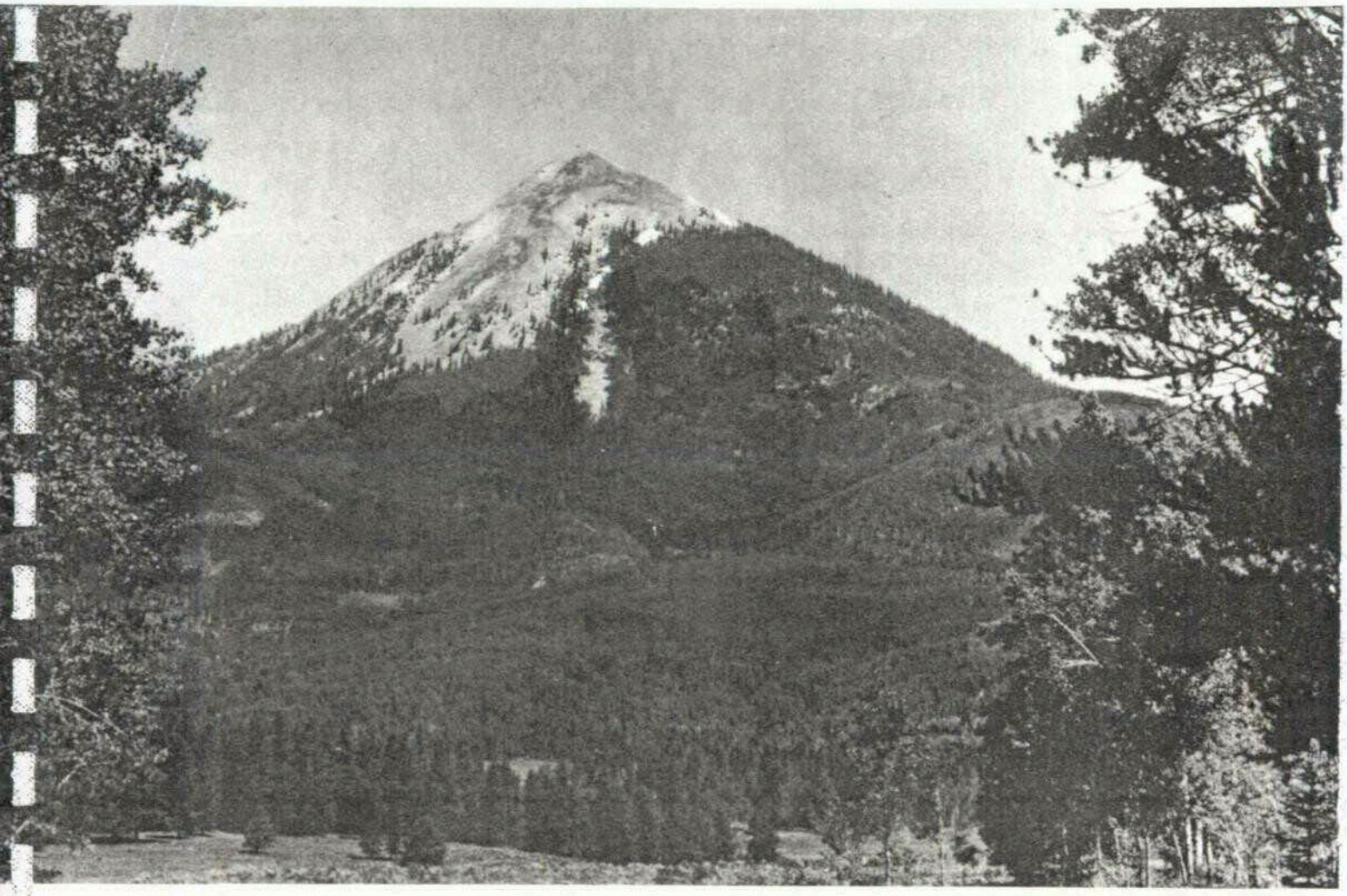
WATER AND RELATED LAND RESOURCES

YAMPA RIVER BASIN
COLORADO AND WYOMING



HAHNS PEAK

A Report Based on a Cooperative Study by

COLORADO WATER CONSERVATION BOARD

and

UNITED STATES DEPARTMENT OF AGRICULTURE

ECONOMIC RESEARCH SERVICE - FOREST SERVICE - SOIL CONSERVATION SERVICE

002910

JOHN A. LOVE, Governor

COLORADO WATER CONSERVATION BOARD

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March 21, 1969

Honorable John A. Love,
Governor, State of Colorado
State Capitol Building
Denver, Colorado 80202

Dear Governor Love:

The attached cooperative report prepared by the Colorado Water Conservation Board and United States Department of Agriculture presents information regarding opportunities for watershed protection, flood prevention and water resource development of the Yampa River Basin in Colorado and Wyoming.

This cooperative survey was undertaken in response to a request from the Colorado Water Conservation Board dated March 14, 1963, for cooperation by the Department of Agriculture in such a survey. The Department's part of the cooperative survey included the development and presentation in cooperation with the Colorado Water Conservation Board of the material contained in this report.

Department of Agriculture participation in the survey was under the provisions of Section 6 of Public Law 566, 83rd Congress, as amended, which authorized the Department to cooperate with other Federal, State, and local agencies in making investigations and surveys of the watersheds of rivers as a basis for the development of coordinated programs.

This investigation and survey has been coordinated with the study and reports of the Colorado Water Conservation Board relating to the various tributaries of the Colorado River Basin of western Colorado. It also presents information obtained from cooperative investigations by the Economic Research Service, Forest Service, and Soil Conservation Service of the Department of Agriculture.

