3.0 SETTING

This chapter presents basic physical information about the Green River Basin, current economic and social conditions, and a summary of the legal and institutional constraints on water use.

3.1 PHYSICAL SETTING

The Green River Basin (Basin) includes lands in Wyoming, Colorado, and Utah that drain to the Green River. In Wyoming, the Basin is bordered on the east by the Continental Divide formed by the Wind River Range in the north and northeast, the Great Divide Basin centrally, and the Sierra Madre Range in the southeast. The Wyoming portion of the Green River Basin is bordered on the south by the Wyoming-Colorado and Wyoming-Utah state lines. The Basin's western border is defined by the Tunp Range[1], which forms the division between the Green and Bear River Basins, and the Wyoming Range, which separates the Green from the Greys River Basin. The far northwest of the Basin is bounded by the Gros Ventre Range.

Counties with significant areas in Wyoming's Green River Basin are Sweetwater, Sublette, Carbon, Lincoln, and Uinta; small areas of Fremont and Teton Counties are also located within the Basin, giving the Wyoming portion of the Basin an area slightly larger than the State of West Virginia. Figure 3-1 is a river basin planning map of Wyoming.

3.1.1 Land Area and Ownership

The land area of Wyoming's Green River Basin is approximately 21,047 square miles and comprises 21.3 percent of the state. Of that, 69 percent is federally owned, 27 percent privately owned, 4 percent is owned by the state and local government, and less than 1 percent is water surface (*Equality State Almanac, 2007)*. Table 3-1 presents Green River Basin land area by county and Figure 3-2 shows the distribution of State, Federal and Private Lands across the Basin.

3.1.2 Physiography

Topography

The Basin generally slopes to the south, and the majority of the Basin has an elevation in the range of 6,000 to 7,000 feet above sea level. This area is characterized by the buttes, mesas, and badlands associated with high, arid desert plains. Mountainous peaks that form the majority of the Basin border frequently exceed 10,000 feet in

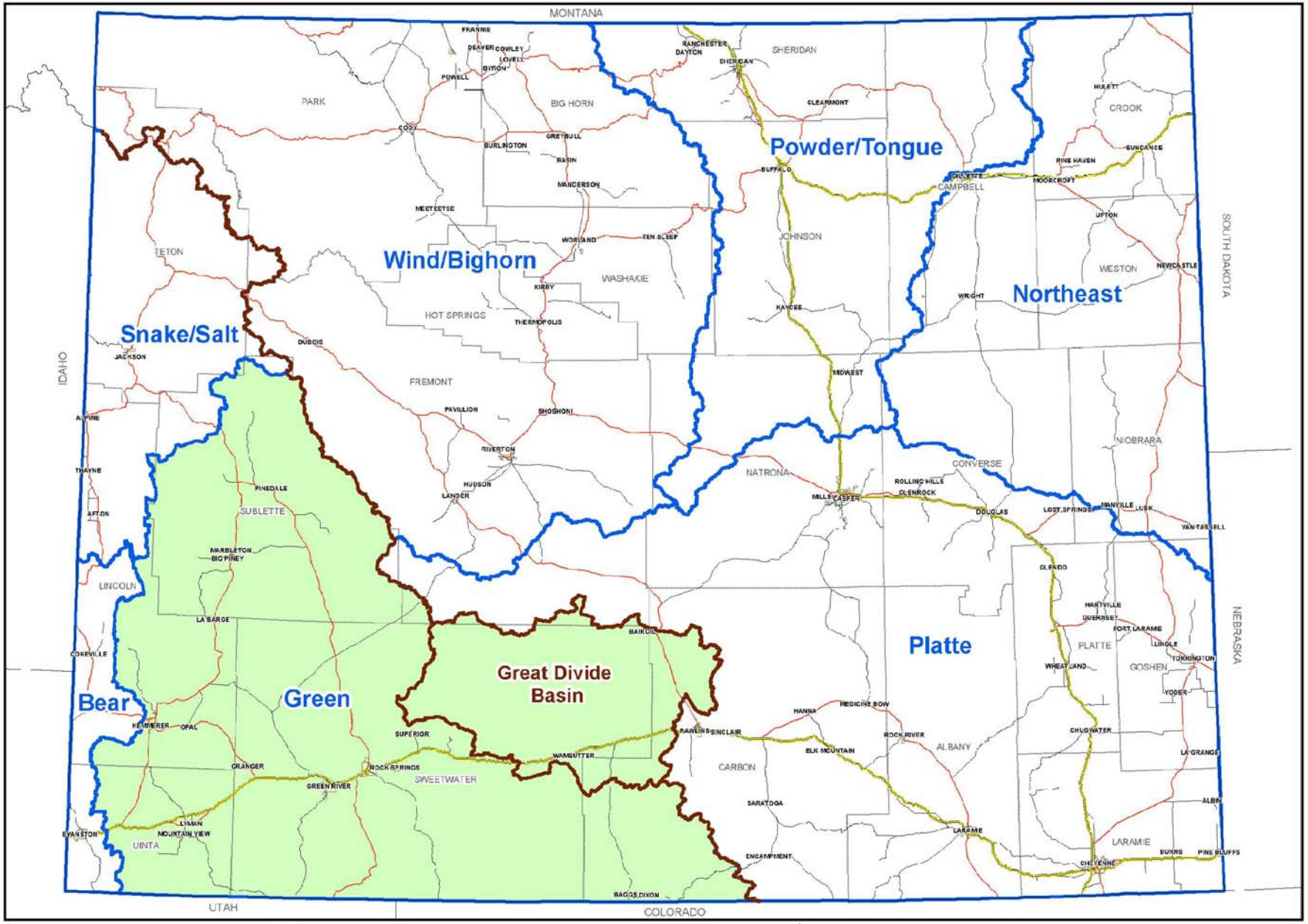
[1] "More mountains lie to the north that are not considered part of the Tunp Range, but are effectively contiguous. This includes Commissary Ridge to the northeast. The Tunp Mountains are in the Bridger National Forest."

elevation in the northern and northeastern reaches of the Basin, and 9,000 feet in the southern reaches of Wasatch National Forest. The highest point in the Basin (Gannett Peak, elevation 13,804) is also the highest point in the state, and the lowest point (elevation 6,040) occurs along the Green River where it passes into Utah at Flaming Gorge Reservoir.

Table 3-1 Land Area by County

	Area of County (Acres)	Area of Green River Basin in County (Acres)	Area of Great Divide Basin in County (Acres)
Teton	2,706,987	6,890	0
Sublette	3,161,111	2,846,065	0
Lincoln	2,621,447	1,243,945	0
Uinta	1,338,374	1,023,433	0
Sweetwater	6,716,917	4,824,077	1,870,281
Carbon	5,096,770	977,672	551,168
Fremont	5,932,823	53,536	72,725
Total Acres	27,574,430	10,975,618	2,494,174
Total Square Miles	43,085	17,149	3,897
Total Area of Green and Great Divide Basins (square miles)			21,047

Source : Areas in this table were determined from GIS shape file coverages available from WYGISC.

