Wyoming Water Planning Program
Report No. 9

WATER & RELATED LAND RESOURCES
OF THE
PLATTE RIVER BASIN, WYOMING

September 1971

STUDY AREA
SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

This is a summary of the report prepared as a step in developing a "State Water Plan," authorized by an act of the Wyoming Legislature in 1967. The program is partially funded by the National Water Resources Council under Title III of the Water Resources Planning Act of 1965. Copies of the entire report can be obtained from the Wyoming Water Planning Program, 2001 Central Avenue, Cheyenne, Wyoming, 82001.
WATER & RELATED LAND RESOURCES OF THE PLATTE RIVER BASIN, WYOMING

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

SUMMARY

The Platte River Basin, in the southeastern quarter of Wyoming, is a mountains and plains region of varying climate. Included in the area of study are the North Platte, South Platte, and Niobrara River Basins. Most of the plains receive 9 to 16 inches of precipitation, while the mountains receive 20 to 40 inches annually. The annual snowfall is 35 to 65 inches over the plains and much more over the mountains. Figure V-1 shows the area and the potential water development alternatives in the Basin.

The streams with dependable water supplies rise in the mountains and derive most of the annual runoff from the spring and early summer snowmelt. Water demands by crops are greatest in July and August, and storage is required to provide irrigation water for the late growing season. The estimated streamflow originating in the Platte River Basin in Wyoming under natural conditions is about 1,240,000 acre-feet per year. Adding the measured inflow to the State, the undepleted streamflow that would be leaving the State under natural conditions is estimated to be about 1,770,000 acre-feet per year. On the average, 580,150 acre-feet of surface water are consumed by irrigation, 9,760 acre-feet by industry, 8,720 acre-feet by municipal and domestic uses, and 179,560 acre-feet by evaporation. The depleted streamflow leaving Wyoming in Platte River streams and the canals of the North Platte Project is about 992,000 acre-feet per year.

Flood damage is not a major problem in the Basin, with certain exceptions. A major flood on the North Platte could cause damages in Casper, Douglas, and Torrington. Along tributaries agricultural developments, towns, highways, and railroad crossings have experienced flood damage. That part of Goshen County crossed by the Interstate and Fort Laramie Canals is susceptible to damage by flash floods from the small drainages that cross the area.

The quality of interstate waters in the Basin generally is within the limits of established standards. Municipal and industrial waste water sources present little or no problem to water quality in the Basin. Irrigation return flows may in some areas carry significant amounts of dissolved solids into receiving streams, but no practical problems of
significance are being caused by these return flows. Other agricultural enterprises presently have a minor effect on water quality.

Water rights are based on the law of appropriation and "first in time is first in right." Priority of appropriation is based upon the date on which the application for permit was accepted in the State Engineer's Office. An application for a permit must be submitted to the State Engineer for approval before water uses are made.

The total of lands with adjudicated rights or permits in good standing in the Basin is about 1,180,000 acres. The total of actually irrigated lands identified by field examination in 1969 is 552,760 acres. The excess of water rights over actually irrigated lands presents a special problem in the North Platte River drainage area, where irrigation is limited by a U. S. Supreme Court decree.

Appropriations of water for irrigation began in the 1860's, and the dependable water supplies in the Laramie River were appropriated by 1910 and in the North Platte River by 1930. Interstate disputes over regulation of these streams were litigated in the U. S. Supreme Court.

Under the Laramie River Decree, the State of Colorado can divert from the Laramie River and its tributaries 49,375 acre-feet of water each calendar year for use in Colorado, of which 19,875 acre-feet per year may be diverted out-of-basin. The return flow and remaining river water are allocated to Wyoming.

The North Platte River Decree limits irrigation in the State of Wyoming on the main stem of the North Platte River above Guernsey Reservoir and the North Platte tributaries above Pathfinder Dam to 168,000 acres of land, exclusive of the Kendrick Project. Exclusive of Seminoe Reservoir, not more than 18,000 acre-feet of irrigation water may be stored in Wyoming on the North Platte River or its tributaries above Pathfinder Reservoir in any water year. The natural flow of the North Platte River from Guernsey Dam to the Tri-State Dam (1 mile beyond the State line in Nebraska) is divided 25 percent to Wyoming and 75 percent to Nebraska. Glendo Reservoir has a right to store, in addition to evaporation, 40,000 acre-feet of the natural flow of the North Platte River and its tributaries below Pathfinder Dam. Of this storage, 15,000 acre-feet are for irrigation in Wyoming below Guernsey Dam, and 25,000 acre-feet are for irrigation in Nebraska. The storage in Glendo Reservoir, including carry-over, may not exceed 100,000 acre-feet.

