

**THE
WYOMING
FRAMEWORK WATER
PLAN**

A SUMMARY

**OCTOBER 2007
WYOMING WATER DEVELOPMENT
COMMISSION**

This report was prepared by:

WWC Engineering
Hinckley Consulting
Collins Planning Associates
Greenwood Mapping, Inc.
States West Water Resources Corporation

Front Cover Photo Credit:

Lisa Swanson at WWC Engineering for Wyoming Water Development Commission

THE WYOMING FRAMEWORK WATER PLAN

INTRODUCTION

The Wyoming Framework Water Plan has two objectives. Volume I is an inventory of the state's water resources and related lands, a summary of the state's present water uses, a projection of future water needs, and an identification of alternative decisions to meet the indicated future water needs. The second objective, and the subject of Volume II of the Framework Water Plan, is to provide future water resource planning direction to the State of Wyoming.



This executive summary encompasses both volumes of the Wyoming Framework Water Plan.

Seven basin plans were completed - one for each of the major drainage basins of the state. These efforts were undertaken by the Wyoming Water Development Commission (WWDC) and its consultants between 2000 and 2006. The Wyoming Framework Water Plan Report, Volume I presents the information from the separate basin reports on a statewide basis. Projections of future water needs presented in Volume I were used to identify alternative water resource projects that may be required for the future.

The Framework Water Plan is also presented on the World Wide Web and available for any user with a web browser and internet connection. A PDF version and GIS products can be downloaded at: <http://waterplan.state.wy.us/frameworkplan.html>. In addition, a Presentation Tool provides an interactive, searchable interface to the entire Framework Water Plan. The Presentation Tool is hosted by the Water Resources Data System, College of Engineering, University of Wyoming, and is available at: <http://waterplan.wrds.uwyo.edu/fwp/>.

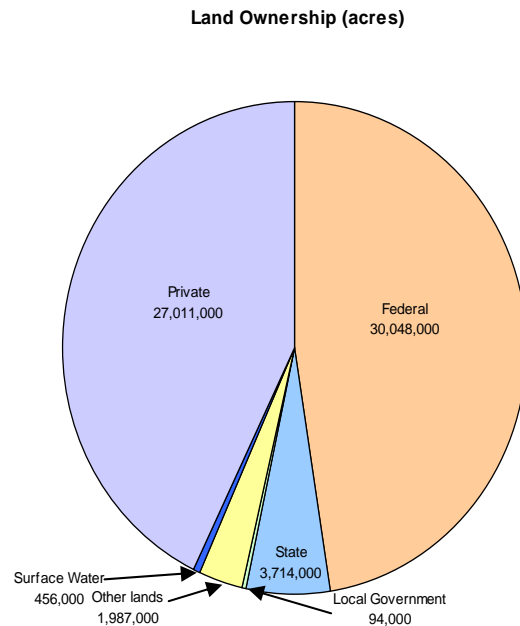
The previous statewide water planning process was completed in 1973 with the publication of the Wyoming Framework Water Plan. As with the current planning process, the process in the 1970s was performed basin-by-basin to capture the unique water situation and needs in each basin. Since 1973, technological advances have been made in water resource planning. Also, political and regulatory conditions in water resource management have changed. Therefore, it was necessary that Wyoming complete an updated statewide water planning report. This current Wyoming Framework Water Plan provides information for decision making for a 30 year planning horizon.

VOLUME I

SETTING

PHYSICAL SETTING

Wyoming's geographic location, human resources, physical characteristics, and natural resources are presented in the Setting Chapter of the Wyoming Framework Water Plan. The State contains 23 counties and encompasses 98,210 square miles, making it the ninth largest of the United States. The breakdown of land ownership is shown in the pie chart to the right. Wyoming ranks high in the production of minerals and energy due to the state's abundant natural resources. Much of Wyoming's heritage stems from its agricultural and livestock industry. Transportation, combined with the scenic beauty of open spaces, rugged mountains, forests, and national parks, enhances an important and growing tourist industry.



Wyoming is a region of considerable physiographic diversity including high mountain ranges, steep river valleys, foothills, narrow terraces, plains, rolling hills, badlands, and uplifts. The mean elevation is about 6,700 feet, making the state the second highest in the United States. Most of the water flowing through the state originates within the state's boundaries, with the following few exceptions. Colorado's mountains contribute to Wyoming's streamflow via the North Platte, Laramie, and Little Snake Rivers. Montana contributes streamflow in the Clarks Fork River. The headwaters of the Blacks Fork, Henrys Fork, and the Bear River are in Utah.

Wyoming's climate is a product of its latitude, elevation, and topography. Wyoming has large seasonal and daily temperature ranges. Temperatures higher than 110° F and lower than -50° F have been recorded, and daily temperature changes of 40° F and more are not unusual.