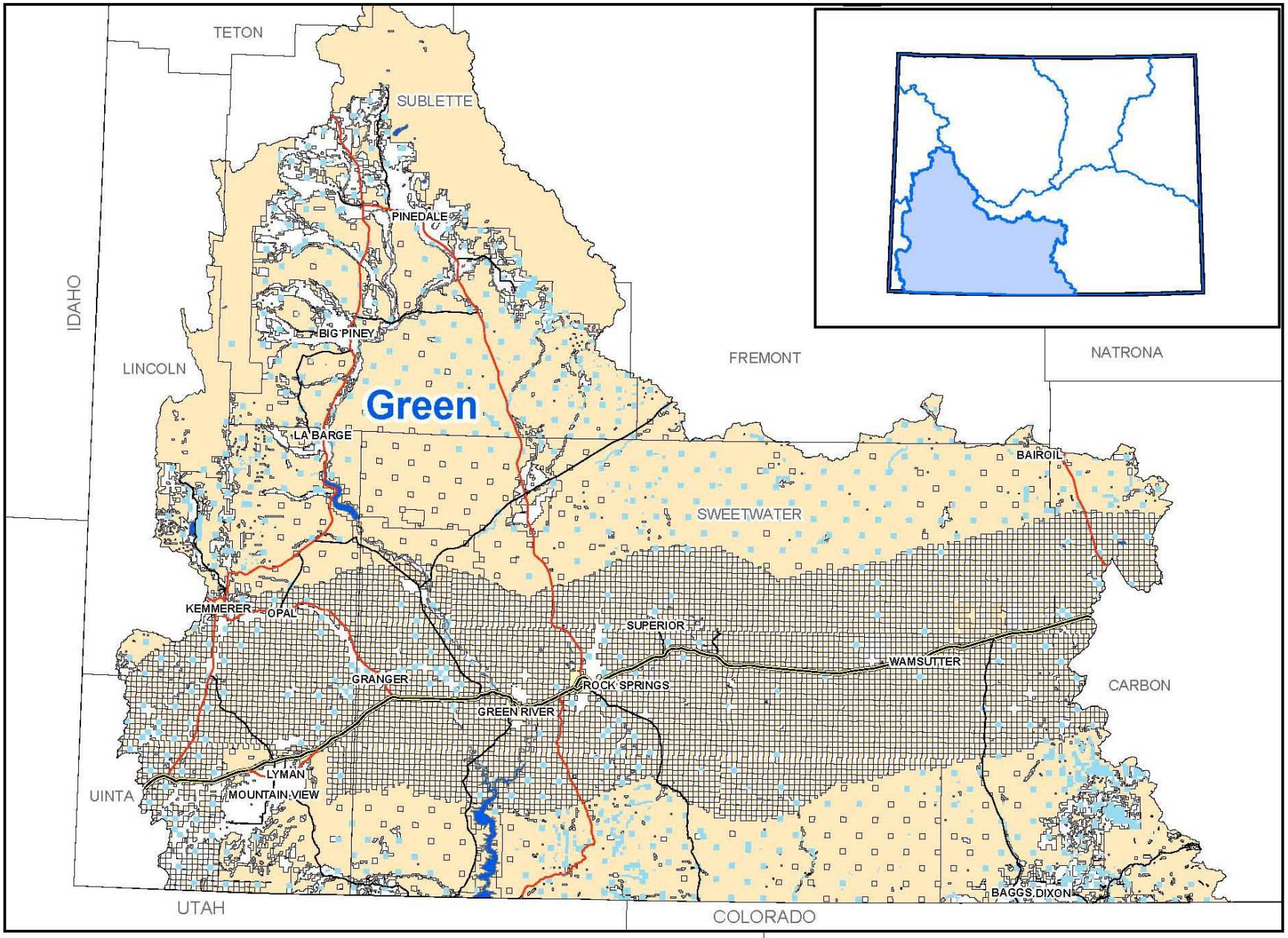


LEGEND

River Basin Planning Area — Continental Divide

Note: The Great Divide Basin is a closed basin included within the Green River Basin Planning Area.

Figure 3-1
River Basin Planning Area Map



LEGEND

Private State Federal

Figure 3-2
Green River Basin Land Ownership

Drainage System

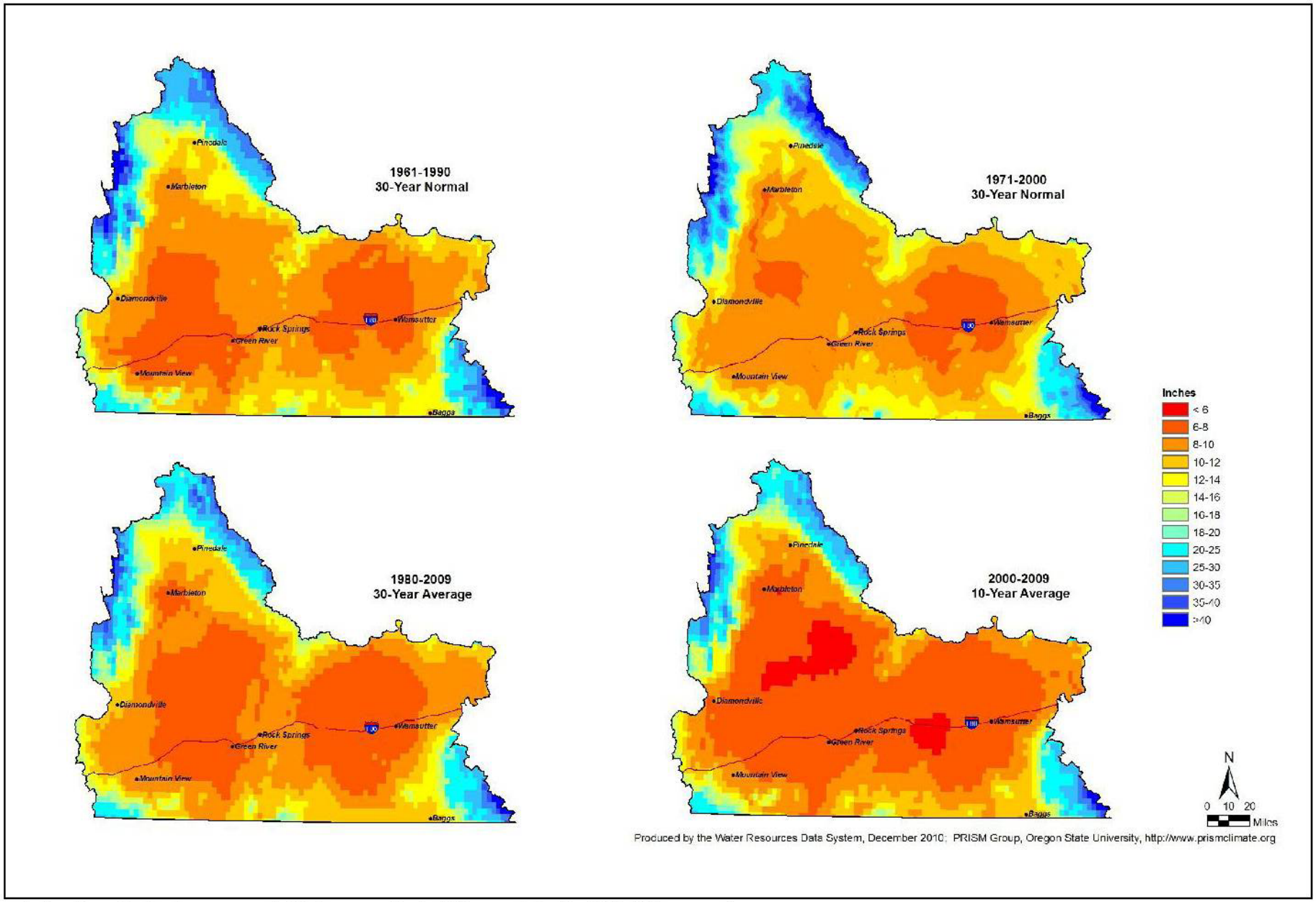
The Green River Basin's rivers and streams drain to the Green River, the largest tributary of the Colorado River. For purposes of this plan the Green River Basin includes the Great Divide Basin, a closed basin that does not contribute runoff to the Green River. The Great Divide Basin drains 4 percent of Wyoming. The Little Snake Basin, which flows into the Yampa River in Colorado which in turn is tributary to the Green River, is also included in the Green River Basin for this plan; these three drainage basins together are sometimes referred to as the Greater Green River Basin and here shall simply be referred to as the Green River Basin or the Basin.

3.1.3 Climate

Water gathered into rivers and streams originates as precipitation. Water that "makes it" to the stream is that which is not evaporated from the surface by solar and wind energy; not intercepted by plants whose capacity and need for water is influenced by solar radiation and relative humidity; and not taken up by the soil moisture reservoir, whose capacity is determined by antecedent precipitation and temperatures. In a snowmelt-driven system, timing and intensity of runoff is related to both accumulated precipitation as snow, and springtime temperatures, radiation, and wind. Hence, water availability is governed by climate.

Climate throughout the Basin varies as a function of elevation, latitude and orographic effects, but most of the Basin follows the pattern of a high desert region. Higher precipitation and lower temperatures generally accompany higher elevations. On average, the Basin receives between 10 to 15 inches of precipitation annually with less than 13% of the Basin receiving more than 20 inches. The southwestern slopes of the Wind River Range, the eastern slopes of the Wyoming Range, and the western slopes of the Sierra Madres receive the most precipitation in the Basin. Lower elevations receiving the most precipitation are located in the upper portion of the Basin in the vicinity of Pinedale. The mountain areas generally have an average annual precipitation from 21 to 59 inches, most of which falls as snow. On average, the Basin receives the most precipitation in April and May and the least in December and February. The higher elevations receive the majority of their precipitation in winter months (October – March) when the lower elevations in the middle of the Basin are at their driest. While long, mild - intensity rainfall events do occur in the Basin, the majority of the rainfall occurs in short, intense storms. Figure 3-3 presents a comparison of precipitation data for different time periods, including the last 10 years of dry records. Figure 3-4 shows how precipitation distribution changes by month.

The warmest average annual temperatures tend to occur in the Flaming Gorge region with the coldest occurring in the upper portions of the Basin, between the Wyoming and Wind River Ranges. Figure 3-5 shows annual average temperatures in the Green River Basin.