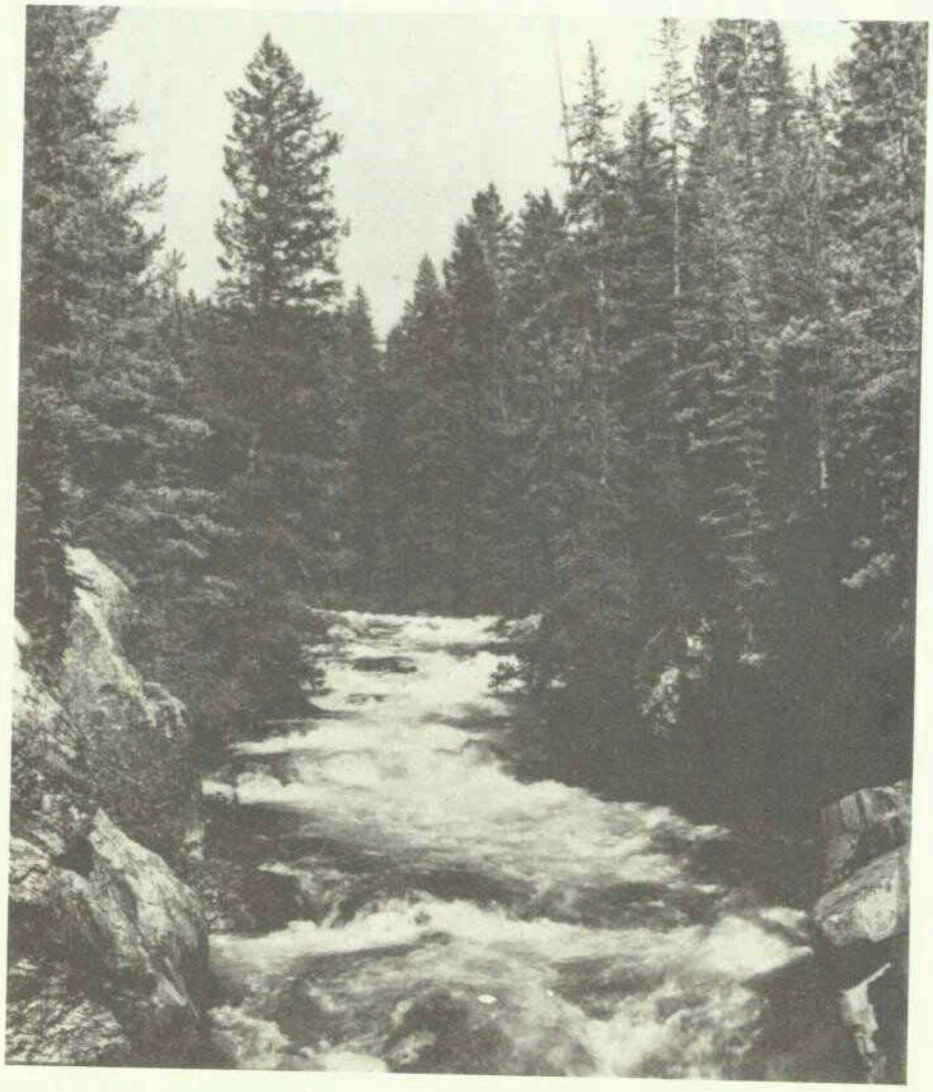
Respectfully yours,

Felix L. Sparks

FELIX L. SPARKS
Director

FLS:ac
Enclosure

WATER AND RELATED LAND RESOURCES
YAMPA RIVER BASIN
COLORADO AND WYOMING



ELK RIVER, TRIBUTARY TO THE YAMPA RIVER

A Report Based on a Cooperative Study by

COLORADO WATER CONSERVATION BOARD

and

UNITED STATES DEPARTMENT OF AGRICULTURE

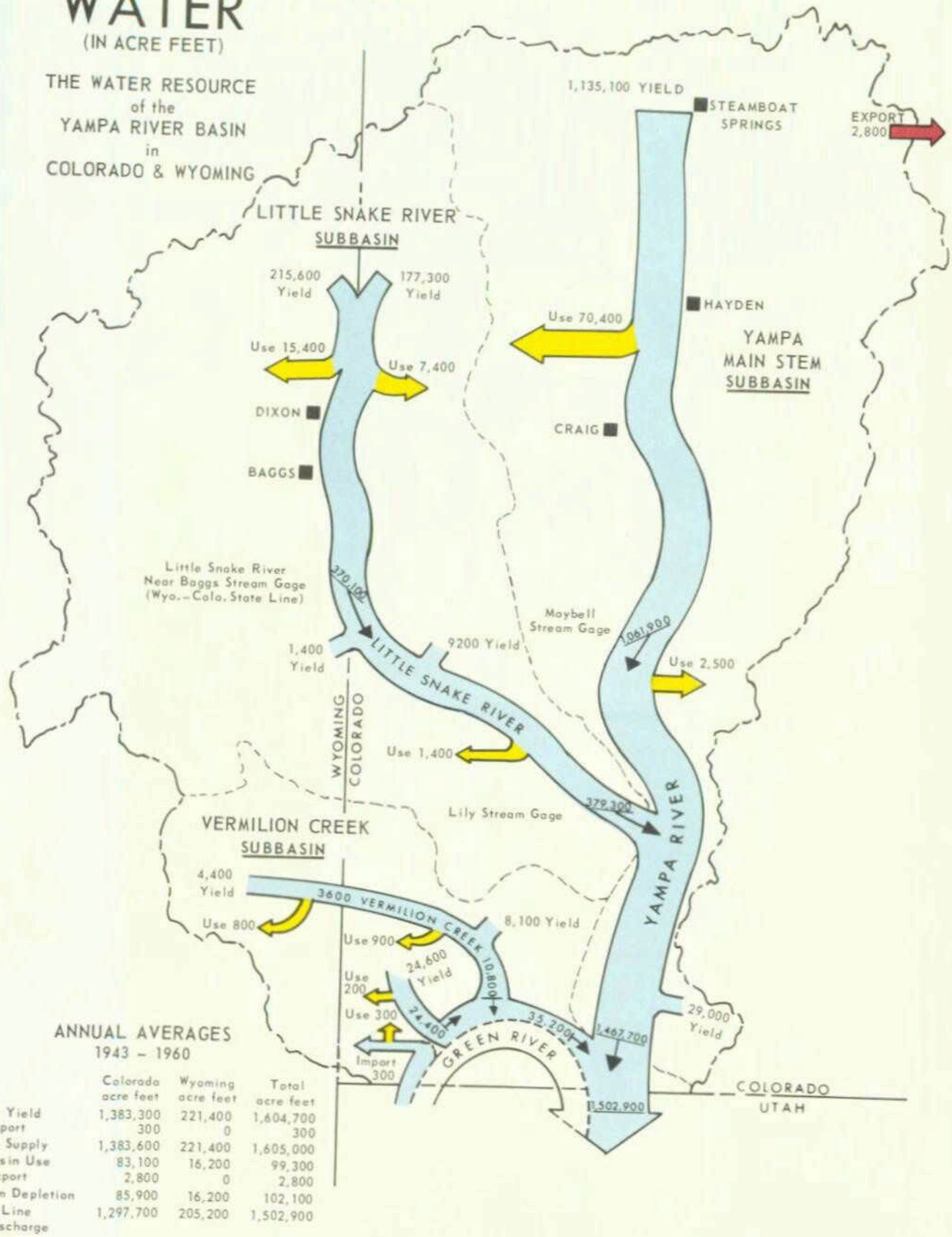
PREPARED BY

ECONOMIC RESEARCH SERVICE - FOREST SERVICE - SOIL CONSERVATION SERVICE

DENVER, COLORADO — APRIL 1969

WATER
(IN ACRE FEET)

THE WATER RESOURCE
of the
YAMPA RIVER BASIN
in
COLORADO & WYOMING



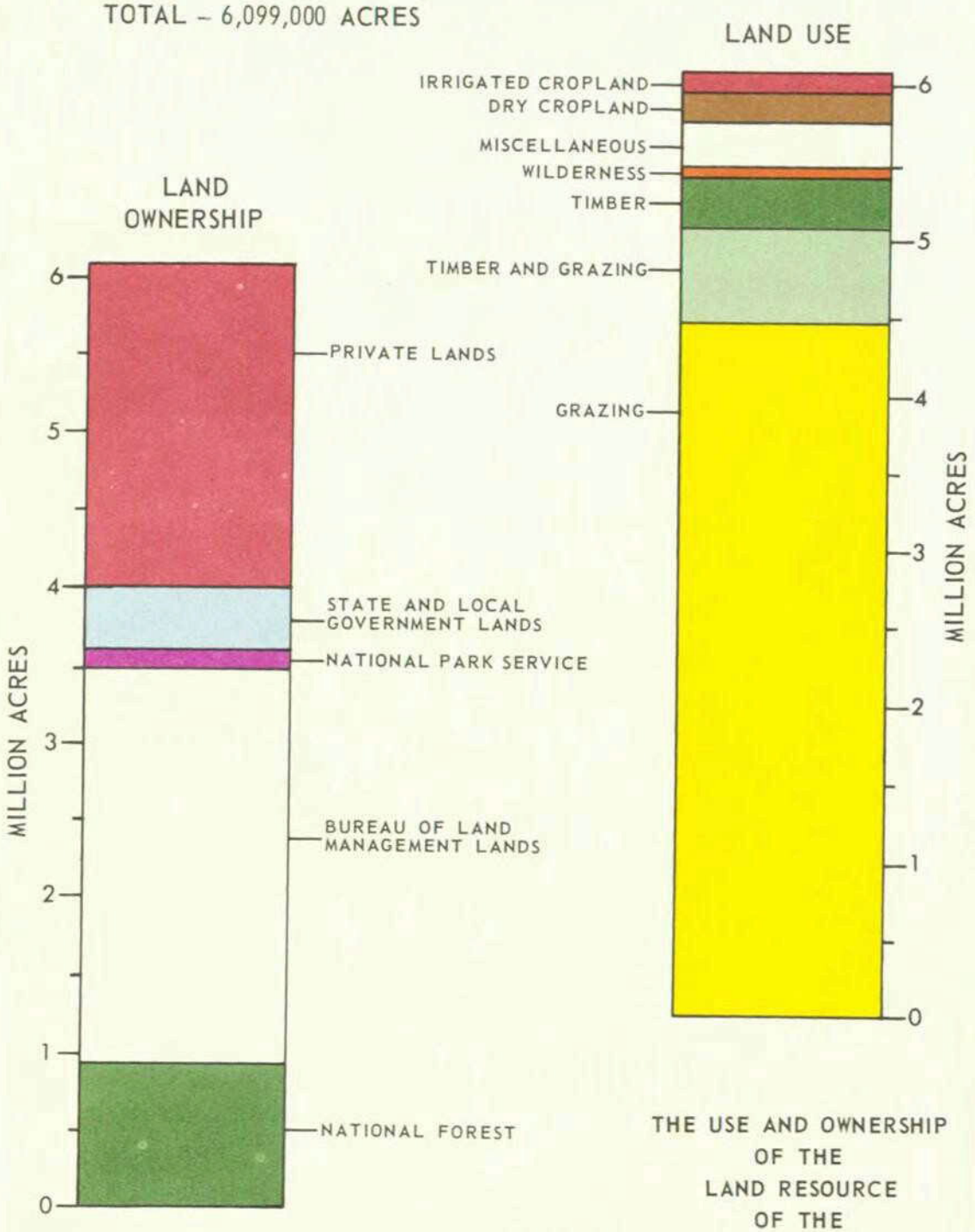
ANNUAL AVERAGES
1943 – 1960

	Colorado acre feet	Wyoming acre feet	Total acre feet
Water Yield	1,383,300	221,400	1,604,700
Import	300	0	300
Water Supply	1,383,600	221,400	1,605,000
In Basin Use	83,100	16,200	99,300
Export	2,800	0	2,800
Stream Depletion	85,900	16,200	102,100
State Line Discharge	1,297,700	205,200	1,502,900

FRONTISPIECE 1

LAND

COLORADO – 4,300,000 ACRES
WYOMING – 1,799,000 ACRES
TOTAL – 6,099,000 ACRES



THE USE AND OWNERSHIP
OF THE
LAND RESOURCE
OF THE
YAMPA RIVER BASIN
IN
COLORADO & WYOMING

FRONTISPIECE 2

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FIGURES

TABLES

WATER AND RELATED LAND RESOURCES

YAMPA RIVER BASIN IN COLORADO AND WYOMING

I. SUMMARY

This report presents information concerning water and related land resources of the Yampa River Basin in Colorado and Wyoming. It is based on a cooperative study by the Colorado Water Conservation Board and the U. S. Department of Agriculture. Department of Agriculture participation was authorized under the provisions of Section 6 of Public Law 566, 83d Congress, as amended and supplemented. This is one of the series of cooperative river basin surveys being conducted on the Upper Colorado River and its tributaries on the western slope of the State of Colorado. Information for the Wyoming portion of the basin was developed only to the extent necessary to make possible evaluations on a complete river basin basis with integrated consideration of all existing and proposed major projects which would be affected by developments within the basin.