SOCIOECONOMIC SETTING

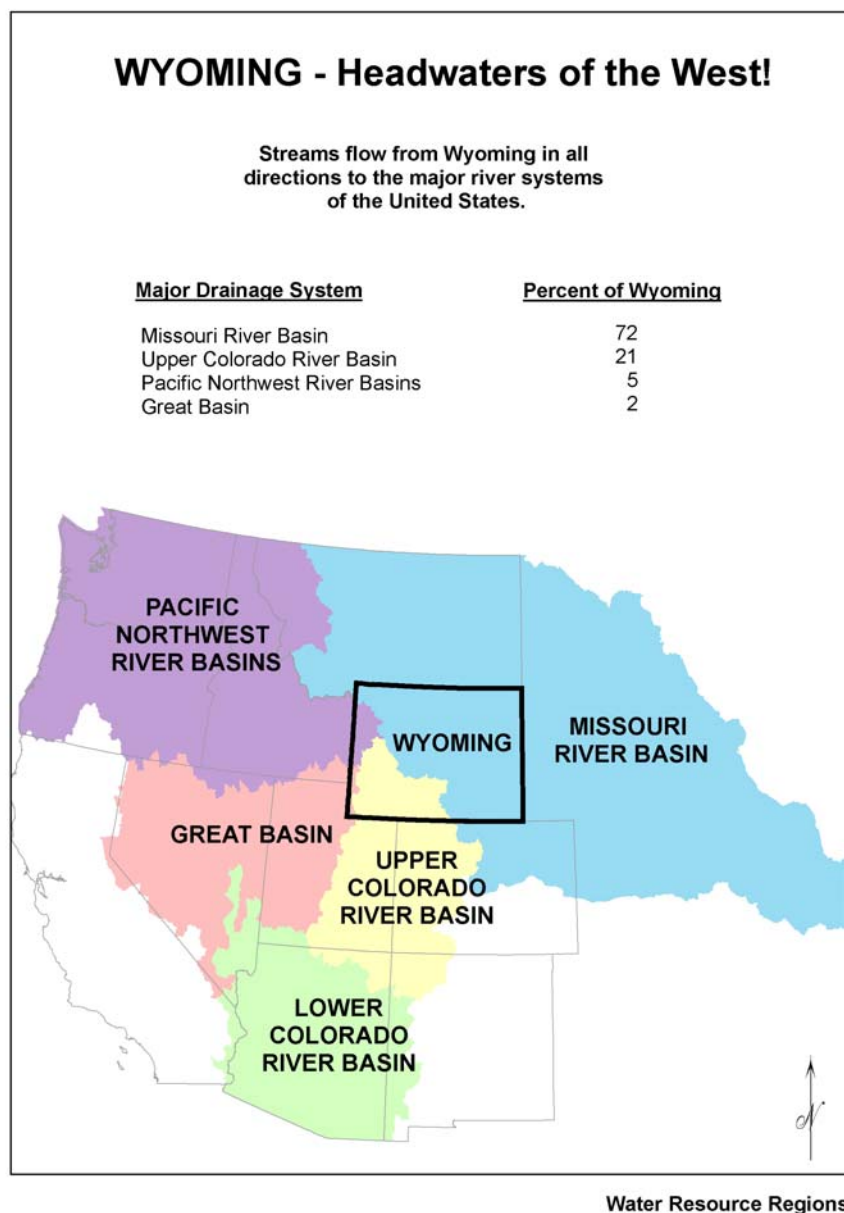
According to the 2000 census, the population of Wyoming was 493,782, an increase from 332,416 in 1970. This ranks Wyoming fiftieth in population.

Agriculture's impact on the state's land and water use is significant. The energy and mineral sectors have historically added volatility to the economy but have also provided high-paying jobs and often require a comparatively large amount of water. While municipal water consumption is a small percentage of overall water used in the state, cities and towns have unique requirements that demand reliability. Travel, tourism, and recreation contribute to Wyoming'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 state, which in the long run may increase the economic base and may create new demand for water supplies. The future of each of the water demand sectors is integral to economic, demographic, and water demand projections for Wyoming.

LEGAL AND INSTITUTIONAL SETTING

The constraints or bounds that water users must operate within are defined by a mixture of state law, federal law, interstate agreements, and court decrees. Wyoming water law is the basis upon which existing use, future planning, and investment in the State's most valuable and renewable resource are made. Interstate compacts provide for the distribution and use of the waters of streams or rivers that flow across state lines. There are several compacts and court decrees that affect Wyoming's water supply.

Water environmental laws are another important aspect of water availability. Various programs have been set up to control potential pollution, both for point and non-point sources and for surface water and groundwater.



RESOURCES

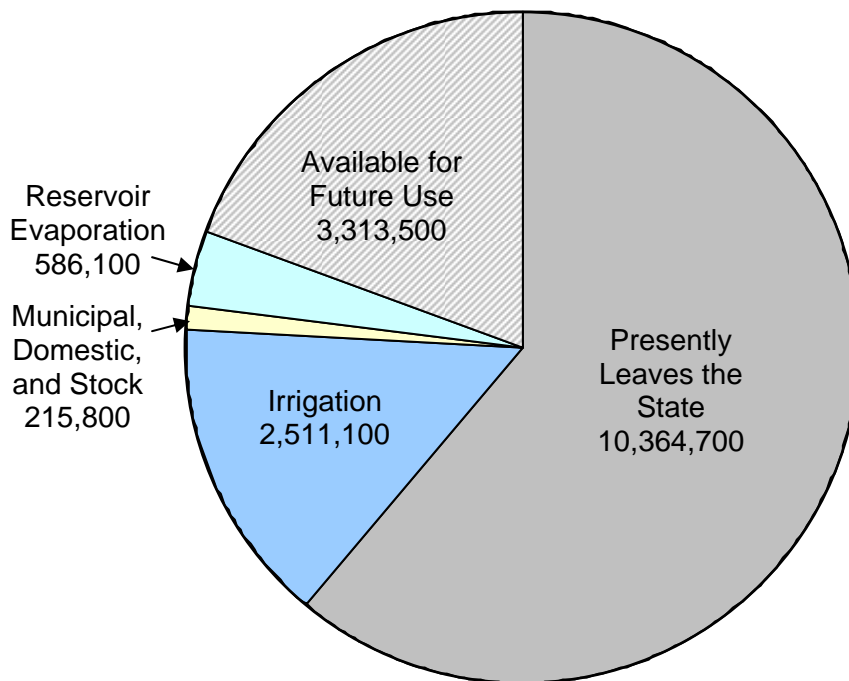
OVERVIEW

Because Wyoming is a headwaters state, precipitation is the source of most of the water. The mean annual statewide precipitation rate is 13.07 inches per year. This equals approximately 68 million acre-feet per year of precipitation, which joins 1.5 million acre-feet of surface inflows to create the total water resource. Most of the precipitation will evaporate from the surface or be taken up and transpired by local vegetation. Precipitation and snowmelt in excess of these immediate demands will either run off, feeding rivers, streams, and lakes, or infiltrate to become groundwater. Approximately 15 million acre-feet per year of water become either surface water or groundwater and thus available for use. This estimate is made up of the water that flows into the state plus the precipitation that runs off as streamflow or infiltrates as groundwater.