The North Platte River Decree provides that "ordinary and usual domestic, municipal, and stock water" uses and consumption are not affected or restricted by the orders in the
FIGURE V-1
POTENTIAL WATER PROJECTS AND ALTERNATIVE RESOURCE DEVELOPMENTS

Potential Dam and Reservoir Sites
1. Bates Creek
2. Deer Creek
3. Box Elder Creek
4. Wagonhound Creek
5. LaBonte Creek
6. Horseshoe Creek
7. Grayrocks Reservoir
8. Corn Creek Reservoir
9. McIntosh Reservoir
10. Rawlins Reservoir
11. Seminole Enlargement

Potential Transbasin Diversion Alternatives
FROM GRAND RIVER BASIN

Potential Groundwater Developments

Area of greatest potential irrigation development
Potential municipal and industrial groundwater development

Identified Blocks of Potentially Irrigable Lands
Numbers in block refer to the location of the blocks of irrigable lands as indicated in table V-1.
decree. Questions to be considered are: What is "ordinary" municipal use? Is it unlimited?

The Upper Niobrara River Compact is an agreement between Wyoming and Nebraska for the regulation of Niobrara River water west of Range 55 West (6th P.M.). The compact limits the storage and storage season for large reservoirs and limits the size of stock water ponds. The apportionment of groundwater was delayed until adequate information about groundwater becomes available.

About 2,000,000 acre-feet of surface water, including reuse of return flows, are diverted annually for irrigation. Under present water uses and constraints, the surface water resources of the Basin are nearly fully utilized, although limited water developments are possible on North Platte River tributaries below Pathfinder Dam.

Groundwater is available at depths less than 500 feet. The most significant aquifers are found in rocks of Quaternary and Tertiary ages. Major sources of groundwater are alluvium and terrace deposits and consolidated sandstones. The availability of groundwater is influenced by quality as well as quantity. Groundwater is classified by the amount of total dissolved solids in parts per million, by hardness (as calcium carbonate) in parts per million, and by its salinity and sodium hazard if it is to be used as irrigation water. Radioactive elements are not common as mineral constituents of groundwater, but the presence of mineable uraniferous ore bodies creates the possibility of these elements being found in underground waters.

The Ogallala formation provides water satisfactory for most domestic and stock uses; the Arikaree appears to have the best overall quality. The quality of water in the White River locally is below acceptable standards for domestic use. Water in the Fort Union may be limited in use-capability due to high iron, sulfate, and dissolved solids content. Water quality in pre-Tertiary aquifers is highly variable; generally, quality is better near outcrop areas and deteriorates towards the interiors of the geological basins.

Groundwater is used extensively in the Basin as domestic, stock, municipal, industrial, and irrigation water. The largest use is irrigation, which accounts for the consumption of more groundwater in the Basin than all other uses combined. By the end of 1970 there were about 1,000 irrigation wells in the Basin providing an original water supply to approximately 68,500 permit acres, based on information submitted to the State Engineer's Office. From random sampling, it is estimated that in many instances lands actually irrigated are about 75 percent of the reported amounts. Based on this estimate, groundwater is the original supply for between 51,000 and 68,500 acres. A very large percentage of the total amount of
irrigated lands using groundwater as the original supply is in Goshen and Laramie Counties. The total estimated amount of groundwater consumed annually as the original supply by irrigation is approximately 71,000 to 95,000 acre-feet. Another 35,000 acre-feet are consumed as a supplemental supply for approximately 70,000 acres.

On the basis of economic projections and a sampling of well completion statements, it is estimated that by the year 2020 as many as 130,000 acres of land in the Basin may be irrigated using groundwater as the original source of supply. Another 175,000 acres may be using groundwater as a supplemental supply. The estimated total amount of groundwater projected to be consumed in the Basin during the period 2000-2020 is 300,000 to 350,000 acre-feet annually.