The principal objective of this study was to develop information on water and related land resource use and management with particular regard to multiple use, to provide a basis for coordinating USDA programs with the related activities of local, State, and other Federal agencies. This study will serve as an important source of information in the preparation of an overall water plan for the State of Colorado.

The Yampa River is a tributary of the Green River, which is tributary to the Colorado River. The basin encompasses 9,530 square miles with 6,719 square miles in northwestern Colorado and 2,811 square miles in south-central Wyoming (Figure 1). This is about 6 percent of the State of Colorado and 3 percent of the State of Wyoming. Elevations range from 5,000 to more than 12,000 feet above sea level while precipitation ranges from less than 9 inches in the desert areas to more than 50 inches along the Continental Divide. The average growing season (above 28°F.) in the irrigated areas varies from 102 to 125 days.

Water and related land resource problems include erosion damage on rangeland and dry cropland, inefficient water management on irrigated lands, sediment and salinity production from exposed shale areas, flood-water damage from snowmelt runoff, range and forest fires, and a shortage of irrigation water for late season use. Present and future needs for water and related land resource development include erosion control practices, improved irrigation and drainage systems, increased efficiency in irrigation water management, proper range management, sediment control, water storage facilities for multiple use, recreation, and wildlife development.

The first major settlement in the basin took place during 1876-1900 after the fur trapping period. Early development began after the discovery of gold prior to 1860. Colorado became a State in 1876.

The basin is sparsely populated. The 1960 population was approximately 13,160. The population increased rather consistently between 1900 and 1940 when the area was being developed. The 1967 population estimate of 13,400 is close to the 13,850 population in 1930. In 1960, agriculture was the largest employer with 906 people (19.3 percent) of the labor force. Projected population is 15,500 by 1980, 19,300 by the year 2000, and 24,400 by 2020.

Fifty-nine percent of the land in the basin is in Federal ownership, 35 percent is privately owned, and approximately 6 percent is owned by State and local governments. Approximately 6 percent of the lands are used for crop production. The remaining 94 percent are used for grazing, timber production, watershed, recreation, wildlife, and other purposes (Land Resource Frontispiece).

The average annual undepleted water supply 1/ for the 1943-60 period was 1,605,000 acre-feet, average annual depletion was 102,100 acre-feet, and average annual discharge at the Colorado-Utah state line was 1,502,900 acre-feet (Water Resource Frontispiece). The major use of water was for irrigation.

The average irrigated acreage during the 1943-60 period was 96,500 acres. Potential developments, adjusted for expected encroachments on the irrigated land, would add 68,500 acres for a total of 165,000 acres of irrigated land in the basin (Colorado and Wyoming) by the year 2000. For the Colorado portion of the basin projections of irrigated acreages are 98,000 for 1980, and 142,000 for 2000 and 2020.

Livestock production dominates the agricultural industry of the basin. About 50 percent of the cropland is devoted to production of feed and forage crops. About 60,500 acres are used for wheat production and a small acreage of other crops are grown. The 1959 Census of Agriculture showed 56,700 cattle and calves, and 237,600 sheep and lambs in the Colorado portion of the basin. Rangeland provides 511,000 animal unit months of grazing and pasture and cropland grazing 144,000. Total agricultural income from sale of farm products was about 10.3 million dollars in 1959; of this, the sale of livestock and livestock products amounted to about 8 million dollars.

1/ Aggregate natural runoff of the river basin plus 300 acre-feet import before diminishment by man-related depletions.

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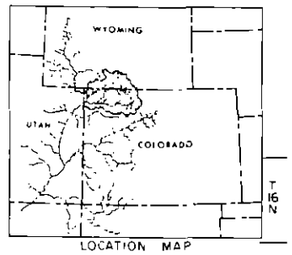

LEGEND

- Populated Places
- Reservoir
- Basin Boundary
- Subbasin Boundary
- County Boundary
- State Boundary
- National Forest, Monument and Wilderness Area Boundaries

VERMILION CREEK SUBBASIN

LITTLE SNAKE RIVER SUBBASIN

YAMPA MAIN STEM SUBBASIN

DESERT BASIN

POISON BASIN

WILLIAMS FORK MOUNTAINS

SWEETWATER COUNTY, Wyoming
MOFFAT COUNTY, Colorado

CARBON COUNTY, Wyoming
ROUTT COUNTY, Colorado
JACKSON COUNTY, Colorado

MOFFAT COUNTY
RIO BLANCO COUNTY

ROUTT COUNTY
GRAND COUNTY

GARFIELD COUNTY

DAGGETT COUNTY, Utah
UINTAH COUNTY, Utah
MOFFAT COUNTY, Colorado

DINOSAUR NATIONAL MONUMENT

BROWNS PARK

MEDICINE BOW NATIONAL FOREST

ROUTT NATIONAL FOREST

WHITE RIVER NATIONAL FOREST

MT. ZIRKEL WILDERNESS AREA

STEAMBOAT SPRINGS

CRAIG

ECHO PARK

FIGURE 1

DRAINAGE MAP

YAMPA RIVER BASIN

COLORADO AND WYOMING

MAY 1967

SCALE IN MILES

M7-S-18988-N

The basin is a recreation area of regional significance. Hunting, fishing, skiing, guest ranches, and recreation resorts constitute the principal activities. In 1960 use of campground facilities amounted to 168,800 visitor-days. Tourist use of hotels and motels amounted to 137,500 visitor-days in 1960. Guest ranches and resorts provided about 190,500 activity days of outdoor recreation in 1960. Skiing is a rapidly growing recreation activity since the opening of the Mt. Werner ski area in 1962.

Many studies concerning proposed water and related land resource developments have been made by State, Federal, local agencies, and private enterprise. Those that appear to have the most potential of being developed have been included in this report's projection of land and water use by the years 1980, 2000, and 2020. Constraints imposed by ownership, legal and institutional factors, location, and water supplies will determine availability of land for future development.

With projected developments, estimated total water depletions will be 217,800 acre-feet by the year 1980, 346,700 acre-feet by 2000, and 393,500 acre-feet by 2020. Water resources are adequate to meet water requirements of proposed resource developments outlined in this report, including potential municipal and industrial requirements.

With development of the basin, the conservation of land and water resources will become increasingly important. The multiple purpose aspects of Public Law 566 projects offer effective solutions to many of the land and water problems. Field examinations have been made on three potential watershed projects, Fortification Creek, Dry Creek, and Storm Mountain. Planning action on these projects has been tabled or suspended but problems in these areas will require some type of project action in the future probably in the 1980-2000 period. There are other project opportunities available for USDA assisted development. The Farmers Home Administration (FHA) has four inquiries and one application for municipal and industrial water developments. There are many smaller land and water development opportunities. These are generally of a type or size that could be assisted through other USDA programs. Assistance could include cost-sharing through ASCS pooling agreements and SCS technical help to group enterprises or individuals. The Forest Service provides improvements on national forest lands to the extent that available funds permit.

There are four potential Bureau of Reclamation projects, the Juniper, Yampa Valley, Yellow Jacket, and Savery-Pot Hook. These projects would include large developments of land for irrigation and a considerable amount of water for multiple use purposes. In some cases these projects proposed under Public Law 485 may be more easily developed at a somewhat smaller scale under Public Law 984. Portions of these and similar small water development projects involving irrigation facilities may also be developed as integral parts of watershed projects under Public Law 566 or other authorities which may be made available in the future. Much of the

potential irrigated land in the proposed reclamation projects is under the administration of the Bureau of Land Management. Transfer of this land from public to private ownership will require planning and coordination in addition to the active management program on the remaining public lands.