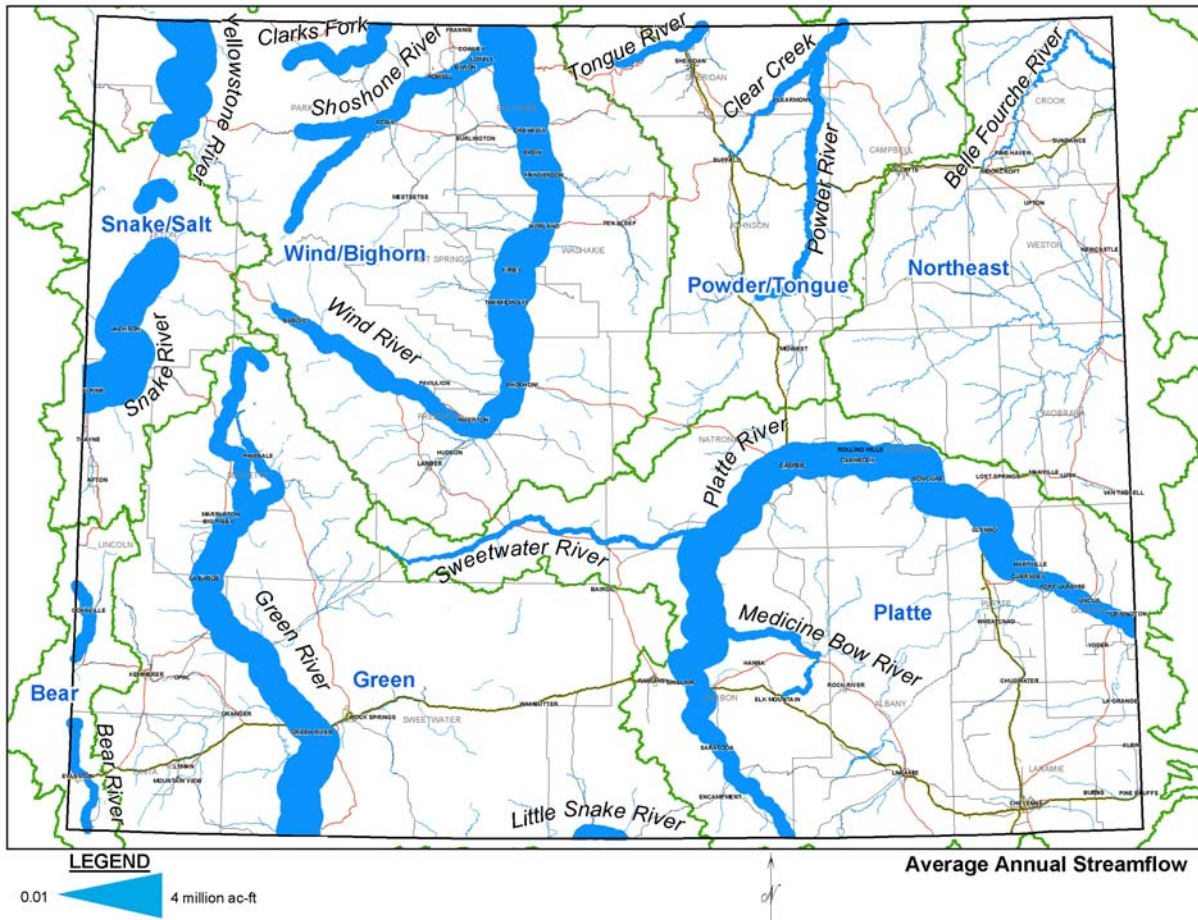
SURFACE WATER

An estimate of the surface water volume in the state can be made by adding the quantity of surface water leaving the state to estimates of surface water depletions. The estimates of water leaving the state come directly from gaging station records. The estimates for surface water depletions come from data in the seven basin plans. Approximately 17 million acre-feet run into Wyoming or are produced within the state based on the normal yield scenario. Water flowing out of Wyoming was estimated to be 13,678,200 acre-feet. Wyoming's share of this supply under the existing compacts is estimated to be 3,313,500 acre-feet leaving 10,364,700 acre-feet flowing to down stream out of state uses.

Surface Water Resources (ac-ft)



The figure below shows the relative flows of the rivers exiting the state. The figure clearly shows that the water supplies are more abundant in the West and Northwest part of the state.



GROUNDWATER

There are several types of aquifers in the state. The three types of major aquifers are: alluvial, sandstone, and carbonate. Alluvial aquifers can produce well yields of 500-1,000 gallons per minute (gpm), making this the most productive group. Although the sandstone aquifers are classified as a major aquifer, most of the deposits and formations in this group include zones of poor production, due to local clay content or lack of fractures. Carbonate aquifers' productivity is a function of fracturing and solution features. The minor aquifers are typically thinner, less extensive, and/or less productive than the major aquifer groups, with modest yields of less than 50 gpm. Marginal aquifers are capable of yields on the order of 1-5 gpm. Major aquitards are formations that typically produce poorly, with poor water quality.