AGRICULTURE

The agricultural enterprises of greatest potential for future expansion are livestock production and the feed grains and forage crops needed to support the livestock industry. To maintain Wyoming's share of national production of beef, lamb, and mutton will require some additional irrigated land along with increased productivity per acre. Dry cropland is the major source of land for new irrigation developments which will utilize groundwater as a source of supply.

COAL

The projected growth of the coal industry in the Basin, as stated in a study by Cameron Engineers, will show a sevenfold increase in employment by the year 2000 and nearly a ninefold increase by 2020. Capital investment will increase about 10 times by the year 2000 and 15 times by 2020. The present consumptive use of water by this industry (5,000 acre-feet per year) is forecast to increase to 65,000 acre-feet per year by 2000 and to 80,000 acre-feet per year by 2020.

OIL AND GAS

The oil and gas industry provides a significant payroll in Wyoming and provides a major tax base for the State. The industry has an apparently finite limit of resources and may pass out of existence. In 1967 the industry consumed 6,050 acre-feet of water.

URANIUM, CEMENT, IRON ORE, TIMBER

The Basin has been prominent in the development of Wyoming's uranium industry. Uranium ore is produced in the Crooks Gap area in the Sweetwater River drainage and in the Shirley Basin. Groundwater presently supplies all the uranium mills. The cement and iron ore industries use water from both surface and underground sources. The timber industry may consume small quantities of water in the future.

MUNICIPAL, DOMESTIC, AND STOCK WATER

The present population served by municipal water systems is 138,531 people. Municipal and domestic water diversions are presently about 34,200 acre-feet per year, about one-half of which is consumptively used. The City of Cheyenne imports water from the Colorado River Basin, making the present municipal and domestic depletion from Platte River sources 13,100
acre-feet per year. The present annual stock water consumption is approximately 10,500 acre-feet. The projection for the year 2020 estimates a total annual consumption by municipal, domestic, and stock uses of approximately 48,000 acre-feet, compared to approximately 24,000 acre-feet in 1970.

Outdoor recreation is of increasing importance in the Basin. Fishing pressure in the Basin is relatively heavy, but sufficient capacity exists to provide for the estimated pressure for at least the next 50 years. The total annual hunting capacity is estimated to be more than 263,000 hunter-days. The Basin offers many opportunities for water sports and boating. The present consumptive uses assigned directly to recreation and fish and wildlife activities are small. Future increases of recreation water demand will be met primarily in conjunction with providing water for other purposes.

Electrical energy requirements are supplied by interconnected power systems with part of the power generated by six Federally operated hydroelectric plants on the North Platte River and the remainder by Pacific Power and Light Company's coal-fired Dave Johnston plant. The combined generating capacity of the six hydroplants is 181,200 kilowatts. The Dave Johnston plant has an installed capacity of 420,000 kilowatts; another 330,000-kilowatt unit is under construction. In the future, pumped-storage hydropower developments may complement coal-fired steam-electric powerplants developed in the Basin.

Flood damage is not a major problem in Wyoming's Platte River Basin. There is a large amount of storage control on the North Platte River, but only Glendo Reservoir has a specific storage allocation for flood control. The Corps of Engineers has recommended that additional flood control space be provided on the North Platte River above Glendo Reservoir. Some tributaries of the North Platte River, principally those entering the river below Alcova Dam, have a history of causing flood damages. Considerations for flood control should be included in any future projects on these streams.

A summary of present and projected consumptive uses of Platte River Basin surface water and groundwater is as follows:

<table>
<thead>
<tr>
<th>Water Uses</th>
<th>1,000 Acre-Feet Per Year</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Present</td>
</tr>
<tr>
<td>Irrigation</td>
<td>651</td>
</tr>
<tr>
<td>Industry</td>
<td>13</td>
</tr>
<tr>
<td>Municipal, Domestic, and Stock</td>
<td>24</td>
</tr>
<tr>
<td>Total</td>
<td>688</td>
</tr>
</tbody>
</table>

Reservoir and stock pond evaporation presently consumes an additional 180,000 acre-feet per year.
Water supplies to meet the projected future water needs of the Basin will be developed from groundwater and surface water resources in the Basin and from transbasin diversions of water from other river basins. The increased use of irrigation water will be for the development of 106,240 acres of new irrigated land, 84,240 acres of which will use groundwater. Future water needs of the uranium industry have been projected to be met with groundwater resources. Coal developments near the Dave Johnston steam-electric plant and in the Hanna district are projected to require an additional 75,000 acre-feet of water by the year 2020.