Program coordination is necessary to assure that proposed project and resource development opportunities complement each other and provide for coordinated development of the resources of the basin. Program coordination can be accomplished through USDA Technical Action Panels (TAP). The purpose of these panels is to facilitate and assist private, nongovernmental and State and local governmental efforts to bring about more rapid and widespread rural areas development.

WATER AND RELATED LAND RESOURCES

YAMPA RIVER BASIN IN COLORADO AND WYOMING

II. INTRODUCTION

This report presents information on water and related land resources of the Yampa River Basin in the states of Colorado and Wyoming. Information on the Colorado portion of the basin is based on a cooperative study by the Colorado Water Conservation Board and the United States Department of Agriculture. Information for the Wyoming portion of the basin was developed by the United States Department of Agriculture and the State Engineer's Office. Wyoming data was developed only to the extent necessary to evaluate the existing and proposed projects which would be affected by developments within the basin.

In the study of the Colorado River there is an urgent need for a systematic survey of the water and related land resources and the associated problems in the Yampa River Basin. Basinwide information is needed to present the relationships between programs and projects of various departments and agencies working in the basin as an aid to the efficient development of the basin's resources. Development in most of the basin has reached a stage where expansion and development depend upon efficient use of the presently available water, salvage of nonbeneficially used water, or the development of new water supplies. Conditions in the Yampa River Basin are such that an overall framework plan is a prerequisite to the sound development of Public Law 566 projects that are coordinated with existing or prospective projects or programs of other agencies.

The principal objective of this study was the collection and development of information on water and related land resource use and management with particular regard to multiple use, to provide a basis for coordinating USDA programs of watershed protection, flood prevention, land and water management, fish and wildlife development, recreational development, municipal and industrial water development with the related activities of local, State, and other Federal agencies. Information is also presented which will provide a basis for development of projects under the Watershed Protection and Flood Prevention Act, Public Law 566, as amended. This study will serve as an important source of information in the preparation of an overall water plan for the State of Colorado.

Participation of the United States Department of Agriculture was authorized under provisions of Section 6 of the Watershed Protection and Flood Prevention Act (Public Law 566), 83d Congress, as amended and

supplemented. This authorizes the Department to cooperate with other Federal, State, and local agencies in making investigations and surveys of watersheds of rivers as a basis for development of coordinated programs.

Survey work by the United States Department of Agriculture was carried out by technicians of the Soil Conservation Service, Forest Service, and Economic Research Service under the direction of a USDA Field Advisory Committee, Colorado Rivers, composed of representatives of the above agencies.

This is one of a series of cooperative river basin surveys being conducted by the U. S. Department of Agriculture and the Colorado Water Conservation Board. Previous studies resulted in reports on Water and Related Land Resources of the Gunnison River Basin (1962), the Colorado River Basin in Colorado (1965), and the White River Basin in Colorado (1966). Similar studies have been initiated for the Dolores and the San Juan river basins.

This study utilized applicable data from previous investigations wherever possible. The report is developed from field surveys and analysis of material collected from many sources. It is presented in the form of an inventory or information document rather than as an action or authorizing report. The data provided will serve as a basic source of information for use in the Upper Colorado Region Comprehensive Framework Study.

For these currently scheduled river basin surveys, hydrologic and water supply studies are being standardized to include the years 1943-60 as a base study period. These years have been selected because of the greater availability of streamflow data and other necessary records, and because they include periods of both above and below longtime average streamflows. They are reasonably representative of conditions existing during recent time periods and may be compared with other base periods through statistical or analytical procedures. Where possible, other data within the report have been developed for the same base period. There are some instances, such as in recreation, where records are nonexistent or are nonrepresentative of the base period. In these cases, use has been made of existing information regardless of time periods.

In addition to the United States Department of Agriculture, the Colorado Water Conservation Board, and the Wyoming State Engineer's Office, several other Federal and State agencies have provided data and assistance for this report. Chief contributors were the U. S. Bureau of Reclamation, U. S. Bureau of Land Management, Colorado State Soil Conservation Board, Colorado River Water Conservation District, Upper Colorado River Commission, U. S. Bureau of Census, U. S. Statistical Reporting Service, U. S. Geological Survey, U. S. Weather Bureau, National Park Service, U. S. Federal Water Pollution Control Administration, Colorado Division of Public Works, Colorado Division of Commerce and Development, Colorado Department of Agriculture, Colorado Game, Fish and Parks Department, the East Routt, West Routt, Moffat, Yampa, and Little Snake River Soil Conservation Districts, and the water user's associations and conservancy districts within the basin.

III. NATURAL RESOURCES OF THE BASIN

Location and Size

The Yampa River Basin is located in northwest Colorado and south-central Wyoming. The Colorado portion contains most of Moffat and Routt counties and small parts of Rio Blanco, Garfield, and Grand counties. In Wyoming it comprises parts of Carbon and Sweetwater counties. The Red Desert Basin is the northern boundary, the Continental Divide the eastern boundary in both states, the divide between the White and Yampa rivers the southern boundary, and the Utah-Colorado state line is the western boundary. The Utah-Colorado state line is not a natural basin boundary, but it is used to complete the Colorado western slope studies.

The basin land area is approximately 2,811 square miles in Wyoming and 6,719 square miles in Colorado, for a total of 9,530 square miles. The basin is 128 miles long from west to east and averages 75 miles in width.

Climate

The climate varies from the arid desert of the lower basin to the cold humid alpine zones along the Continental Divide. These extremes result from the wide variations in elevation and exposure. The eastern boundary of the basin reaches crest elevations of over 12,400 feet above sea level while the valley floor at Echo Park in Dinosaur National Monument is about 5,000 feet in elevation. The mean annual temperature at Steamboat Springs is 39°F., with extremes of 99°F. to -54°F. Craig's mean annual temperature is 42°F., with a recorded high of 100°F. and a low of -43°F., and Dixon has a mean annual temperature of 42°F., with a high of 97°F. and a low of -50°F. Irrigated lands near Yampa and Steamboat Springs have an average annual growing season (above 28°F.) of 102 days and areas near Craig average 125 days.

Average annual precipitation varies from more than 50 inches along the Continental Divide, (eastern boundary of the basin) to less than 9 inches in the desert areas. Total snowfall at Steamboat Springs averages 160 inches while Echo Park receives approximately 30 inches. A precipitation map (Figure 2) with isohyetal lines showing average annual precipitation follows page 4. The Average Annual Precipitation Map was developed from U. S. Weather Bureau precipitation station data and cooperative snow course measurement records. This information was then correlated with soils and vegetal cover maps, range site descriptions and physical aspects of the basin. The precipitation map was also correlated with the Water Yield Map (Figure 7), which was primarily developed from U. S. Geological Survey (USGS) streamflow data. Craig receives over one-third of its annual average precipitation as snow during the December-April

period, while Steamboat Springs receives nearly one-half of its precipitation as snow in the same period. More than one-third of the precipitation at Craig occurs during the growing season. Steamboat Springs receives little more than one-fifth for the same period. Summer precipitation generally takes the form of showers which contribute little to overall water supplies. Winter snow accumulation is the principal source of streamflow. In the high areas precipitation is typically mountain thundershowers with only localized areas occasionally receiving severe intensities. At lower elevations, summer showers are affected by convective conditions and frequently occur as "cloudbursts". Floods are of short duration and low total water production, but peak flows are high.

Evaporation losses from existing small ponds and reservoirs range from 17 to 20 inches per year depending on their location in the basin.

Physiography and Geology

Physiography

Most of the Yampa River Basin lies within the southern part of the Wyoming Basin physiographic province, a plateau area underlain by widespread deposits of relatively soft sedimentary rocks, bordered in part by abrupt mountain slopes, and containing isolated mountain ridges. Narrow areas along the eastern and southeastern margins of the basin are occupied by the Park Range and White River Plateau portions of the Southern Rocky Mountains physiographic province. The Uinta Mountains portion of the Middle Rocky Mountains physiographic province comprises an area at the southwestern edge of the basin. Elevations vary from 5,000 feet where the Green River crosses the Colorado-Utah state line to 12,493 feet on Flattop Mountain in the southeastern part of the basin.

The Park Range and White River Plateau areas form the headwaters for most of the major streams. The Park Range, extending along the eastern edge of the basin, consists mainly of broad mountain slopes about 10,000 feet in elevation. The high mountain valleys which drain these slopes are generally broad and open. For a distance of about 20 miles south of the Wyoming border the center of the Park Range is a strongly glaciated ridge with peaks rising to above 12,000 feet elevation.