The term "normal" refers to averages calculated across a standard 30-year period, either 1961-1990 or 1971-2000. Such 30-year normals are used in climatic and hydrological analyses, and the normal values presented here were calculated by the NOAA National Climatic Data Center. The term "averages" refers to values calculated by WRDS across a non-standard time period (1980-2009 or 2000-2009).

Figure 3-3
Annual Precipitation Comparisons

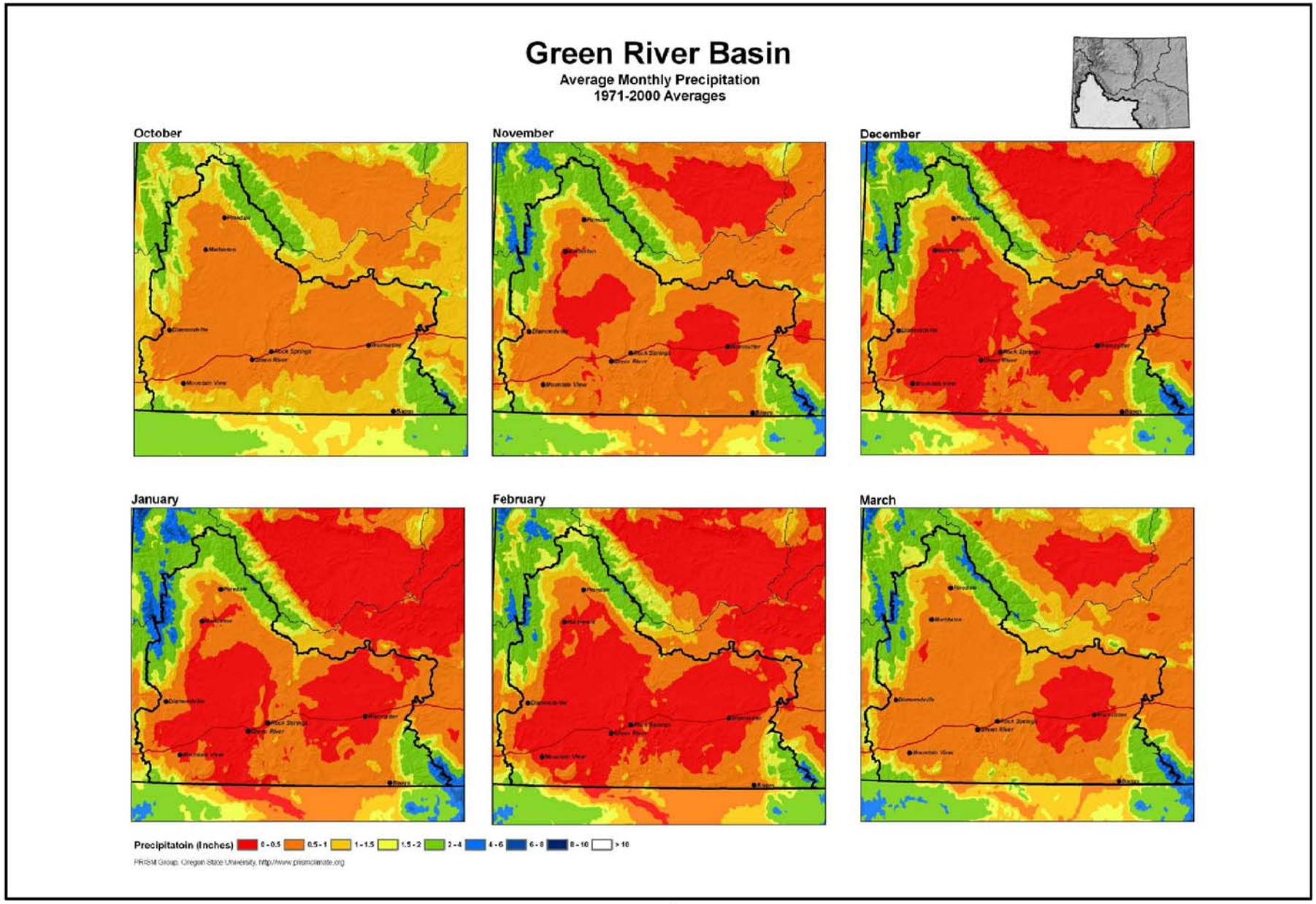


Figure 3-4
Average Monthly Precipitation, 1971-2000 Averages

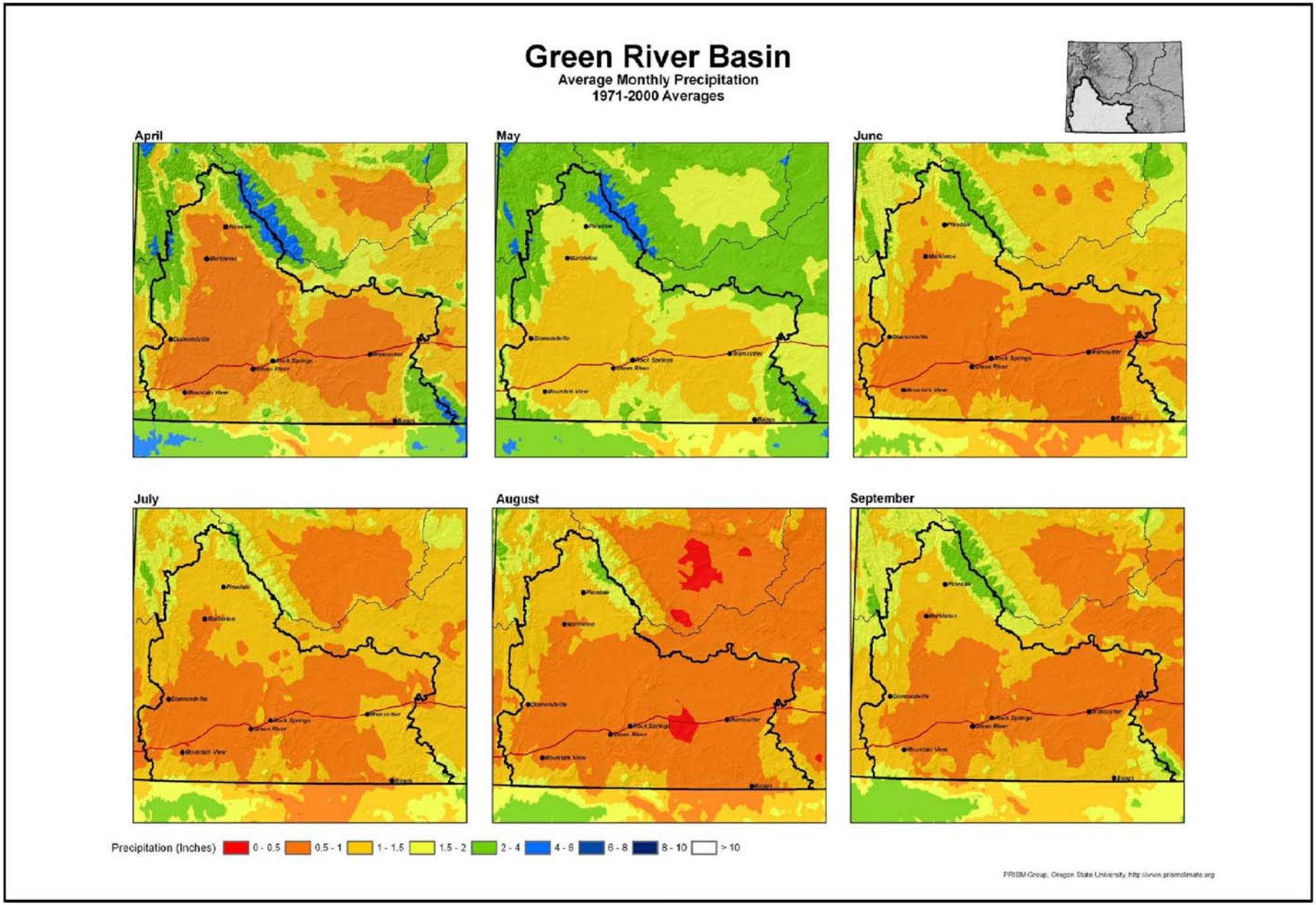
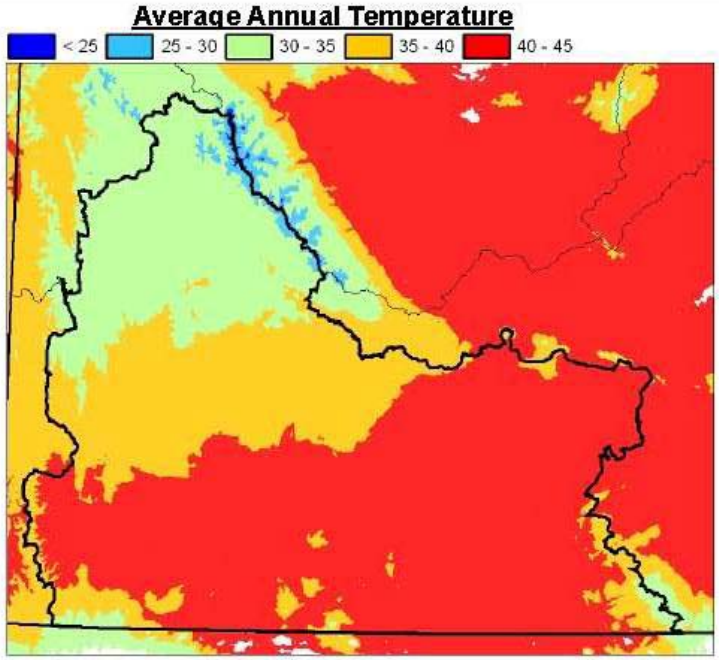
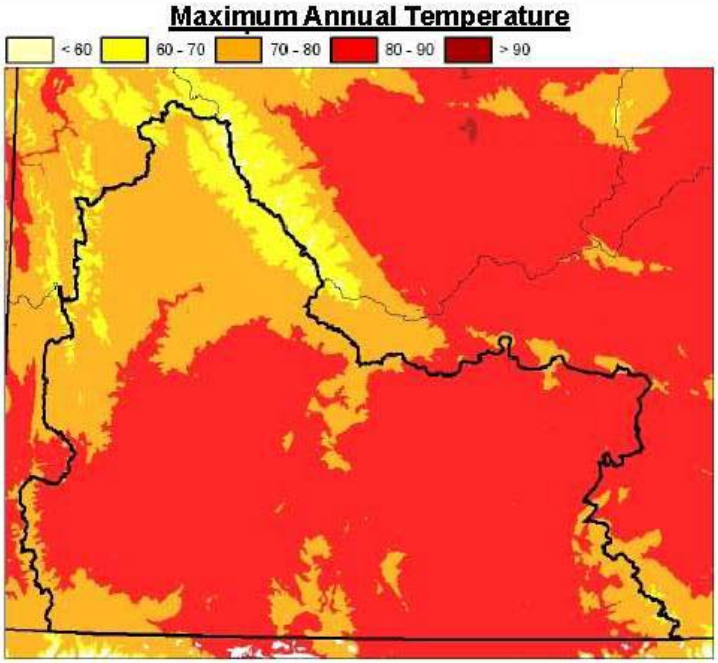
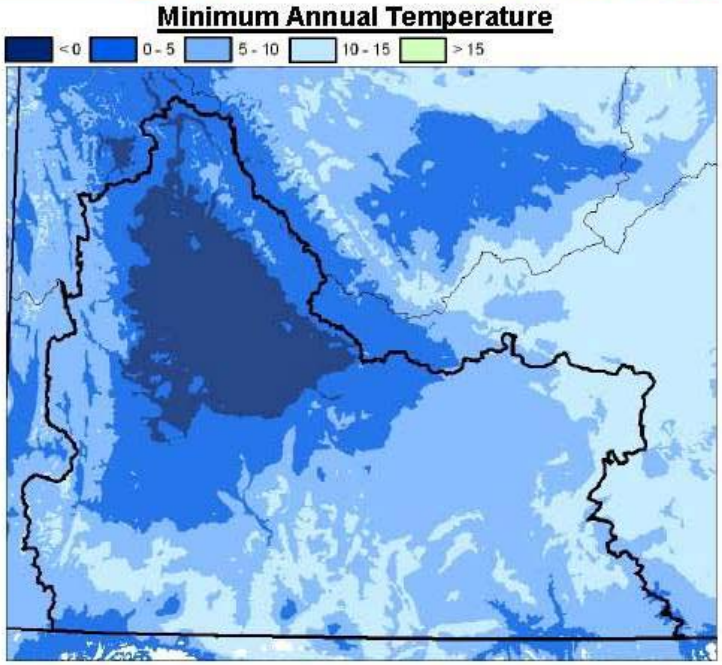