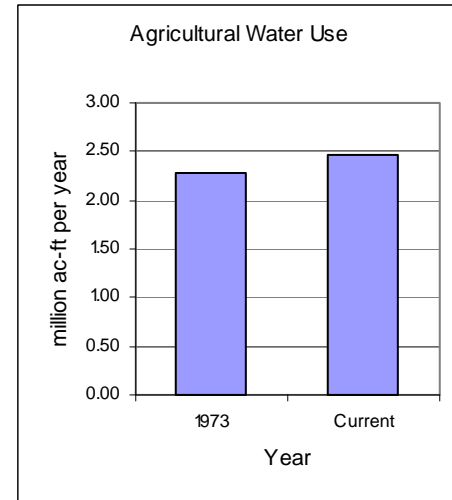
WATER USE

Wyoming's water using sectors are broken out into the agricultural sector, municipal and domestic sector, industrial sector, recreational sector, environmental sector, and reservoir evaporation. Of the sectors, agriculture is by far the largest water consumer. However, municipal and domestic and industry require the highest level of reliability. The following sections are a sector by sector discussion of water use.

AGRICULTURAL

The majority of the appropriated water in the state has been designated for the irrigation of land. The nearly 2 million total irrigated acres is approximately 225,000 acres more than was estimated in 1973 – a 13 percent increase. The increase came from the Northeast Wyoming, Platte, Powder/Tongue, and Wind/Bighorn River Basins, which combined, accounted for approximately 217,000 acres of the total increase. The nearly 2 million irrigated acres consume approximately 2.5 million acre feet of surface water per year.

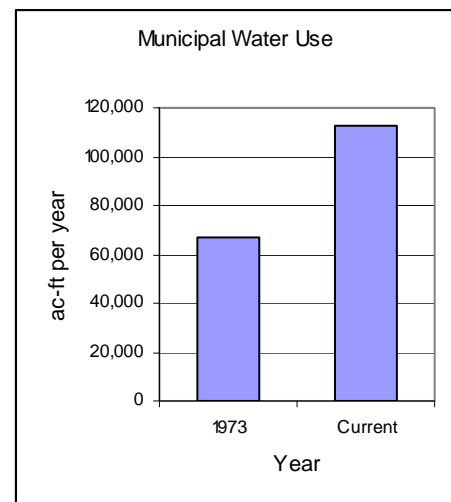
Wyoming's crop production, especially forage crops, is largely connected to the livestock industry. Thus, much of Wyoming's crop water consumption, especially through forage crops, is driven by the need to produce feed for livestock. The annual livestock consumptive use is approximately 19,100 acre feet, which is less than 1 percent of all agricultural water consumption statewide.



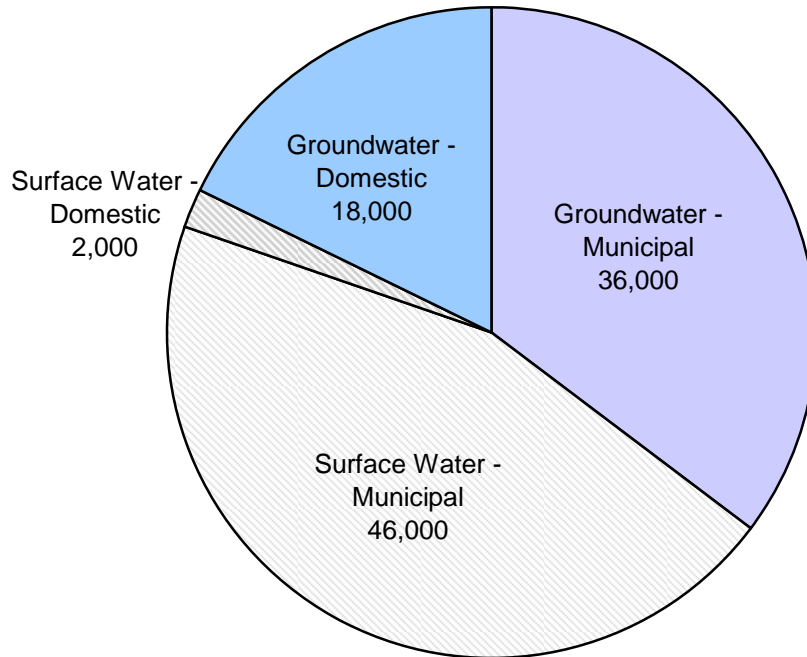
MUNICIPAL AND DOMESTIC

Municipal water uses are those uses satisfied by a public water supply system. Municipal water use is a relatively small but important part of Wyoming's water use. Municipal needs are served by surface water, groundwater, and in some cases, a combination of both surface water and groundwater.

Domestic water uses are uses which are satisfied by individual wells and small water systems. The principal users of non municipal domestic water supplies are rural homes, subdivisions, small trailer courts, commercial establishments, parks, campgrounds, rural schools, domestic uses at coal mines, and other small water uses that are not supplied from a central public water system. These uses are almost exclusively supplied from groundwater. A notable exception is limited irrigation of lawns and gardens from available surface water sources.



Municipal and Domestic Water Use (ac-ft)