The White River Plateau, lying along the southeast margins of the basin, consists mainly of basalt uplands between 10,000 and 11,500 feet in elevation, with a few peaks above 12,000 feet. The upland surface of the plateau is dotted with numerous shallow, flatbottomed depressions, many of which contain lakes. The borders of the plateau are approximately 1,000 to 2,000 feet above the surrounding terrain and have vertical cliffs, angular mesas, and steep-sided canyons.

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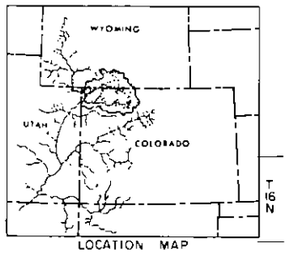


LOCATION MAP

LEGEND

Isohyetal lines showing 1943-60 average annual precipitation, in inches

Isohyetal Interval

- Below 9 inches
- 9 — 9 to 12 inches
- 12 — 12 to 16 inches
- 16 — 16 to 20 inches
- 20 — 20 to 25 inches
- 25 — 25 to 30 inches
- 30 — 30 to 40 inches
- 40 — 40 to 50 inches
- 50 — Above 50 inches
- Precipitation Stations
- Snow Course Stations

FIGURE 2

1943-60 AVERAGE ANNUAL PRECIPITATION MAP

YAMPA RIVER BASIN

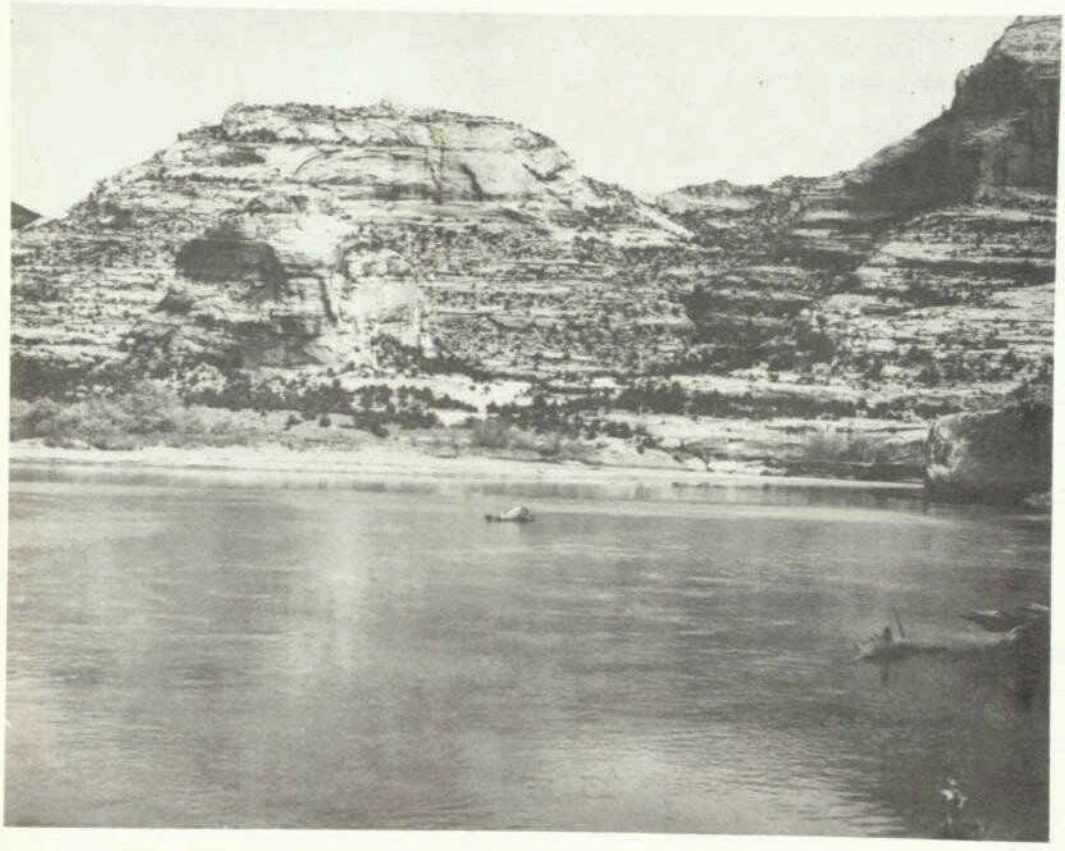
COLORADO AND WYOMING

MAY 1967

SCALE IN MILES

M7-S-18989-N

The eastern end of the Uinta Mountains extends in an east-west alignment across the southwestern corner of the basin. This area consists of a central platform with broad slopes about 8,000 feet in elevation and bordered by abrupt slopes on the north and south. The most outstanding features of this area are the spectacular canyons cut through the mountain range to depths of as much as 3,000 feet by the Green and Yampa rivers. The Green River flows southward through the Lodore Canyon and the Yampa River flows westward through the Bear Canyon to their confluence at Echo Park in Dinosaur National Monument.



Echo Park in Dinosaur National Monument

The remainder of the Yampa River Basin, lying within the Wyoming Basin physiographic province, is an area of diverse topography containing broad plains, gently-sloping ridges, and rough badlands interspersed with hogback ridges and low mountains. Most of the area lies between 6,500 and 7,500 feet elevation. Low dunes of sand and silt are locally prominent features, especially in alkali areas where the scarcity of vegetation permits the soil to drift into low hummocks.

Along the south-central side of the basin is a prominent topographic feature, the Axial Basin, formed by an uplift whose axis has been deeply eroded exposing underlying soft rocks and forming a sharply outlined trough. Two isolated mountains rise abruptly from the floor of this trough, Juniper Mountain and Cross Mountain. The Yampa River cuts through both of these mountains in deep canyons. Along the south side of the Axial Basin is a low range of hills, the Danforth Hills, lying about 2,000 feet above the adjacent valleys. Northeast of the Axial Basin, the Williams Fork Mountains are a high hogback ridge formed by resistant sandstone layers.

The Elkhead Mountains in the east-central part of the basin consist mainly of flat-lying soft sedimentary rocks protected by basalt flows. The highest peaks reach elevations of from 10,000 to 11,000 feet.

Geology

Rocks ranging in age from Precambrian through Quaternary are exposed in the Yampa River Basin (Figure 3 - Generalized Bedrock Geology Map). They consist of crystalline rocks of Precambrian age, volcanic rocks of Tertiary age, and a thick sequence of sedimentary rocks of Paleozoic, Mesozoic, and Cenozoic age. Areal distribution of these rocks is controlled by four major structural features, the Washakie Basin, the Park Range uplift, the White River uplift, and the Uinta Mountains uplift. These structural features were formed gradually over an interval beginning near the end of the Mesozoic and continuing through the early Tertiary.

The Washakie Basin occupies all of the central and northern parts of the Yampa River Basin. It is a broad structural depression which was also the original basin of deposition for early Tertiary sediments. On the east it is flanked by the Park Range uplift, on the southeast it is flanked by the White River uplift, and on the southwest by the Uinta Mountains uplift.

The oldest part of the basin geologically is in the Park Range and Uinta Mountains uplifts. Precambrian rocks make up most of the Park Range and consist of metamorphic schist and gneiss which are extensively intruded by granitic igneous rocks consisting mainly of quartz monzonite.

The Precambrian rocks of the Uinta Mountains uplift consist primarily of red siliceous sandstone and quartzite of the Uinta Mountain Group. These are overlain by more than 3,000 feet of lower Paleozoic sedimentary rocks including quartzite, sandstone, limestone, and shale. Among the more prominent Paleozoic formations are the limestones of Mississippian age, the Morgan Formation and Weber Sandstone of Pennsylvanian age, and the Park City Formation of Permian age.

FIGURE 3

GENERALIZED
BEDROCK GEOLOGY MAP

YAMPA RIVER BASIN

COLORADO and WYOMING

AUGUST, 1967

SCALE IN MILES

TERTIARY
- Tv — Tertiary volcanics
- Tbp — Browns Park Formation
- Tb — Bridger Formation
- TTwg — Fort Union, Wasatch, Green River Formations

MESOZOIC
- Mz

PALEOZOIC
- Pz

PRECAMBRIAN
- Pc

U.S. DEPARTMENT OF AGRICULTURE · SOIL CONSERVATION SERVICE

M7-S-18798-N

Mesozoic rocks crop out mainly around the eastern and southern margins of the Washakie Basin and include several thousand feet of alternating beds of shale, siltstone, and sandstone. This sequence of rock includes: the Moenkopi and Chinle Formation of Triassic age; the Navajo Sandstone of Triassic and Jurassic age; the Carmel Formation, Entrada Sandstone, Curtis Formation, and Morrison Formation of Jurassic age; the Dakota Sandstone and Mowry Shale of early Cretaceous age; and the Frontier Formation, Mancos Shale, Mesaverde Group, Lewis Shale, and Lance Formation of late Cretaceous age.