Figure 3-4 Cont
Average Monthly Precipitation, 1971-2000 Averages







Source: WRDS Climate Data,
PRISM Group, Oregon State University,
http://www.prisimclimate.org, 2009

Figure 3-5
Green River Basin
Average Temperatures
In Degrees Farenheit

The Green River Basin is characterized by a relatively short growing season due to high elevations, a short frost-free period in the spring, summer, and fall, and sporadic distribution of precipitation throughout the year. Climate data presented herein comes from PRISM (Parameter-elevation Regressions on Independent Slopes Model), a spatially gridded average monthly and annual precipitation for the 30 year period 1971-2000. PRISM is a unique knowledge-based system that uses point measurements of precipitation, temperature, and other climatic factors to produce continuous, digital grid estimates of monthly, yearly, and event-based climatic parameters. This way of calculating averages across the entire Basin is more accurate than averaging individual stations because it leaves fewer gaps on the landscape and in time.

3.2 SOCIOECONOMIC SETTING

3.2.1 Historic Population Growth

Most demographic data are compiled on the basis of political units such as states, cities, and counties, and most economic data are reported on the county, state, or national level. Because much of the following data is not reported or maintained on a river basin basis, approximations were calculated using the five counties that make up the Green River Basin: Carbon, Lincoln, Sublette, Sweetwater, and Uinta (excluding Fremont and Teton counties which make up a small percentage of the Basin and whose portions of the Basin are largely unpopulated). County rural population data was adjusted by the percentage of the county that lies in the Green River Basin. Cities and towns were included if they are within the boundary of the Green River planning area.

The population of the Green River Basin was estimated at 34,325 in 1950 and grew to about 60,283 in 2005 according to the Wyoming Department of Administration and Information, Economic Analysis Division (WDAI) based on U.S. Census Bureau estimates of reported populations of incorporated cities and towns plus estimated rural population from GIS data. GIS-based census data were only available for 2000 and 2005 from WDAI. Almost two-thirds of the Basin's current population (63%) resides in Sweetwater County; Lincoln, Sublette, and Uinta Counties each have 11 to 13 percent of the Basin's population, while only 2 percent resides in Carbon County. The relatively large population concentration in Sweetwater County is attributable to the fact that it contains the two largest communities in the Basin, Rock Springs and Green River. These two cities, with a combined population of about 30,559, account for 51 percent of the Basin's current population.

From 1970 to 1980, the population of the Basin grew from 29,574 to 60,255, an increase of 30,681 persons. That increase came about as a result of rapid development of energy and mineral resources in the Basin and the associated influx of workers. Since then, barring a minor decrease during the 1980-1990 Energy Bust, the Green River Basin's population has been increasing fairly steadily. Rapid changes in population are often associated with or tied to booms and busts in the energy and mineral sectors. Table 3-2 shows population changes by county.

Table 3-2 Green River Basin Population

County/Community	Population	
	2000	2005
Carbon Co.	**1,075**	**1,106**
Baggs	348	354
Dixon	79	81
Rural	648	671
Lincoln Co.	**7,300**	**7,781**
Diamondville	716	695
Kemmerer	2,651	2,560
La Barge	431	421
Opal	102	99
Rural	3,400	4,006
Sublette Co.	**5,594**	**6,541**
Big Piney	408	455
Marbleton	720	811
Pinedale	1,402	1,658
Rural	3,064	3,617
Sweetwater Co.	**37,613**	**38,015**
Bairoil	97	96
Granger	146	146
Green River	11,808	11,787
Rock Springs	18,649	18,772
Superior	244	239
Wamsutter	261	265
Rural	6,408	6,710
Uinta Co.	**6,685**	**6,840**
Lyman	1,938	1,937
Mountain View	1,153	1,163
Rural	3,594	3,740
Total[1]	**58,267**	**60,283**

Source: WWC Engineering, Tech. Memo, 2009 (M)

[1] This is the five county area within the Green River Basin total, neglecting Teton and Fremont Counties.

3.2.2 Aging Populations, Employment, and Labor Force Participants

Wyoming's population is older than the national population; the median age in Wyoming is 38.4 years while the national median age is 36.6 years. Wyoming has progressed from one of the youngest states to one of the oldest states. This increasing proportion of older residents is likely due to three factors: the aging of the large baby boom generation as seen across the U.S., the migration of retirees into Wyoming seeking

Wyoming's low cost of living, and the migration of young people out of Wyoming looking for employment opportunities. Table 3-3 shows the age group percentages of the population of the 5 counties that encompassed the populated area of the Green River Basin in 2005. It is assumed that populations in the Green River Basin will age in a similar manner to the State of Wyoming populations.

