding and accessible fishing, boating, hunting and camping opportunities in the United States
- Five major BOR reservoirs, hundreds of miles of streams and numerous smaller lakes, ponds and large wetland areas provide amenities for residents and attract numerous out of state visitors
- The Goshen/Lower Platte and Laramie Plains wetlands alone total more than 107,000 acres
- Recreation Strategies:
  - Promote "Ecotourism"
  - Promote trophy fishing and encourage development and enhancement of privately owned recreation areas
  - Target the Colorado Front Range Market for advertising water based recreation opportunities
  - Evaluate enhancement of water based recreation through purchasing, gifting, or leasing water rights
  - Evaluate the value of recreation to the economy of the Basin

## Water Development Strategies and Recommendations

- Operational Enhancements – Existing Storage and Conservation
  - Evaluating re-operation of Glendo Reservoir
  - Municipal and Agricultural Water Use Conservation
  - Evaluating more efficient use of reservoir storage in the Above Pathfinder Subbasin
- Weather Modification (Cloud Seeding)
- New, Imported, Exchanged, and Transferred Water Supplies
  - Industrial Water Use Changes
- Transbasin Diversion
- Watershed Planning and Small Storage Program
- Development, Regulation and Enhancement of Groundwater Resources
  - Regulatory Controls on Groundwater Use Imposed by the SEO
  - Aquifer Storage and Recovery

### Platte Water Resources Quick Facts – Last Thoughts

- Since 2006 the WWDC has committed more than $41 M to construct 33 projects in the basin... another 45 Projects are underway totaling nearly $75 M...$111 M - Total
- The SEO considers the Platte River Basin in Wyoming "Fully Appropriated"
- WWDC's Small Project Program and Groundwater Development Program are feasible mechanisms for developing water resources
- Agricultural water use may be declining – the data used to determining agricultural water use in the Basin Plan should be updated more often
- http://waterplan.state.wy.us/plan/platte/2017/platte-plan.html

### Your Thoughts and Suggestions

The WWDC is here to provide the residents of Wyoming with adequate, affordable water supplies to enhance municipal, agricultural, industrial and environmental uses of this critical resource

http://waterplan.state.wy.us/plan/platte/2017/platte-plan.html