The most extensive of the Mesozoic rocks are the Mancos Shale and the Mesaverde Group. The Mancos Shale has a thickness of more than 5,000 feet. It consists essentially of dark gray calcareous marine shale and often underlies broad open valleys or basins. The Mesaverde Group consists mainly of sandstone with interbedded shale and several coal beds. These rocks are usually resistant to erosion and often form prominent mesas, ridges, and cliffs.

Rocks of early Tertiary age include the Fort Union Formation, Wasatch Formation, Green River Formation, and Bridger Formation. The Fort Union Formation crops out along the eastern side of the Washakie Basin and consists of interbedded sandstone, shale, and coal beds. The Wasatch Formation occurs extensively around the Washakie Basin and consists mainly of red, purple, and gray shale and clay with some sandstone layers. The Green River Formation crops out in the central portions of the Washakie Basin and is composed mainly of light gray to light brown shale and marlstone with some sandstone, limestone, and oil shale. The Bridger Formation occupies large areas in the central parts of the Washakie Basin where it forms extensive badland areas. It consists mainly of gray to greenish gray sandy tuffaceous mudstone.

The Browns Park Formation of late Tertiary age, whose type locality is Browns Park north of the Uinta Mountains, consists predominately of chalky white to light gray soft crossbedded tuffaceous sandstone with thin layers of greenish gray sandy mudstone. This formation extends as an irregular band from the type locality eastward along the southern flank of the Washakie Basin to Cedar Mountain northwest of Craig, Colorado. Other prominent exposures occur along the east side of the Yampa River Basin at the foot of the Park Range, along the north flank of the White River uplift, and throughout the Elkhead Mountains.

Volcanic rocks of late Tertiary age occur in the Elkhead Mountains and adjacent areas and in the White River Plateau area. The volcanic rocks of the Elkhead Mountains consist of a number of intrusive dikes, sills, stocks, and plugs as well as thick flows of basaltic lava. The rocks of the White River Plateau consist of basaltic lava flows several hundred feet in depth.

Glacial deposits of Pleistocene age are widespread in the Park Range and the White River Plateau. Moraines representing several intervals of glaciation are present along most of the major valleys in the higher portions of these areas. Several levels of Pleistocene stream terraces underlain by sandy and gravelly deposits occur along the Yampa River and its larger tributaries. Recent alluvium occurs in floodplains of most smaller tributaries as well as along the larger streams.

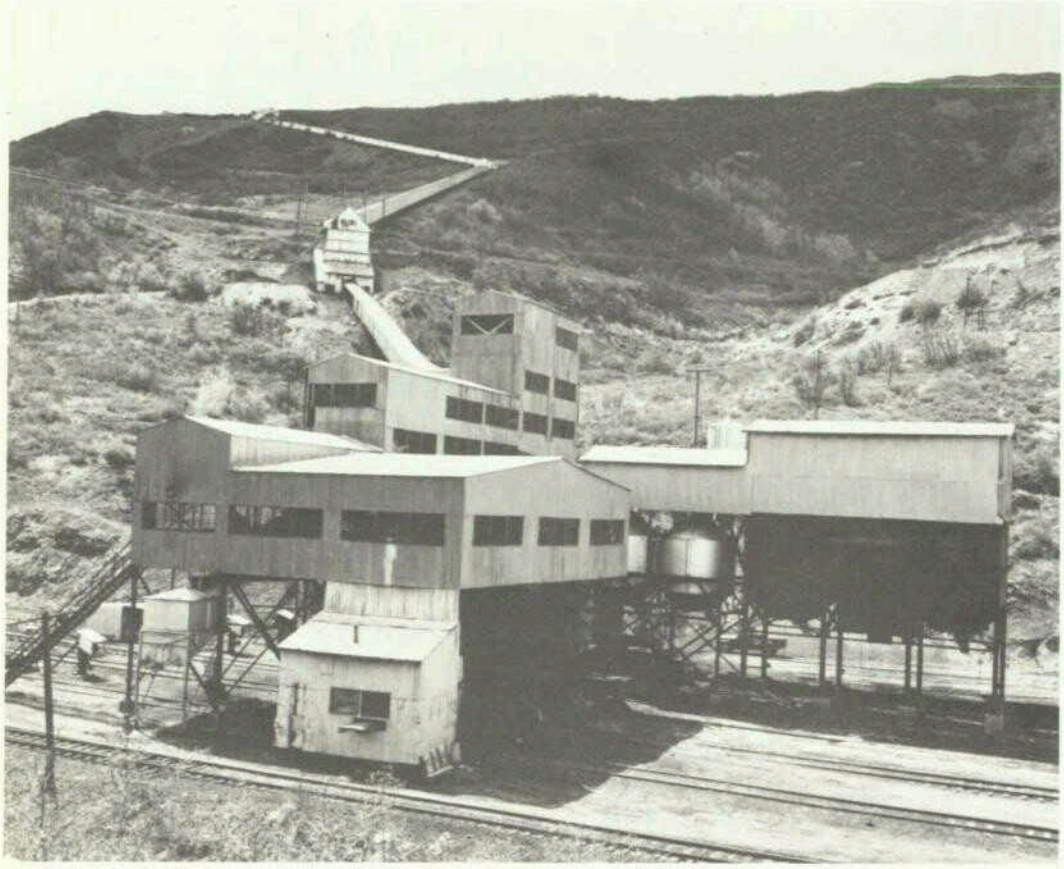
Mineral Resources

Petroleum, natural gas, coal, sand, and gravel are the most important minerals being produced currently in the basin. Most of the oil and gas production has been in Moffat County, Colorado, with minor amounts being produced in Routt County, Colorado, and Sweetwater County, Wyoming. In 1963, Moffat County produced 1.3 million barrels of oil and 10,274,526 mcf of gas. The principal fields are Powder Wash and Hiawatha in the western part of the basin.

The coal resources of the basin are located mainly in the Yampa coal field in Routt and Moffat counties, Colorado. An extension of this field continues into Carbon County, Wyoming. The coal occurs in the Williams Fork Formation of the Mesaverde Group of Mesozoic age and in the Lance and Fort Union Formations. Most of the coal is of high-volatile C bituminous rank and is low in ash and sulfur content. A total of about 23,607 million tons of coal, 76 percent of which is bituminous in rank and 24 percent of which is subbituminous, is estimated by the U. S. Geological Survey to have been originally present in this field.

Coal mining operations have been carried on over a substantial area in Moffat County. This area extends north from the White River-Milk Creek divide to Craig. It also extends several miles both east and west of State Highway 13 (Figure 8, following page 66) between Axial and Craig. Underground mining in Moffat County (1967) produced approximately 214,000 tons (99 percent) of coal. The remaining 2,000 tons (1 percent) was taken from surface mines.

The Routt County coal mining area lies in the Oak, Trout, and Fish creek areas and extends northwest to the vicinity of Mount Harris. This area extends about 20 miles south and about 16 miles west of Steamboat Springs. Mining in the area has produced a large tonage of coal over a long period of time from underground mines. Presently, however, the major portion of the coal produced is by strip mining methods. The strip mine production (1967) of the Pittsburg and Midway Coal Mining Company was 692,000 tons; the Peabody Coal Company produced 597,000 tons; and the Energy Coal Company produced 495,000 tons for a total of 1,784,000 tons. Other production in Routt County amounted to 30,000 tons. The Hayden plant of the Colorado Ute Electric Association receives coal from the Peabody Coal Company. The majority of the remaining coal production in Routt County is marketed in eastern Colorado.



Coal mine near Oak Creek in Routt County

Sand and gravel, produced at plants near Steamboat Springs and Craig, are used mainly for construction purposes such as aggregate for concrete, mortar, asphalt, and as road base.

Metallic mineral production in the basin has been relatively small. The largest production has been in Routt County, Colorado, mainly from the Hahns Peak district, which has been an intermittent producer of gold, silver, copper, and lead since 1866. The principal product until about 1895 was placer gold. Since that time attempts have been made to produce gold, silver, copper, lead, and zinc from small irregular veins found within the Tertiary intrusive rocks and adjacent Precambrian rocks. The total value of all metallic mineral production from the district through 1954 has been estimated at about $500,000.

Potentially valuable mineralization in Carbon County, Wyoming, includes gold, silver, lead, zinc, copper, nickel, barite, graphite, and iron in the Precambrian crystalline rocks near the headwaters of Battle Creek and

Little Sandstone Creek. Placer gold has been recovered on the Little Snake River between Dixon and Baggs. In Moffat County the Paleozoic sedimentary rocks north of the Yampa River contain fissure veins with small amounts of copper and gold. Some zinc and iron have also been recovered. Alluvial sands and gravels contain placer deposits in several areas of Moffat County, particularly north of Lay.