Employment figures and data are not reported or maintained on a river basin basis. To approximate the employment situation in the Green River Basin, data from the five counties that largely comprise the Green River Basin are presented in Table 3-4. The county data were adjusted by the percentage of the county that lies in the Green River Basin Planning area.

In 2005 the annual average wage for the five-county area making up the Green River Basin was about $34,064. Table 3-4 shows the 2005-five county employed labor force, the county average wage and the county total earnings. These numbers, made up of the five-county totals, are not technically accurate for the Green River Basin hydrologic planning area but are indicative of the employment and earnings situation in the Green River Basin. Figure 3-6 shows employment demographics for the five county areas that make up the Green River Basin. Due to rounding, some of the sectors are shown as 0% in Figure 3-6 when in fact they do have a small level of employment.

3.2.3 Key Economic and Water Use Sectors

Agriculture, primarily irrigation, is by far the largest water consumer in the Basin. The energy and mineral sectors have historically added volatility to the economy, but they have also provided high-paying jobs and often require a large amount of water. While municipal water consumption is a small percentage of overall water use in the Basin, cities and towns have unique requirements that demand reliability. Travel, tourism and recreation contribute to the Green River Basin's 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 to the Basin, which in the long run may increase the economic base and create new demand for water supplies. Each of the water demand sectors is integral to economic, demographic, and water demand projections for the Green River Basin.

Table 3-3 - 2005 Aging Population of the Green River Basin Five-County Area

Age Group	County					Total	Percent
Years	Carbon	Lincoln	Sublette	Sweetwater	Uinta		
Less than 5	847	981	347	2,678	1,468	**6,321**	6.6%
5 to 14	1,650	2,175	814	4,961	2,976	**12,576**	13.1%
15 to 19	979	1,279	489	3,092	1,694	**7,533**	7.8%
20 to 24	1,003	1,259	460	2,791	1,685	**7,198**	7.5%
25 to 34	1,658	1,759	864	4,619	2,235	**11,135**	11.6%
35 to 44	2,185	1,956	981	5,213	2,621	**12,956**	13.5%
45 to 54	2,831	2,727	1,277	6,994	3,626	**17,455**	18.2%
55 to 64	2,128	1,858	935	4,495	2,083	**11,499**	12.0%
65 to 74	1,140	1,111	475	1,762	831	**5,319**	5.5%
75 +	910	894	284	1,370	720	**4,178**	4.3%
Total	**15,331**	**15,999**	**6,926**	**37,975**	**19,939**	**96,170**	**100%**

Source: Equality State Almanac 2007

Note: the county population estimates provided in this table do not reflect adjustments for cities and towns that lie outside the Green River Basin.

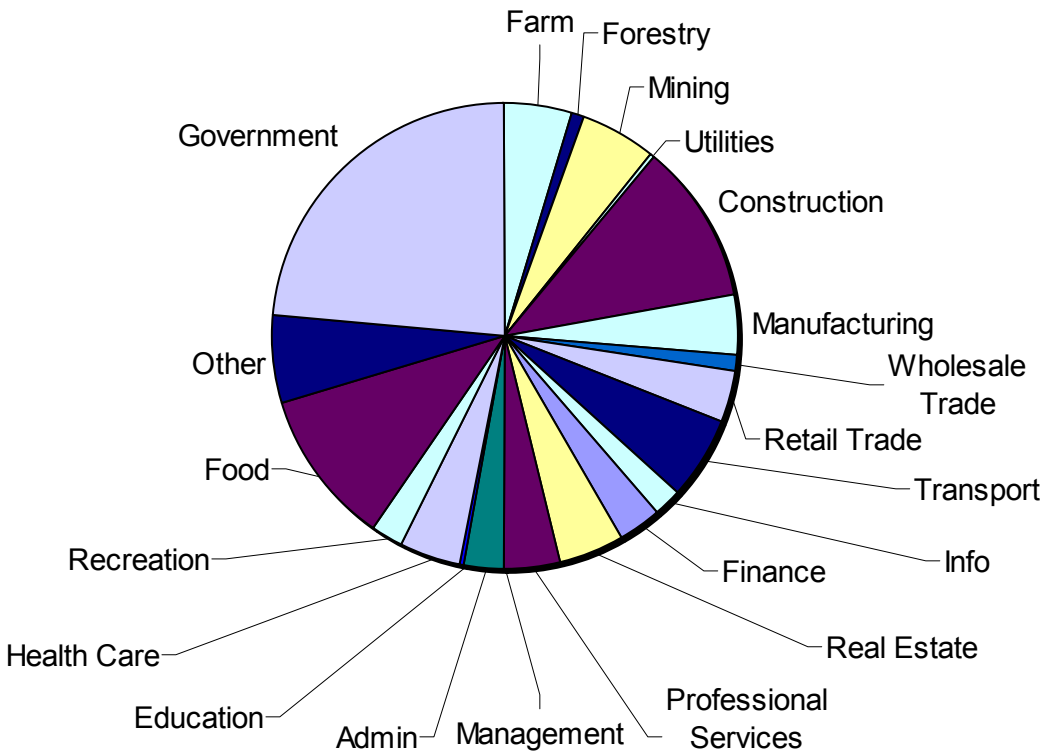
Table 3-4 - 2005 Labor Force Employed and Average Annual Wages for the Green River Basin Five-County Area

County	Labor Force Employed	Average Wage	Total Wages
Carbon	7,530	$28,903	$217,639,590
Lincoln	7,686	$31,524	$242,293,464
Sublette	5,109	$36,751	$187,760,859
Sweetwater	22,044	$42,088	$927,787,872
Uinta	10,599	$31,056	$329,162,544
GRB Total	**52,968**	**$35,958**	**$1,904,644,329**

Source: Equality State Almanac 2007

Note: The employed labor force estimates alone do not reflect adjustments for cities and towns that lie outside the Green River Basin.

Figure 3-6 Estimated Green River Basin Employment



Source: Equality State Almanac, 2007

Agriculture

Agriculture, specifically irrigation, consumptively uses more water than any other economic sector. In 2005 there were approximately 2,167 full and part time agricultural jobs in the five counties that make up the Green River Basin. In 2006-2007 there were 1,560 farms in the Green River Basin. For the same year the total value of agriculture in the Basin was $335.6 million. In 2007 there were 447,900 acres of irrigated agriculture, 28,816 acres of dry farm agriculture, and 4,951,421 acres of range land with a total assessed valuation of $30,273,944. Table 3-5 exhibits the types, amounts, and value of the different sectors of agriculture.

Livestock

Livestock production is the dominant agricultural practice in the Green River Basin and is the reason for the large amounts of alfalfa and grass hay grown in the area. Livestock numbers have declined since 2000 due to the severe drought the state has been experiencing. Drought conditions drive up feed prices and ranchers cannot afford to raise

as many cattle and sheep. Livestock water consumption estimates are based on ten gallons of water per cow per day and four gallons of water per sheep per day. In 2005 the estimated livestock consumptive use was 3,200 acre-feet of water per year. For 2006-2007 the estimated value of livestock in the Green River Basin was $315.3 million.

Crops

The main crops in the Green River Basin consist of forage such as grass hay and alfalfa with very few small grain and cash crops. Typically the irrigated forage grasses are consumed by the producers' herds although some is sold locally or exported from the Basin. For 2006-2007 the estimated value of crops in the Green River Basin was $50.4 million.

Industrial

The industrial sector of the Green River Basin employed approximately 19,059 people in mining, utilities, construction, manufacturing, and transportation and warehousing in 2005. Total wages were $1,290,309,000. Natural gas is Wyoming's largest export product, and Sublette County is the top natural-gas producing county in the state. There is also significant coal mining in Lincoln and Sweetwater Counties. The Green River Basin is the location of three electric power generation facilities, one hydropower and two coal-fired. In 2006 the Green River Basin produced 13.9 million tons of coal, 15.9 million barrels of crude oil, 19 million tons of trona, and 1,451,245 thousand cubic feet (MCFs) of natural gas.

Table 3-5 - Acreage and Assessed Valuation of Agricultural Land in the Green River Basin

	Irrigated		Dry Farm		Range	
County	**Acres**	**Value**	**Acres**	**Value**	**Acres**	**Value**
Carbon	138,363	$4,312,565	10,059	$137,535	1,775,926	$4,045,465
Lincoln[1]	78,523	$4,343,625	18,757	$294,101	416,445	$1,606,876
Sublette	133,549	$2,968,810	0	0	412,525	$3,170,288
Sweetwater	23,121	$986,062	0	0	1,702,407	$3,365,557
Uinta[1]	74,344	$2,967,476	0	0	644,118	$2,075,584
Total	**447,900**	**$15,578,538**	**28,816**	**$431,636**	**4,951,421**	**$14,263,770**

Source: Equality State Almanac 2007

Note: The methods used to estimate irrigated acreage, as reported in the Equality State Almanac, are unknown to WWC Engineering. We acknowledge that the acreage in the above table is different than estimates presented elsewhere in this Plan.