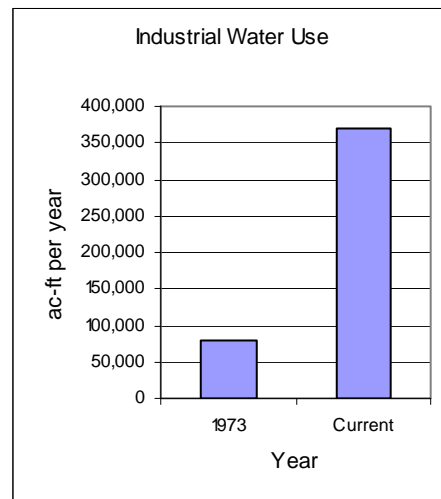


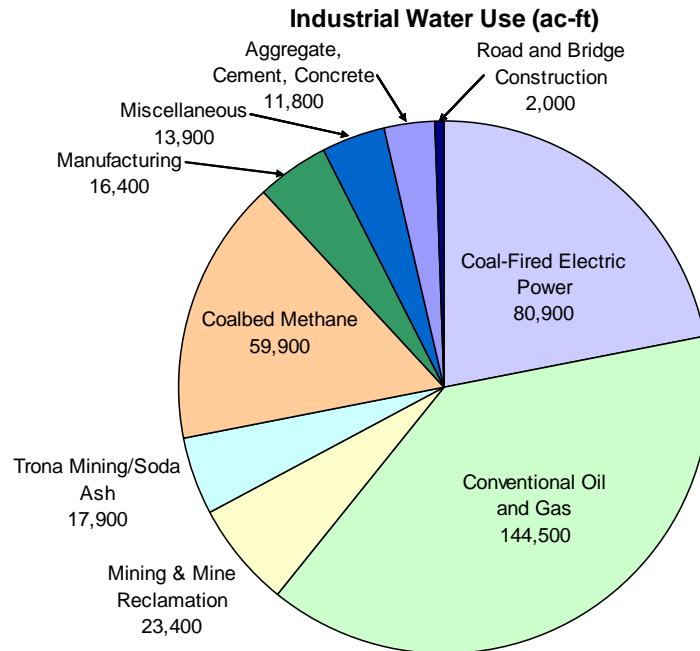
The total municipal and domestic water use for the state is approximately 102,000 acre-feet per year, 48,000 acre-feet of surface water and 54,000 acre-feet of groundwater.

INDUSTRIAL

The industrial water use sector includes electric power generation, coal mining, conventional oil and gas production, uranium mining, trona mining and soda ash production, bentonite mining, gypsum mining, coalbed methane (CBM) production, manufacturing, aggregate, cement, and concrete, and road and bridge construction.

Total current industrial surface water use for Wyoming is estimated to be 125,000 acre-feet per year. Total current industrial groundwater water use is estimated to be 246,000 acre-feet per year.





RECREATIONAL

Recreational uses of water are important and include boating, fishing, swimming, and waterfowl hunting, among others. While consumption of water is usually not involved, the existence of a sufficient water supply for a quality experience is important. The quality and quantity of good recreational opportunities are highly dependent on water quality and quantity. Recreation, including tourism, is one of Wyoming's three major industries. Hunters and anglers alone spent \$700,588,360 in the state in the year 2000.

Two of the recreational uses that consume water are golfing and skiing. The primary consumptive water use for golfing is irrigation of the greens and fairways, while the major consumption for skiing is evaporation during the snowmaking process.

ENVIRONMENTAL

Environmental uses in the state of Wyoming are largely nonconsumptive. Previous studies have estimated the amount of water designated for or consumed by various environmental uses. These include, but are not necessarily limited to, instream flow water rights permitted by the Wyoming State Engineer, minimum reservoir pools, instream flow bypasses designated to enhance fisheries and wildlife habitat, wetlands, direct wildlife consumption, evaporation from conservation pools, and maintenance of riparian areas.

EVAPORATION

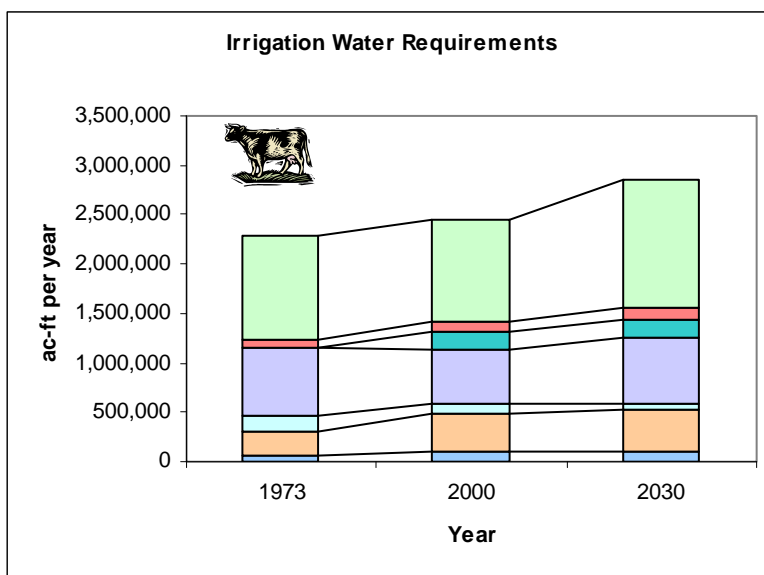
Evaporative loss from reservoirs is a loss or use that is not typically thought of as a consumptive use. The increased surface area of a reservoir provides an ideal condition for evaporation to take place. A similar situation occurs for natural lakes and streams. For the average or normal condition, it was estimated that reservoir evaporative loss amounts to about 370,000 acre-feet per year for the state.

PROJECTIONS

Three alternative planning scenarios were developed for the seven river basin studies: Low, Mid, and High. The Mid Scenario was chosen for the following projections because it represents average growth for the state. The projections were compiled for the following sectors: agriculture, municipal and domestic, industrial, recreation, and environmental. Projections indicate the potential for a considerable increase in water uses in Wyoming in the next 30 years. Total consumptive water uses could increase from approximately 3 million acre-feet per year to approximately 3.3 million acre-feet per year under the mid scenario.

AGRICULTURAL PROJECTIONS

The largest single water use in Wyoming is irrigation. To determine the level of need and demand for irrigation water, all irrigated lands in the seven river basins were mapped as part of the river basin planning efforts. The total projected consumptive irrigation use under the mid scenario is 2,859,000 acre-feet per year. The Wind/Bighorn River Basin has the highest projected new irrigated lands development.