Surface water supplies available for development are limited. Groundwater will become increasingly important as water supply. Improved efficiency in existing water uses will provide water for additional uses. Change of use of irrigation water rights might provide water for industry. Weather modification may artificially augment streamflows in the future, but amounts of water and uses are not now predictable because such operations are in the process of research and development. Water could be imported into the Platte River Basin from either the Green River Basin or the Bighorn River Basin, or from both.

The potentials for developing surface water supplies to improve existing water uses and future water needs were identified. Storage project potentials include several sites in the North Platte River Decree area above Pathfinder Reservoir and sites on Bates Creek, Deer Creek, Box Elder Creek, LaPrele Creek, Wagonhound and LaBonte Creeks, Horseshoe Creek, Laramie and North Laramie Rivers, and Seminoe Reservoir Enlargement (see Figure V-1). Where desired and feasible, water supply improvements may be possible on other streams that are overappropriated. Modification of the U. S. Supreme Court decree on the North Platte River could enhance irrigation in Wyoming. A modification might enable more storage in Wyoming above Pathfinder Reservoir and additional irrigated acreage. Other potential surface water projects include the use of Glendo inundated water rights and the Corn Creek Project. These projects could provide water supplies for irrigation, municipal, industrial, recreation, and fish and wildlife purposes. Flood control and water quality management could also be included as project functions.

A considerable potential for developing groundwater supplies for irrigation exists in Laramie, Platte, Goshen, and Niobrara Counties in southeastern Wyoming. Other parts of the Basin also have a potential but not to the extent probable in southeastern Wyoming. The annual groundwater withdrawals for irrigated lands will increase from the estimated present pumpage of approximately 150,000 acre-feet to 395,000 acre-feet per year. Groundwater may be developed for large-scale M & I uses. Two aquifers where a potential for such development exists are the Arikaree formation in the Sweetwater
River drainage and the Battle Spring formation in the Great Divide Basin. Such developments will deplete the aquifers in time, and the water uses dependent upon the groundwater will have to be curtailed or replaced with other water supplies.

Surplus water from the Bighorn River Basin or the Green River Basin could be imported into the Platte River Basin to meet future M & I water needs. The Bighorn River is subject to the terms of the Yellowstone River Compact, and diversion of water from the Yellowstone River tributaries into the Platte River Basin requires approval of the States of Montana and North Dakota. No approvals are required to utilize Green River water in the Platte River Basin. It appears that the future M & I water needs of the Platte River Basin could be met with a transbasin diversion from the Green River. Such a diversion could be stage-developed and could provide water supplies for Green River Basin uses as well as for Platte River Basin uses. Although the cost of imported water in the Platte River Basin appears to preclude irrigation use, irrigation might be developed on an interim basis, or as a result of stage development.

Three alternative approaches for the future water resource development in the Basin are:

1. No development — it is assumed that "no development" means no dams or other major facilities would be constructed to develop water supplies for new uses. Unless economic development were suppressed, however, M & I water needs could be met from transfers of water uses from irrigation to M & I. This alternative requires consideration and approval by the State Engineer, Board of Control, and, perhaps, the courts of the State. The ability of the State to participate in or influence future water development could be restricted. M & I growth would occur at the expense of agriculture.

2. Development of Basin water resources only — requires construction of many of the projects previously mentioned and utilization of groundwater resources. Depletion of groundwater may result in a curtailment of the use or in a requirement to replace the water supply by transfer of water rights or water importation.

3. Importation of water into the Basin — could meet future M & I water requirements and put to use a portion of Wyoming's unused compact allocation of water of the Green River. Alternative 3 meets the directive of the legislature to make maximum use of Wyoming's allocated water resources.

The environmental impacts of the water resource development alternatives described in this report could be both beneficial and adverse. Each proposed development should be examined closely to determine its effect on the environment.
Proponents of both economic development and environmental protection should cooperate to insure that (1) developments do not occur which will cause undue environmental damage, and (2) developments which do occur cause maximum enhancement (or minimum damage) to the natural environment. In all cases, water resource developments must comply with Wyoming's water quality standards and regulations.