[1] A large portion of Lincoln and Uinta County irrigated acreage is actually in the Bear River Basin.

Municipal and Domestic

Municipal and domestic water use is a relatively small but important part of overall water use. Census data for 2000 indicated that 64% of the population in the Green River Basin lived in urban areas. This urbanization trend is expected to continue with a greater percent living in urban areas served by municipal water resulting in a greater demand on municipal water.

Population in the Green River Basin increased 3.4% between 2000 and 2005, a trend that is expected to continue. This increase in population translates to increased water needs and use in both rural and urban sectors.

Recreation, Travel and Tourism

Water is an important component in recreation and tourism, providing opportunities for boating, fishing, hunting, camping, golfing, and skiing taking place on or near rivers, streams, lakes, and reservoirs of the Green River Basin. The top 15 outdoor recreation activities in the Basin are directly dependent on or related to water, Recreation employed 5,750 people in the Green River Basin with those people earning $121.5 million in 2007. A total of $550 million was spent on travel and tourism in the Basin in 2007, or about 20% of the total in Wyoming. Table 3-6 summarizes the economic impacts of travel and tourism in the Green River Basin.

The Green River Basin has several major reservoirs. Flaming Gorge Reservoir and Fontenelle Reservoir are important destinations for recreation although they are not strictly recreation reservoirs. Other major reservoirs such as Eden, Viva Naughton, Meeks Cabin, Willow and Big Sandy Reservoirs were constructed for flood control, irrigation, power generation, and/or municipal water supply and do not have recreation reserve pools. As a result, recreational use at these reservoirs usually peaks in July and then declines as water levels are drawn down to satisfy their permitted uses.

Table 3-6 - Economic Impacts of Travel by Green River Basin County, 2007

County	Travel Spending	Travel Spending Change 97-07	Earning	Employment	Employment Change 97-07
	$ Millions		$ Millions		
Carbon	159.6	8.50%	33.1	1,580	3.80%
Lincoln	62.4	7.30%	12.2	630	1.20%
Sublette	50.5	10.10%	17.2	510	3.30%
Sweetwater	176.5	7.90%	39.3	2,010	3.40%
Uinta	101.2	8.20%	19.7	1,020	2.60%
Total or Average	550.2	Avg=8.4%	121.5	5,750	Avg=2.9%
State Total	2,68.7	6.50%	675.9	30,330	1.60%
Percent of State Total	20%	n/a	18%	19%	n/a

Source: ERO Resources Corporation, Tech. Memo, 2009 (J)

Environmental

For the purposes of water demand forecasting, environmental water use includes only water used in efforts to enhance environmental conditions, such as improving or maintaining fish and wildlife habitats. Much of the environmentally beneficial water use within the state is a by-product of other uses, such as reservoirs, and not from water rights specifically directed at environmental protection. Wyoming's Instream Flow Law and the Seedskadee National Wildlife Refuge right to 5,000 acre-feet of reservoir water are two exceptions to this. Enhancement or creation of wetlands is an environmental use that may see more development in the future, along with more applications for instream flow rights.

3.3 LEGAL AND INSTITUTIONAL SETTING

The legal framework that water users must operate within is defined by a mixture of state law, federal law, interstate agreements, and court decrees.

3.3.1 Wyoming Water Rights

Wyoming water law is the foundation upon which all water use, development, and protection are based. WWDC has stated that Wyoming water law shall be respected in all aspects of the water planning process. The water rights system in Wyoming is administered by the State Engineer's Office and the State Board of Control, which are constitutionally based administrative and quasi-judicial entities of state government.

Wyoming's water laws have evolved from the early establishment of legal principles that were later embodied in the State Constitution and a series of laws written and adopted early in Wyoming's history that have stood the test of time. One early water dispute that involved two territorial pioneers, William McCrea and Charles Moyer, is instructive regarding the history of water law in Wyoming. Moyer, whose name is associated with a now-famous spring in the coal-mining region north of Gillette, developed that spring for irrigation in 1890. Previously, McCrea had developed an irrigation project along the Little Powder River downstream of, and partially supplied by, Moyer's spring. With Moyer's development, McCrea's ditch was short of water, and the resulting argument eventually reached the Wyoming Supreme Court. In one of its first rulings on water matters, the Court affirmed the "first in time, first in right" doctrine by siding with McCrea. Through this 1896 ruling, the Court recognized the concepts of the prior appropriation doctrine that Territorial Engineer Elwood Mead had been advocating in the days leading to statehood and the constitutional conventions.

Mead, who became the first State Engineer, understood that water in an arid region must be administered in a predictable and equitable fashion, and the methods he fostered were to allow the earlier developer of water to establish the senior right for its continued use. The Wyoming State Constitution adopted this priority system of

appropriation and established the position of State Engineer. Through the efforts of Mead, the Constitution also embodied the basis of appropriating water on the concept of "beneficial use" to avoid the potential for exaggerated amounts of water being tied up by early settlers and developers of water diversion systems. Mead also led the movement affirming a strong, active, independent state role in all aspects of appropriating and administrating the waters of the state as well as developing the process for resolving water disputes. Rather than use a water court system as in the neighboring state of Colorado, Wyoming established the State Board of Control within its Constitution. In addition to its independent authority to review matters initially decided by the State Engineer, the Board of Control is the adjudicator of all water rights and the decision-maker of all requests for changes to adjudicated water rights. The Constitution declares all water in the state to be the property of the state, subject to appropriation for beneficial use through the administrative permitting of water rights. Water rights are considered property rights that attach to the land or place of use. However, the law provides that the owner of these rights may change the location of use, or the type of use, by seeking approval from the Board of Control. The final decisions of the Board of Control are subject to judicial review. The Board of Control is made up of the State Engineer and the four Water Division Superintendents.

Within this constitutional framework, the detailed statutory authority, procedures, and administration were further defined by legislation and periodic Court decisions. The State Engineer's role is defined in Title 9, Chapter 1, Article 9, along with the general authority to establish fees for certain services and some other minor activities of the agency.

The majority of Wyoming's water laws are now codified primarily in Title 41 of Wyoming Statutes entitled "Water." Under this title, there are 14 chapters that include the authority and activities of the Water Development Commission and the laws associated with irrigation, drainage, watershed improvement, water and sewer districts, interstate compacts, and the use of watercraft. Chapters 3 and 4 contain the important laws relating to the appropriation, administration, and adjudication of water rights in Wyoming. These statutes relate to all waters of the state, whether they are from surface streams, springs, natural lakes, or underground waters.

The key elements of Wyoming's water laws were established in the Constitution and the early statutory laws before and near the turn of the century. From time to time, the legislature has modified the laws to address emerging new issues of the water users in the state. The laws addressing reservoirs were passed in the early 1900s; laws specific to groundwater sources were introduced in the 1940s and 1950s, with the last significant change adopted in 1969. Laws addressing instream flow water rights were codified in 1986. The basic framework of water right permitting actions and administration has remained the same, all the while allowing for flexibility in answering the needs of water users.

This set of laws is a part of the principles upon which the 2010 Green River Basin Plan is based.

3.3.2 Interstate Compacts, International Treaty, Court Decrees, Contracts, and Agreements

Colorado River Compacts (1922 and 1948)

A compact between the River Basin states (Wyoming, Colorado, New Mexico, Utah, Arizona, Nevada, and California) was negotiated in 1922. This compact allocated 7.5 million acre-feet of annual consumptive use to the Upper Basin. The Compact requires that Upper Division States not cause flow of the Colorado River at Lee Ferry to be depleted below an aggregate of 75,000,000 acre-feet for any period of ten consecutive years. Lee Ferry is the point on the river dividing the Upper Basin from the Lower Basin. In addition, provision was made for future treaties with Mexico. As a result of this clause, the 1944 Colorado, Tijuana, and Rio Grande Treaty influences the regulation of the Colorado River. In 1948, a compact among the Upper Basin states was negotiated. It was ratified by all the states and the federal government in 1949. Arizona has a small area in the Upper Basin and therefore was included in the Upper Basin negotiations. This Upper Colorado River Basin Compact apportions the use allocated to the Upper Basin by the 1922 compact as follows: 50,000 acre-feet per annum to Arizona and of the remaining quantity 51.75 percent to Colorado, 11.25 percent to New Mexico, 23 percent to Utah, and 14 percent to Wyoming. The 1948 compact divided the waters of Henry's Fork between Wyoming and Utah on a straight priority basis for existing development. Waters of the Little Snake River used under rights existing prior to this compact and diverted below the river's confluence with Savery Creek are administered on a straight priority basis (irrespective of the state line). Water uses developed after the compact's signing are administered to equally share the available water supply.