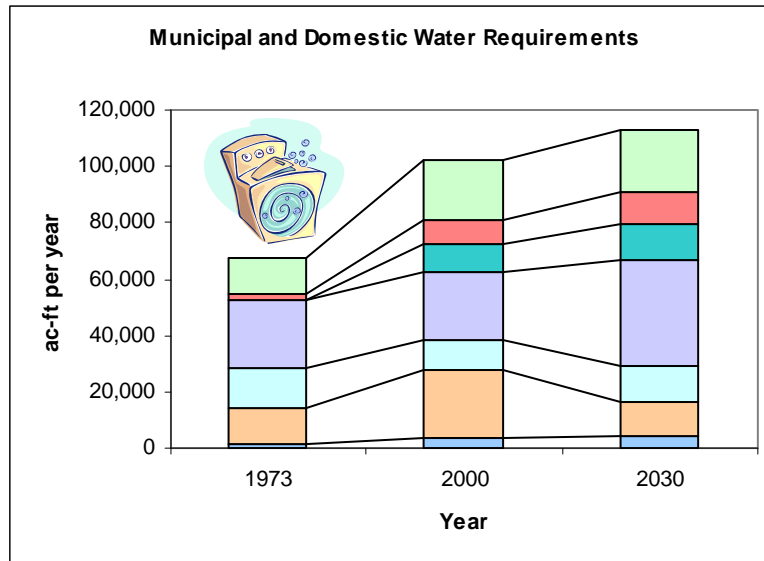


	River Basin	Year		
		1973	2000	2030
	Bear	64,700	94,000	95,000
	Green	242,800	401,000	423,000
	Northeast	159,700	86,000	91,000
	Platte	686,100	550,000	661,000
	Powder/Tongue		184,000	194,000
	Snake/Salt	84,400	102,000	107,000
	Wind/Bighorn	1,041,300	1,039,000	1,306,000

Note: The Powder/Tongue Basin was included in the Northeast Basin for the 1973 Framework Plan.

MUNICIPAL AND DOMESTIC PROJECTIONS

To estimate projected municipal and domestic uses, current per capita use rates for municipal water consumption were applied to population projections for incorporated cities and towns of the state. The total projected municipal and domestic water use under the Mid Scenario is 112,600 acre-feet per year. This includes both surface water and groundwater supplies.

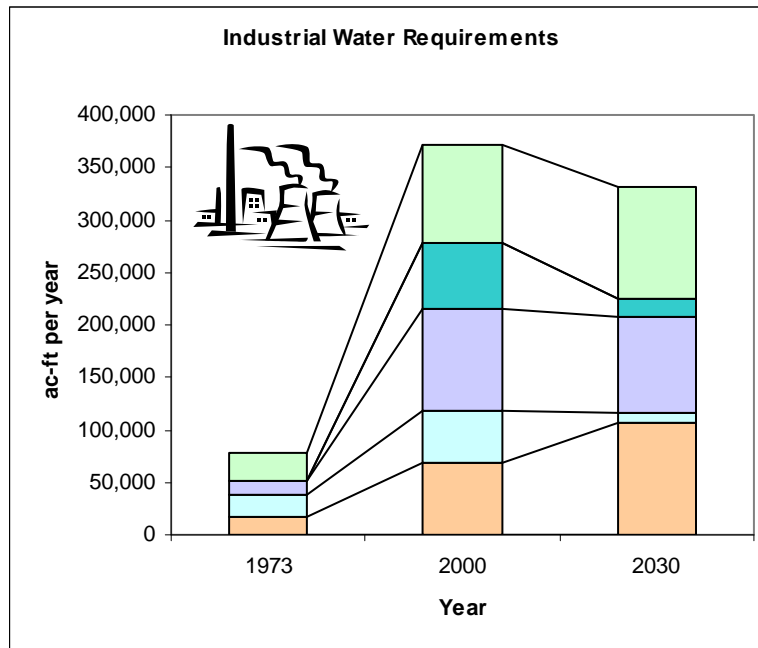


	River Basin	Year		
		1973	2000	2030
	Bear	1,190	3,300	4,500
	Green	13,000	24,600	11,600
	Northeast	14,000	10,100	12,700
	Platte	24,000	24,500	37,900
	Powder/Tongue		9,700	12,500
	Snake/Salt	2,140	9,100	11,500
	Wind/Bighorn	13,000	20,900	21,900

Note: The Powder/Tongue Basin was included in the Northeast Basin for the 1973 Framework Plan.

INDUSTRIAL PROJECTIONS

The industrial water use projections include several types of industries: coal, uranium, and miscellaneous mining; oil production and refining; CBM and natural gas production; coal conversion facilities; soda ash production; and miscellaneous industry. The state is well represented with respect to electric power production and chemical manufacturers (the soda ash, phosphate, and ammonium nitrate industries fall into this group). It appears likely that any new water-intensive industrial developments in the state over the next 30 years will fall into the electric power generation and/or chemical products categories. The other two intensive water use industries, primary metals and paper producers, tend to locate near the source of their largest process inputs – metals and wood respectively. The total projected industrial use under the Mid Scenario is 331,000 acre-feet per year.



	River Basin	Year		
		1973	2000	2030
	Bear	370	390	0
	Green	16,200	67,900	106,400
	Northeast	21,250	49,900	9,100
	Platte	12,823	97,800	92,500
	Powder/Tongue		62,300	17,000
	Snake/Salt	50	140	48
	Wind/Bighorn	27,963	92,200	106,000

Note: The Powder/Tongue Basin was included in the Northeast Basin for the 1973 Framework Plan.

RECREATIONAL PROJECTIONS

Future demands for recreational water resources in Wyoming depend upon numerous factors, including population growth, tourism growth, and participation rates in various water-based recreational activities. The projections are based upon the assumption that recreational demands are proportional to growth in population and tourism in the respective basin. Boating, water-skiing, swimming, camping, fishing, and hunting could approach the limits of presently available water-based recreational capacities in some areas of the state in the next 30 years.