Uranium mineralization is widespread throughout the basin, occurring mainly in the Browns Park Formation. The main areas of prospecting have been the Miller Hill area, Browns Hill area, and Poison Basin area in Wyoming and the Maybell-Lay-Juniper Springs area in Colorado. Most of the mineralization is low grade, but production has been substantial.

Land Resources

Soils

The former systems of soil classification 1/ 2/ followed in the United States placed all soils in six categories. In descending sequence the six were: order, suborder, great soil group, family, series, and type. Great soil groups alone and in defined associations are sometimes used as map units on general soil maps and that procedure was followed in this report.

In January 1965 a new national classification system 3/ was adopted for field use by the Soil Conservation Service and agencies participating in the National Cooperative Soil Survey. The new system retains six categories but names and limits are different than those used in the old system. Great group names of the new system are shown in estimates of composition for each map unit in table 2, following page 19. Readers requiring detailed information on characteristics of the groups and an explanation of terminology should consult recent publications. 3/ 4/

1/ Baldwin, Mark; Kellogg, Charles E.; and Thorp, James "Soil Classification," USDA yearbook, 978-1101, 1938.

2/ Thorp, James T., and Smith, Guy D. "Higher Categories of Soil Classification; Order, Suborder, and Great Soil Groups," Soil Sci. 67:117-126, 1949.

3/ Soil Survey Staff, SCS, USDA "Soil Classification, a Comprehensive System 7th Approximation," 1960 and as amended through October 1966.

4/ Aandahl, Andrew R. "The First Comprehensive Soil Classification System." Journal of Soil and Water Conservation 20:243-246, 1965.

By drawing lines around areas of land with similarities in soil, relief, geology and vegetation it is possible to make a general soil map of the basin. The different kinds of soil are broadly associated and form patterns that are repeated from place to place.

A general soil map is useful to compare different parts of the basin or locate soil having general similarities and suitability. The broad characteristics and relationships show in a general way potential of the soils for agricultural, industrial, commercial and recreational uses.

The basin is divided on the General Soil Map (Figure 4) among 7 major units for purposes of broad interpretation. So that more specific statements could be made concerning soils and agriculture, soil mapping unit 2.0 was divided further into four units and soil mapping unit 5.0 was broken into three units. Twelve mapping units have been delineated and described. Separations between units are generalized in accordance with requirements imposed by the map scale. Acreage distribution of units and percent that each occupies is given in table 1.

Table 1.--Acreage of soil mapping units and percent of area covered, Yampa River Basin in Colorado and Wyoming, 1966.

Map symbol	Colorado		Wyoming		Yampa River Basin	
	Acres	Percent	Acres	Percent	Acres	Percent
1.0	586,000	13.7	1,050,000	58.4	1,636,000	26.8
2.1	294,000	6.8	28,000	1.5	322,000	5.3
2.2	0	0	257,000	14.3	257,000	4.2
2.3	715,000	16.6	30,000	1.7	745,000	12.2
2.4	100,000	2.3	0	0	100,000	1.6
3.0	377,000	8.8	0	0	377,000	6.2
4.0	445,000	10.4	0	0	445,000	7.3
5.1	917,000	21.3	155,000	8.6	1,072,000	17.6
5.2	36,000	.8	112,000	6.2	148,000	2.4
5.3	498,000	11.6	81,000	4.5	579,000	9.5
6.0	309,000	7.2	86,000	4.8	395,000	6.5
7.0	23,000	.5	0	0	23,000	.4
Total	4,300,000	100.0	1,799,000	100.0	6,099,000	100.0

Source: USDA Field Party

Soil Mapping Unit 1.0: Light colored soils of the desert

Soils of this unit are located in two areas on the general soil map. The largest extends from south of the confluence of the Yampa and Little Snake rivers in Colorado northward to the state line and into Wyoming. It includes most of Sweetwater County in the basin and that part of Carbon County west of Muddy Creek. The smaller delineation extends from near Greystone westward through Browns Park to Utah. This is the most extensive soil unit in the basin.

Desert rangeland near Two Bar Ranch
(soil mapping unit 1.0)

The landscape is characterized by rolling hills broken by gently sloping strips of alluvial soils bordering deeply incised drainageways and colluvial slopes. There is a sparse cover of saltbush and shadscale on the uplands while greasewood and rabbitbrush are conspicuous along drainageways. Larger expanses of gentle slopes are along the Green,

002929

FIGURE 4

GENERAL SOIL MAP

YAMPA RIVER BASIN

COLORADO and WYOMING

AUGUST, 1967

SCALE IN MILES

LOCATION MAP

LEGEND

- 1.0 Light colored soils of the deserts
- 2.0 Moderately dark colored soils of the uplands and valleys
- 2.1 Shallow rocky or gravelly soils with associated deep soils
- 2.2 Moderately deep and shallow shale and sandstone soils
- 2.3 Deep loamy soils
- 2.4 Deep sandy soils
- 3.0 Moderately dark colored soils of the mountains and canyons
- 4.0 Dark colored soils of the uplands and valleys
- 5.0 Dark colored soils of the cold mountain slopes
- 5.1 Soils with moderately dark or dark subsurface horizons
- 5.2 Shallow stoney or gravelly soils
- 5.3 Soils with light colored subsurface horizons
- 6.0 Light colored soils of the cold mountain slopes
- 7.0 Dark colored soils of alpine region

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Yampa, and Little Snake rivers and Vermilion and Muddy creeks. A significant body of playas interspersed with hummocks and low sandhills extends from east of Kenney Rim in Wyoming to beyond Sand Creek. Very steep and intricately dissected shale badlands are scattered within the unit both in Colorado and Wyoming.

Surface soils are light colored, relatively low in organic matter and range in texture from loamy sand to silty clay. Subsoils are principally sandy loam, clay loam or clay in texture and have a rapid to slow permeability rate. Sandy subsoils with a rapid permeability are a minor component. Generally, these soils have an alkaline reaction and are limy at or within a few inches of the surface.

Some soils on fans and terraces are very strongly alkaline in reaction and high in exchangeable sodium as evidenced by scattered "slick spots" that are devoid of vegetation. Injurious accumulations of soluble salt are largely restricted to bottomland soils and areas bordering shale badlands.

Soil Mapping Unit 2.0: Moderately dark colored soils of the uplands and valleys

These soils are separated into four separate units on the map that differ in proportions of different kinds of soil and on the map they are shown as 2.1, 2.2, 2.3, and 2.4. They are all dominated by moderately dark colored soils and occupy sagebrush and pinyon-juniper lands in the foothill transition between deserts and mountains. Moisture conditions are more favorable for plant growth than in the desert but cropping of non-irrigated land is limited by the low annual precipitation.

Soil Mapping Unit 2.1: Shallow rocky or gravelly soils with associated deep soils

There is only one delineation of this unit in Wyoming but there are three in Colorado. It is mainly confined to western Moffat County. The unit encompasses steep gravelly slopes and rocky ledges covered with scattered pinyon-juniper. Associated with the steep slopes are higher-lying moderately sloping sagebrush uplands. The landscape is highly dissected by intermittent stream channels.

The most intensive component of unit 2.1 is shallow gravelly or stony soils. They overlie sandstone or shale at depths of 20 inches and are usually calcareous. At many locations the soft sandstone is penetrated by tree roots. Deeper soils that have high proportions of coarse fragments in the subsoil occupy footslope positions within complex patterns of shallow soils. Deep, moderately dark colored loamy soils that are noncalcareous to depths of 6 to 24 inches occupy smoother slopes on the

divides. Often they have formed in calcareous windblown deposits of loamy texture. Surface soils are usually loams or sandy loams. Subsoils range from sandy loam to clay loam in texture and are moderately permeable.

Soil Mapping Unit 2.2: Moderately deep and shallow shale and sandstone soils

There is only a single delineation of this unit on the map. It is all within Carbon County, Wyoming, and extends as a broad belt from south of Muddy Mountain to the north boundary of the basin.

The landscape is a succession of grass and sagebrush mantled low shale hills and sandstone ridges with intervening narrow alluvial valleys. A few low mountains and buttes rise above the hills and have clumps of serviceberry or oakbrush.

The major component of this unit consists of moderately dark colored soils that have formed residually on shales and sandstones. Depth to bedrock over most of the delineation ranges from 20 to 40 inches but there are shallow soils with shale or sandstones at depths of less than 20 inches on upper slopes and ridges.

Surface soils are thin but they have an organic matter content of 1 to 3 percent. Texture of the surface layer ranges from sandy loam to clay. Subsoils are dominantly clayey and are moderately to slowly permeable. Usually the soils are limy at or near the surface but depth to visible lime may range from 10 to 30 inches in the deeper soils.

Soil Mapping Unit 2.3: Deep loamy soils

This is one of the larger soil units and is mainly within Colorado. There are two delineations. The smaller one is south of the Yampa River in the vicinity of Juniper Springs, while the larger extends from Cedar Mountain northward to beyond the Little Snake River in Wyoming.