3.3.3 Contracts and Agreements

Wyoming has also entered into several agreements that limit or modify water use at specific locations.

Fontenelle Reservoir Contract

Wyoming acquired the right to perpetually market 60,000 acre-feet of Fontenelle Reservoir storage from the United States Bureau of Reclamation (USBR) on two separate occasions. A Water Supply Act of 1958 authorized storage to meet anticipated future need for municipal and industrial purposes to be included in any reservoir project to be surveyed, planned, and constructed by the USBR – conditioned upon the willingness of state or local interests to pay for the cost of providing storage for the anticipated future demands. In 1959, the Wyoming Legislature appropriated the funds and authorized the

Natural Resource Board to enter into a contract with the USBR for storage in an amount not to exceed 60,000 acre-feet. In 1974, Wyoming entered into a second agreement with the USBR for an additional 60,000 acre-feet of storage. However, the agreement also gave Wyoming the ability to subcontract not more than 125,000 acre-feet annually, in essence providing conditions in which the State could over-sell.

The State of Wyoming, through the WWDC, has allocated 46,550 acre-feet of water to Jim Bridger Power Plant (35,000 acre-feet per year), FS Industries (10,000 acre-feet per year), Church and Dwight (1,250 acre-feet per year) and Exxon USA (300 acre-feet per year). Four water sale contracts have been executed. The contracts require remittance of a "readiness to serve fee," which reserves an amount of water specified in the contract which may be released as requested by the contractor. If all four contracts called for their associated releases, the amount of water released would total 46,550 acre-feet per year. Therefore, Wyoming has the right to market an additional 78,450 (125,000 less 46,550) acre-feet per year of Fontenelle Reservoir water.

High Savery Reservoir Contract

Construction of the High Savery Reservoir was authorized by the Wyoming Legislature to provide water for recreation, agriculture, municipal and domestic water supplies, environmental enhancement, and mitigation of the Cheyenne Stage I and Stage II transbasin diversion water supply projects. The permitted capacity of the reservoir is 22,433 acre-feet. A 5,724 acre-feet minimum pool requirement was stipulated in the Clean Water Act, Section 404 permit, issued by the U.S. Army Corps of Engineers (USCOE). The USCOE 404 Permit also mandated maintenance of a 12 cfs non-irrigation season releases to Savery Creek below the dam. If actual inflows are less than 12 cfs, the releases are required to match the actual reservoir inflows. Further, the state is to maintain a flow of 10 cfs from July 15 through September 15 below the dam regardless of reservoir inflows. The state has contracted with the Savery-Little Snake Water Conservancy District (District) for the sale of water residing above the elevation of the minimum pool. The District is responsible for remarketing water pursuant to the beneficial purposes described by the enabling legislation. The primary purpose of the reservoir is to provide firm, reliable late-season irrigation water, eight out of 10 years, to lands within the Little Snake River Basin.

3.3.4 Environmental Laws

The Environmental Quality Act was passed by the Wyoming Legislature in 1973. The purpose of the law was to address the concern that pollution "will imperil public health and welfare, create public and private nuisances, be harmful to wildlife, fish and aquatic life, and impair domestic, agricultural, industrial, recreational and other beneficial uses." The act authorized the state "to prevent, reduce and eliminate pollution; to

preserve, and enhance the water and reclaim the land of Wyoming; to plan development, use, reclamation, preservation and enhancement of the air, land, and water resources of the state; to preserve and exercise the primary responsibilities and rights of the state of Wyoming; to secure cooperation between agencies of the state, agencies of other states, interstate agencies, and the federal government in carrying out these objectives" (Wyoming Environmental Quality Act, 1973).

The State of Wyoming has designated the Water Quality Division (WQD) of the Wyoming Department of Environmental Quality (WDEQ) to oversee water quality and enforce the water-related provisions of the Environmental Quality Act. This is being done through a number of programs that have been set up to control various forms of potential pollution. Pollution can come from point and nonpoint sources and can affect surface water and groundwater.

The WQD developed water quality standards, a result of the federal Clean Water Act, which are documented in Chapter 1, Wyoming Water Quality Rules and Regulations, and are available on the WQD website at http://soswy.state.wy.us/rules/search.htm. The surface water quality standards are based on four surface water classifications:

- **Class 1, Outstanding Waters**: Class 1 waters are surface waters in which no further water quality degradation by point source discharges other than from dams will be allowed. Nonpoint sources of pollution shall be controlled through implementation of appropriate best management practices. Water quality and physical and biological integrity which existed on the water at the time of designation will be maintained and protected. The designation of Class 1 waters is reflective of water quality. This includes the following characteristics: aesthetically pleasing, scenic, recreational, ecological, agricultural, botanical, zoological, municipal, industrial, historical, geological, cultural, archaeological, fish and wildlife habitat, the presence of significant quantities of developable water, and other values of present and future benefit to the people.
- **Class 2, Fisheries and Drinking Water**: Class 2 waters are waters, other than those designated as Class 1, that are known to support fish or drinking water supplies or where those uses are attainable. Class 2 waters may be perennial, intermittent or ephemeral and are protected for the uses indicated in each subcategory.
- **Class 3, Aquatic Life Other than Fish**: Class 3 waters are waters, other than those designated as Class 1, that are intermittent, ephemeral, or isolated and because of natural habitat conditions, do not support or have the potential to support fish populations or spawning; Class 3 includes certain perennial waters which lack the natural water quality to support fish (e.g., geothermal areas). Class 3 waters support invertebrates, amphibians, or other flora and

fauna which inhabit waters of the state at some stage of their life cycles. Uses designated on Class 3 waters include aquatic life other than fish, recreation, wildlife, industry, agriculture, and scenic value. Generally, waters suitable for this classification have wetland characteristics, and such characteristics are a primary indicator used in identifying Class 3 waters.

- **Class 4, Agriculture, Industry, Recreation and Wildlife**: Class 4 waters are waters, other than those designated as Class 1, where it has been determined that aquatic life uses are not attainable. Uses designated on Class 4 waters include primary contact recreation, wildlife, industry, agriculture, and scenic value.

Groundwater Quality

The State of Wyoming has identified the following standards for different classes of groundwater:

- Class I groundwater is defined as groundwater suitable for domestic use.
- Class II groundwater is defined as groundwater suitable for agricultural (irrigation) use where soil conditions and other factors are adequate.
- Class III groundwater is defined as groundwater suitable for stock use.
- Class Special (A) groundwater is defined as groundwater suitable for fish and aquatic life.
- Class IV groundwater is defined as groundwater suitable for industry.
- Class V groundwater is defined as groundwater found closely associated with commercial deposits of hydrocarbons, or groundwater which is considered a geothermal resource.
- Class VI groundwater is defined as groundwater that may be unusable or unsuitable for use.

Table 3-7 includes additional information regarding the standards for Classes I, II, and III.

The U.S. Environmental Protection Agency (USEPA) regulates public drinking water supplies in Wyoming since the state has not assumed primacy for this Clean Water Act program. This program provides comprehensive regulation of both surface and groundwater supplies, including enforceable standards for organic and inorganic constituents, complex filtration and disinfection requirements for surface water or groundwater determined to be under the influence of surface water, and monitoring and reporting requirements to ensure compliance. Although these rules and regulations continue to evolve, groundwater is widely considered to be a more desirable source of drinking water if it is available, due to substantially less expensive compliance requirements. Table 3-8 provides a partial listing of the inorganic constituents for which the USEPA has promulgated Maximum Contaminant Levels (MCL). “Primary” standards

are based on human health effects and are required to be met. "Secondary" standards are based on the aesthetics of drinking water and are advisory.

Chapter 8 of the Wyoming Water Quality Rules and Regulations addresses groundwater quality standards and protection. These rules are enforced by WDEQ. Chapter 8 describes various classifications that have been created for groundwater and outlines the rules for discharges to these waters.

Table 3-7 - WDEQ Groundwater Quality Standards[1]

Constituent	Class I (domestic)	Class II (agricultural)	Class III (livestock)
	mg/L		
Chloride	250	100	2,000
Iron	0.3	5	
Sulfate	250	200	3,000
TDS	500	2,000	5,000
SAR[2]		8	

[1] Table only a partial listing of the standards.

[2] Sodium Adsorption Ratio (SAR) has been found to be important with respect to use of coalbed methane waters for irrigation.

Source: Wyoming Department of Environmental Quality, Water Quality Division. 2004. Wyoming Water Quality Rules and Regulations, Chapter 8.