ENVIRONMENTAL PROJECTIONS

Unlike recreational water requirements, environmental water requirements are not necessarily related to changes in population or tourism. Instead, environmental water requirements are at least partially a function of human desires concerning the type of environment in which people want to live. These desires are expressed in many ways, including environmental programs and regulations promulgated by elected representatives at the state and federal levels. Thus, future environmental water requirements will be determined, at least partially, by existing and new legislation dealing with environmental issues at the state and federal levels, and how that legislation is implemented by federal and state agencies.

AVAILABILITY

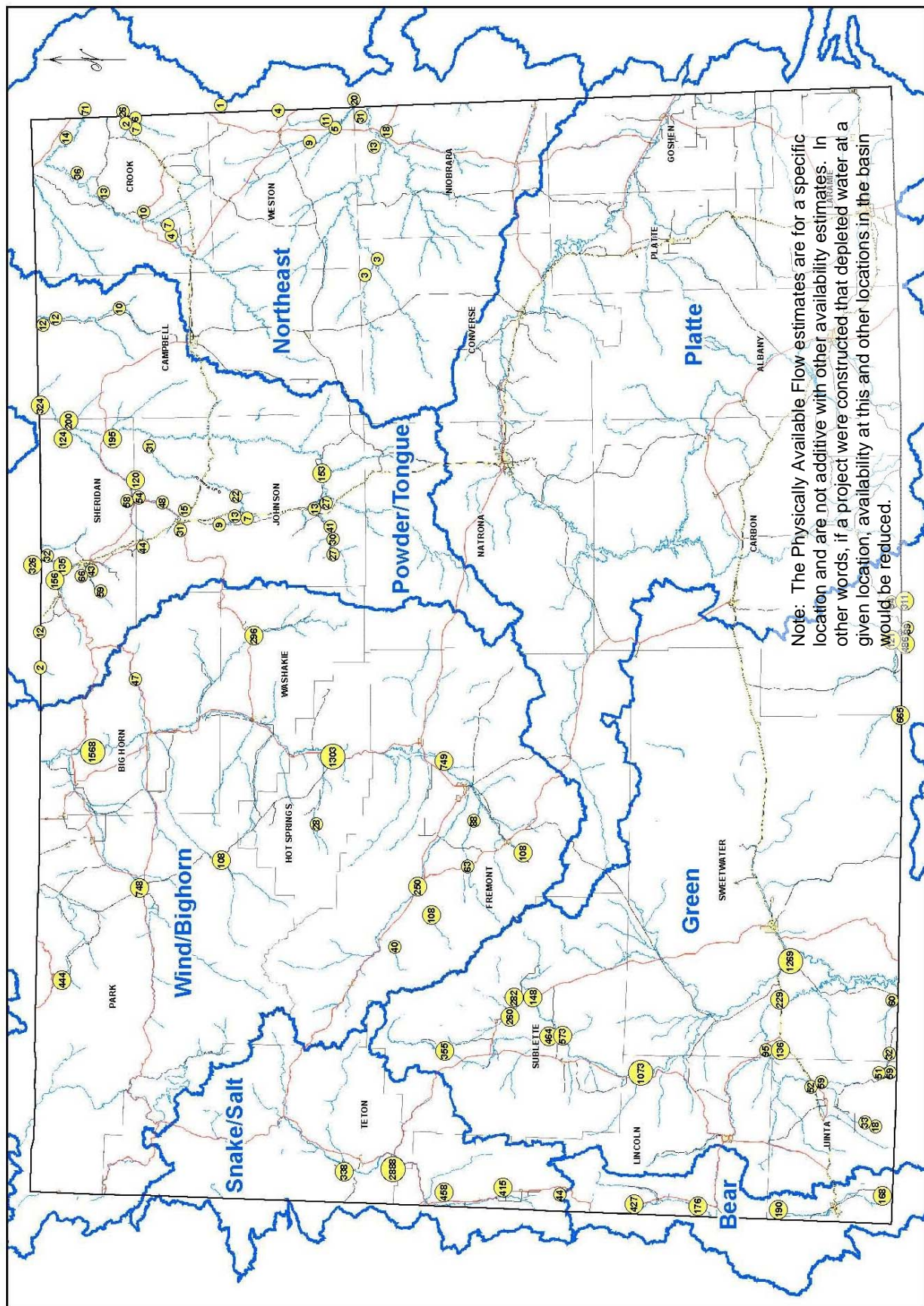
Water is available to meet the state's demands from surface water supplies allocated to Wyoming. In addition, there are groundwater supplies, which are difficult to quantify. Surface water physical availability is defined as water that is physically present at various locations, minus existing uses. Groundwater availability is a function of hydrogeologic conditions and current use as described in existing reports and records.

SURFACE WATER

Spreadsheet-based surface water models were developed in six of the seven basin plans to estimate physically available water. The Platte River Basin was not modeled because it is a fully appropriated basin. A fully appropriated basin is one in which water rights with a current day priority can not be expected to provide a reliable supply. It should be noted that the results described herein denote physical availability over and above existing uses, which is to be distinguished from legal or permitted availability. As projects are proposed in the future, surface water physical availability will be reduced due to environmental and administrative requirements. However, physical availability is the important first step in assessing the viability of any future project. Lack of physical availability of water for a project is an obvious fatal flaw for any water development. The Available Flows figure shows the results of the models for the normal condition. Additional information for the wet and dry scenarios can be found in Chapter 7 of the Wyoming Framework Water Plan, Volume I.

GROUNDWATER

The availability of groundwater is a function of the physical characteristics of the aquifer at the location of interest and the value of the intended use. For example, an industrial use may be able to afford to drill deep wells, sustain large drawdowns, and treat groundwater of undesirable quality, whereas an irrigation use may only be economical where wells are shallow, production is high, and quality is adequate without treatment. In virtually all cases, development of groundwater in sufficient quantities and of sufficient quality to meet specific project goals will require site-specific hydrogeologic analyses.