Very preliminary cost estimates of potential water developments were made for comparative purposes. The capital costs of providing supplemental water for irrigation were found to be in the same range as the cost for new land developments, ranging from $100 to $300 per acre. Construction and repayment costs were estimated for delivering M & I water into the North Platte River. The costs of M & I water in Alternative 1 are largely secondary costs and the cost of water rights purchases. These were not estimated. Comparative estimates of the annual costs for Alternatives 2 and 3 include the costs of repayment of capital plus interest, operation, and maintenance. It was assumed for Alternative 2 that water rights and right-of-way problems could be resolved to enable construction of reservoirs on Deer, LaBonte, and Wagonhound Creeks, and that groundwater resources would support an economical development before being depleted. It was also assumed that supplemental water would be provided in reservoir projects for the existing irrigated lands which could be served by the reservoirs. The estimated annual repayment cost per acre-foot of M & I water in Alternative 2 is $22 to $32, depending upon which aquifer is used as a source of groundwater. Alternative 3 cost was based on supplying M & I water from the potential Lower Green River Reservoir through a pipeline into the North Platte River. The estimated annual cost per acre-foot for this water is $76.
CONCLUSIONS

1. Economic expansion will occur in Wyoming's Platte River Basin in the future. Development of water supplies is required for this expansion.

2. If Wyoming is to maintain its national position in livestock production, additional irrigated land will have to be brought into production. The Platte River Basin has the potential for expansion of irrigation through its suitable climate and soils, but water is a limiting factor. Surface water development potentials for irrigation are limited because of the North Platte River Decree and full utilization of available water in many areas. Groundwater resources can provide for expanded irrigation, but continuing groundwater investigations are needed to provide proper management of groundwater.

3. M & I water supplies can be obtained from four sources: (1) change of use of water rights; (2) surface water developments on North Platte River tributaries not affected by the decree; (3) groundwater; and (4) imported water. Large-scale groundwater developments for M & I water supplies will result in depletion of the water supplies. If economic projections are valid, water will ultimately have to be imported into the Basin.

4. The benefits associated with potential projects and alternatives of development are variable and depend upon desires for flood control, irrigation water, M & I water, recreation, and other purposes.

5. Comparison of alternatives on the basis of estimated water costs alone may not indicate the best future course for water utilization. Other considerations should include: (1) the desirability of a decline in irrigated agriculture, as indicated in Alternative 1; (2) the desirability of mining groundwater resources when unused renewable surface water resources are available; (3) the desirability of putting to use water resources which are presently unused and in the future may not be available to Wyoming because of becoming committed to downstream uses.

6. Importation of water into the Platte River Basin from the Green River (Alternative 3) would meet the directives from the Wyoming Legislature to "make maximum practical, beneficial, and multiple use" of Wyoming's water. If transbasin diversion into the North Platte River is to be undertaken, detailed planning is required to determine the best plan for stage development to meet future water needs.

7. Water resource development will have beneficial and adverse impacts on the environment. Proper project planning can result in maximizing beneficial impacts while minimizing adverse impacts.
RECOMMENDATIONS

1. In formulating a State Water Plan, water needs of the Platte River Basin should be considered in conjunction with the water needs of the State of Wyoming.

2. Public opinion should be ascertained regarding the desired levels of development in the Platte River Basin, the economic impact of the alternatives, and the best alternative(s) to follow.

3. Detailed feasibility studies of the desired project-components of the alternatives should be undertaken to evaluate engineering and economic factors such as direct and indirect project benefits, construction costs, and recreational and environmental values.

4. Sources of financing, such as Federal funds, State loans and bonds, and others, should be reviewed. State laws should be reviewed to determine what legislation would be desirable and necessary for State financing of water development projects.

5. The best plan should be determined from public opinion, feasibility studies, and financial considerations.

6. Short-range and long-range goals should be established and implementation procedures outlined.

7. The type of State or other organization required to administer the construction of water development projects should be determined and established.

8. Soil and water conservation practices in the Basin should be promoted and implemented through programs of the U. S. Department of Agriculture and others. The possibilities of improving water supplies by watershed management, water management, and flood control measures should be investigated.