Table 3-8 Drinking Water Standards

Constituent (unit)	USEPA Maximum Contaminent Level	
	Primary	Secondary
MAJOR IONS (mg/L)		
Chloride		250
Fluoride	4	2
Nitrogen, Nitrate+Nitrite as N	10	
Nitrogen, Nitrite as N	1	
Sulfate		250
NON-METALS (mg/L)		
Cyanide	0.2	
PHYSICAL PROPERTIES		
Color (color units)		15
Corrosivity (unitless)		non-corrosive
Odor (threshold odor number)		3
pH (standard units)		6.5 - 8.5
Total Dissolved Solids (mg/L)		500
Surfactants (methylene blue active substances)		0.5
METALS - TOTAL (mg/L)		
Aluminum		0.05 - 0.2
Antimony	0.006	
Arsenic	0.01	
Barium	2	
Beryllium	0.004	
Cadmium	0.005	
Chromium	0.1	
Copper	1.3	1
Iron	0.3	0.3
Lead	0.015	
Manganese		0.05
Mercury	0.002	
Nickel	0.1	
Selenium	0.05	
Silver		0.1
Thallium	0.002	
Uranium	0.03	
Zinc		5
RADIONUCLIDES - TOTAL (pico Curies per liter)		
Gross Alpha	15	
Gross Beta	50	
Radium 226 + Radium 228	5	

Source: USEPA Maximum Contaminant Levels (MCLs)

Surface Water Quality

The Clean Water Act requires that a 305(b) report be created which covers statewide water quality, along with a 303(d) list, of impaired streams in the state. Impaired streams require the establishment of total maximum daily loads (TMDLs) for problem pollutants. A TMDL is the amount of a specific pollutant that a water body can receive and assimilate in a given time period and still meet water quality standards.

The classification of a stream indicates what use is currently or can be supported by that stream. In general, the water quality in Wyoming is good based upon the number of water bodies supporting their designated uses. Wyoming's 305(b) State Water Quality Assessment Report produced by WDEQ includes 303(d) listings.

Colorado Basin Salinity Control Program

In order to comply with Section 303 (a) and (b) of the Clean Water Act, the Basin states established the Colorado River Basin Salinity Control Forum in 1973. Recently, the Forum published its "2008 Review, Water Quality Standards for Salinity, Colorado River System", which outlines policies that will affect some existing and future water development activities in Wyoming's Green River Basin. These policies are:

* Policy of Implementation of Colorado River Salinity Standards through the NPDES Permit Program. This policy applies to industrial and municipal discharges.

* Policy for Use of Brackish and/or Saline Water for Industrial Purposes. This policy applies to industrial water use.

* Policy for Implementation of Colorado River Salinity Standards through the NPDES Permit Program for Intercepted Ground Water. This policy applies to mines and wells which discharge intercepted ground water.

* Policy for Implementation of Colorado River Salinity Standards through the NPDES Permit Program for Fish Hatcheries. This policy applies to discharges from fish hatcheries.

For additional information regarding the Colorado River Basin Salinity Control Program, please visit http://www.usbr.gov/uc/progact/salinity/.

A technical memorandum summarizing this important institutional constraint was prepared as part of this plan. The reader is encouraged to consult that memorandum for in depth information (Wyoming State Engineer's Office, Tech. Memo, 2009(A).

WYDES Program

The EPA has delegated administration of the National Pollution Discharge Elimination System permitting program to the Wyoming Department of Environmental Quality, who in turn identifies it as the WYDES Program.

This program is a key permitting agency with respect to CBM and Natural Gas extraction activities. For additional discussion and information related to this program the reader is encouraged to consult the Institutional Constraints tech. memo and the Colorado River Basin Salinity Control Program tech. memo. Also the WYDES website address is http://deq.state.wy.us/wqd/WYPDES_Permitting/WYPDES_cbm/cbm.asp.

3.3.5 Federal Environmental Laws

Numerous federal legislative efforts have authorized the remediation and protection of water quality and the environment. These include the Clean Water Act, Pollution Prevention Act, Safe Drinking Water Act, Clean Air Act, NEPA, Solid Waste Disposal Act, Toxic Substance Control Act, and Federal Insecticide, Fungicide and Rodenticide Act. Most of the federal programs involved with water quality allow individual states to obtain primacy to administer the federal programs. The USEPA can step in if a state is not conducting the program to their satisfaction, even if the state has primacy.

The following is a list of water development and management actions that can initiate or trigger federal action or enforcement of environmental laws. A discussion of applicable federal legislation is presented following the list.

- Issuance and renewal of special use and right-of-way permits on federal lands.
- Contracting for storage water from federal reservoirs.
- Discharge of dredged and/or fill material into waters of the United States, including rivers, streams, and wetlands.
- Procurement and renewal of licenses from the Federal Energy Regulatory Commission (FERC) to produce hydropower.
- Use of federal loan or grant funds to construct a new water project or rehabilitate an existing water project.

Key applicable federal legislation includes the following acts:

Endangered Species Act

The Endangered Species Act of 1973 (ESA) requires the Secretary of Interior, through the U.S. Fish and Wildlife Service (USFWS), to determine whether wildlife and plant species are endangered or threatened based on the best available scientific information. The ESA constrains all federal agencies from taking any action that may

jeopardize the continued existence of an endangered or threatened species. If a federal agency is considering an action that may jeopardize an endangered species, Section 7 of the ESA requires that the agency must consult with the USFWS.

Upper Colorado River Recovery Implementation Program

Since 1988, an innovative and cooperative program has been underway to resolve serious conflicts in the Upper Colorado River Basin between further development of Compact-apportioned water supplies and the conservation and recovery of four endangered fish species. The Upper Colorado River Endangered Fish Recovery Program is a multi-agency partnership to recover endangered fish in the upper Colorado River basin while water development proceeds in compliance with state and federal law (e.g., state water law, the Endangered Species Act, and interstate compacts).

Wyoming's participation in the Upper Colorado River Recovery Implementation Program facilitates the process by which most Wyoming projects within Wyoming's portion of the Green River Basin obtain federal clearances under ESA. Rather than spending thousands of dollars on evaluations of potential impacts to the fish species and their designated critical habitat and developing expensive mitigation plans, a project proponent is able to pay a one-time charge for new depletions which are paid into a fund to benefit the endangered fish. The one-time charge is presently approximately $18 per acre foot of the estimated annual depletion. This amount is adjusted annually for inflation.

The Recovery Program was established in 1988 under a Cooperative Agreement signed by the Secretary of the Interior, the Governors of Colorado, Utah, and Wyoming, and the Administrator of the Western Area Power Administration. In December 2001, those same officials signed an extension of the Agreement that extended the program through September 30, 2013. An additional extension that will continue the Recovery Program through the end of fiscal year 2023, the date by which recovery of the four fish species (Colorado pikeminnow, the razorback sucker, the bonytail, and the humpback chub) will be completed pursuant to projections made in the four species' recovery goals (published as part of their recovery plans), is in process currently.

National Environmental Policy Act

The National Environmental Policy Act of 1969 (NEPA) requires that federal agencies consider all reasonable foreseeable environmental consequences of their proposed actions. A review of an action under NEPA can be in the form of a categorical exclusion or environmental assessment (EA), both of which must result in a finding of no significant impact (FONSI), or an EIS and record of decision. Further, NEPA requires federal decision-makers to "study, develop, and describe appropriate alternatives to recommended courses of action in any proposal which involves unresolved conflicts concerning alternative uses of available resources" (42 USC 4321 et seq., Sec. 102(2)E). NEPA provides federal agencies the opportunity to determine which alternative,

including no action, they feel best serves the applicant's purpose and need. The alternative selected by the federal agency may differ from the one preferred by the applicant.

Clean Water Act

Section 404 of the Clean Water Act of 1972 prohibits discharging dredged or fill materials into waters of the United States without a permit from the USCOE. The waters of the United States include rivers and streams and, as of 1993, wetlands. USCOE policy requires applicants for 404 permits to avoid impacts to waters of the U.S. to the extent practicable, minimize the remaining impacts, and finally take measures to mitigate unavoidable impacts. In addition to the alternative review required by NEPA, Section 404(b)(1) guidelines require an alternative review to define the least environmentally damaging practicable alternative.

Section 401 of the Clean Water Act provides that the State of Wyoming certify any federally licensed or permitted facility which may result in a discharge into the waters of the state. The 401 certification provides a mechanism for Wyoming to amend, or perhaps veto, an action that the federal agency might otherwise permit. While the 401 certifications are required for several federal actions, most 401 certifications relate to Section 404 Dredge and Fill Permits required from the USCOE.

3.4 REFERENCES

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