LEGEND

- 50 Physically Available Flow (Thousand Ac-Ft)

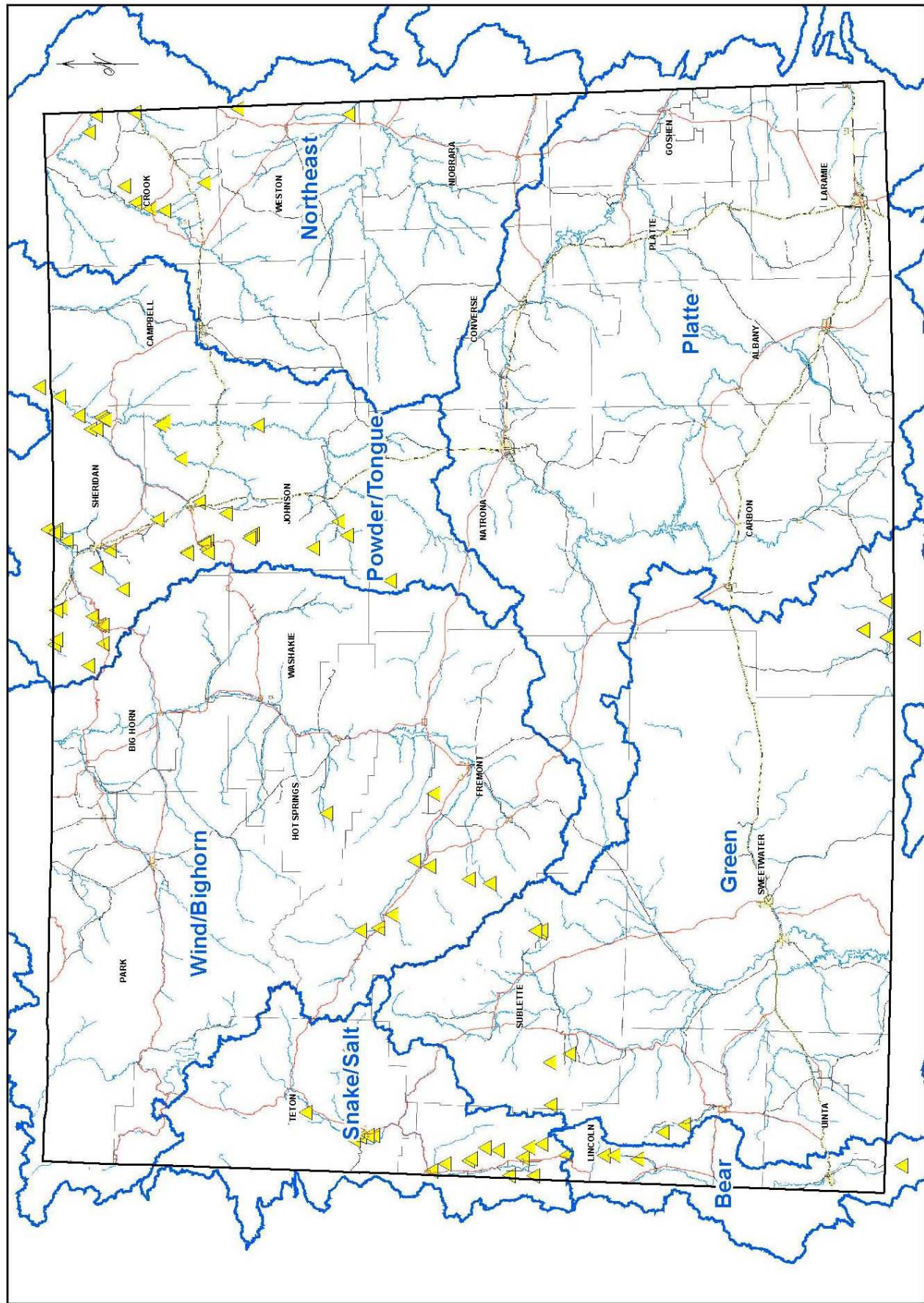
Available Flows - Normal Condition

The Platte River Basin is fully appropriated in that a water supply that is based on a water right with a current-day priority can not be expected to provide a reliable supply due to water rights administration.

OPPORTUNITIES

Surface water supplies have been reserved for Wyoming by interstate stream compacts and court decrees. The largest amounts of water allocated to Wyoming are in the Bighorn, Clarks Fork, Tongue, and Powder Rivers (tributaries of the Yellowstone River) and in the Green River (tributary of the Colorado River). Other compacts involve the Snake, Belle Fourche, Bear, and Upper Niobrara Rivers. Sufficient water has been reserved for future Wyoming water uses to increase streamflow depletions to an estimated average of 3,313,500 acre-feet per year.

The Wyoming Framework Water Plan identifies a large number of alternative potential projects to provide water for current shortages and future uses. The Potential Reservoir Sites figure shows the locations of future water use opportunities in the state. More information on these sites can be found in Chapter 8 of the Wyoming Framework Water Plan, Volume I



LEGEND

-  Future Water Use Opportunity Sites

Potential Reservoir Sites

The Platte River Basin is fully appropriated, and therefore there are no future water use opportunities.

VOLUME II

Volume II offers planning and management direction that is the result of synthesizing a body of ideas from the following sources:

- Ideas, opinions, and issues collected from water users through the Basin Advisory Group (BAG) meeting process.
- Results of a three-tiered planning survey, which included an e-mail survey, conversation with water managers, and a facilitated agency leaders meeting.
- Results of a survey on the planning processes of several other western states.
- Observations on the existing planning process noted by the consulting team during the assembly of Volume I.
- Ideas and opinions of state agency staff that were tasked with providing input and direction to this project (WWDC, State Engineer's Office, and Water Resources Data System).

Volume II presents recommendations related to the structure and content of future basin and framework plans and offers recommendations for the general planning and management direction of the State.