The landscape consists of gently to steeply rolling sagebrush hills separated by numerous intermittent creeks and their tributaries. More level portions of the unit are confined to bottomlands and terraces bordering the Yampa and Little Snake rivers.

Soils of this unit are deep and underlying bedrock is usually below a depth of 40 inches. Surface soil layers contain 1 to 3 percent organic matter, are noncalcareous, and range in texture from sandy loam to clay loam. Subsoils have moderate to strong grades of structure and vary in texture from sandy loam to clay. Permeability of subsoils is moderate or slow. Except for the deep sandy soils, lime is usually present within 24 inches of the soil surface.

Soil Mapping Unit 2.4: Deep sandy soils

There is a single delineation of this unit on the map. It is in Colorado around Maybell, Sunbeam, and Cross Mountain.

The landscape consists of low, rolling, sagebrush hills, choppy sandhills, and associated gently sloping uplands and valleys. Slope gradients are variable and complex within the sandhills.

Deep sand or deep moderately sandy upland soils comprise the major portion of the unit. Surface soil layers have a moderate or low organic matter content and are noncalcareous. Surface textures are chiefly loamy sands or sandy loams. Subsoils are sandy and rapidly permeable. There is little surface runoff. Bordering the Yampa River terraces, upland soils have formed in calcareous, gravelly outwash modified by windblown sands and silts.

Soil Mapping Unit 3.0: Moderately dark colored soils of the mountains and canyons

Soils of this unit occupy three outlined areas in western Moffat County, Colorado. The unit is of special significance because it includes nearly all of Dinosaur National Monument.

The landscape is that of a rocky canyon-plateau area with scattered mountains of greater height rising above the broad plateaus in the distance. Pinyon-juniper is conspicuous on the rocky slopes above the canyons while sagebrush and grasses compose the cover in the valleys. Douglas fir and ponderosa pine are on the higher mountain slopes. The deep canyons of the Green and Yampa rivers are bordered by highly dissected erosional benches and promontories that form spectacular scenic views. Major intermittent tributaries of the rivers are deeply intrenched and cross-country travel within the unit is very difficult. Rockland is extensive even on the plateaus. Steep slopes are characteristic of the unit.

Unit 3.0 is distinctive for the high proportion of canyons, rock outcrop and shallow soils it contains. Most extensive are rocky soils with thin, moderately dark colored, sandy loam surface layers underlaid at depths of less than 20 inches by sandstone or quartzite bedrock. They are noncalcareous. Shallow strongly calcareous limestone soils occupy many of the high plateaus and there are also shallow shale soils.

Deep soils that do not contain high proportions of stone or cobble are limited to valleys and footslopes where there are windblown and colluvial-alluvial deposits. They contain 2 to 5 percent of organic matter in the

surface layer and have loam or sandy loam textures. Subsoils have weak to moderate structure and have a sandy loam or sandy clay loam texture. They are moderately to rapidly permeable and runoff is moderate to slow.

Soil Mapping Unit 4.0: Dark colored soils of the uplands and valleys

There are two areas of this unit on the soil map. The largest extends from southwest of Craig, up the Yampa Valley across Twenty Mile Park, to above the confluence of Green Creek and the Yampa River about 12 miles south of Steamboat Springs. A smaller area is in the east portion of Axial Basin, between Jubb Creek and Morapos Creek in the vicinity of Lloyd. This unit is all in Colorado.

Irrigated valley along the Yampa River
(soil mapping unit 4.0)

The landscape consists of gently sloping irrigated valleys bordered at many places by escarpments and steep colluvial slopes that are adjacent to mesas or rolling uplands. Within the uplands there are many intermittent streams in narrow valleys that are separated by hills and mesas. Upland cover is chiefly big sagebrush and bluegrasses on loamy soils while it is alkali sagebrush and western wheatgrass on clayey soils. There is some scattered oakbrush and serviceberry on higher north facing slopes.

Deep, dark colored soils are the major component of the unit. Surface layers are gray or grayish brown and have organic matter contents ranging from 2 to 5 percent. Surface textures are chiefly loams and clay loams. Subsoils are moderately to slowly permeable and have moderate to strong grades of prismatic and blocky structure. Clayey upland soils are usually calcareous within 20 inches of the surface but loamy soils may be noncalcareous to depths exceeding 50 inches.

Soil Mapping Unit 5.0: Dark colored soils of the cold mountain slopes

These soils are separated into three separate units on the map that differ in proportions of different kinds of soil and on the map they are shown as 5.1, 5.2, and 5.3. They are all dominated by dark colored soils and have the common characteristic of occupying mountain slopes and high plateaus. Moisture conditions are favorable for plant growth but the frost-free period is short.

Soil Mapping Unit 5.1: Soils with moderately dark or dark subsurface horizons

Soils of this unit occupy three separate delineations on the map and extend as an irregular belt from the southwest corner of Moffat County around the lower mountain slopes in Colorado and up the headwaters of Savery Creek in Wyoming.

Steep lower mountain slopes of rugged relief dissected by narrow valleys and streams compose the landscape in Colorado. North of Battle Mountain in Wyoming, the characteristic oakbrush ridges merge into gently sloping sagebrush plateaus dissected by canyons. Slopes are steep except along valleys and on narrow plateaus.

Dominant soils in this unit have dark gray or dark grayish brown surface layers that are underlaid by moderately dark or dark subsurface horizons. Surface layers are high in organic matter content, usually exceeding 5 percent. Loam and sandy loam surface textures are most common. On steep colluvial slopes coarse fragments from higher lying rock ledges and outcrops are usually scattered over the surface. Subsoils are more clayey and may be sandy clay loam to clay in texture. Many subsoils contain gravel, stone and rock fragments. Lime is usually leached to depths of 40 to 60 inches.

Moderately deep and deep soils are intermingled within this unit. At depths between 20 and 40 inches under moderately deep soils there is usually sandstone, shale or basalt. Deep soils have formed over bedrock and in valley fill. Some of the deep soils have dark colored buried soil layers within the upper four feet of the profile. Dark surface layers are unusually thick at some locations and may extend to depths of 20 to 30 inches.

Soil Mapping Unit 5.2: Shallow stony or gravelly soils

This unit is in both Colorado and Wyoming but is of small extent. One delineation is near the three corners area of Colorado, Wyoming, and Utah, while the other borders the Continental Divide south of Miller Hill.

The landscape consists of highly dissected grass and sagebrush covered plateaus extending from a few scattered mountains that are higher in elevation. There are oakbrush, serviceberry, and aspen on the upper slopes. Bordering the plateaus are steep, rock-walled canyons enclosing narrow alluvial valleys.

Shallow stony or gravelly soils are the principal component of this unit. Surface layers have a dark grayish brown color and a moderate to high organic matter content. They are much thinner than those of 5.1. Stony or gravelly loam and sandy loam textures predominate. Subsoils are stony or cobbly and shale, sandstone, or quartzite bedrock is usually at depths of less than 20 inches. Deep, dark colored soils are in the narrow valleys and on lower colluvial slopes.

Soil Mapping Unit 5.3: Soils with light colored subsurface horizons

This unit extends in a broken pattern from the headwaters of Milk Creek in Rio Blanco County, around the upper basin, to northeast of Green Ridge in Wyoming.

The landscape consists of aspen-dominated ridges, steep lower mountain slopes, and valleys. There are frequent springs and perennial streams. A major component of this map unit consists of soils that have dark colored surface layers overlying light colored subsurface horizons. The moderately thick, dark colored, granular A_1 horizons are underlain by light colored or ashy A_2 horizons. There is tonguing of the light colored A_2 horizons into blocky, more clayey subsoils. The gray or grayish brown to dark gray or dark grayish brown surface layers are high in organic matter content. They are neutral in reaction and have a loamy texture. Loam and sandy loam are the dominant textural classes and gravel or stones are often present. Subsoils are more clayey than surface layers and have a moderate or strong blocky structure. Sandy clay loam and clay loam textural classes are common. Subsoils are thick and moderately to slowly permeable.

Underlying parent materials are permeable and often calcareous. Glacial and local wind reworked deposits are extensive. Depth to bedrock is variable but is usually more than four feet.

Soil Mapping Unit 6.0: Light colored soils of the cold mountain slopes

Soils of this unit are mainly at the upper end of the basin bordering the Continental Divide and extend from Divide Peak in Wyoming south to Lone Springs Butte, near Toponas. There are smaller delineations around Sand Mountain, Bear Ears Mountain, and in the vicinity of the Flattops. Nearly all of it is within national forests.

Upper Yampa River and timber slopes
(soil mapping unit 6.0)

Unit 6.0 extends over steep, fir, pine and spruce timbered upper mountain slopes. It encompasses many open grassland parks and narrow valleys.

Table 2 -Composition and characteristics of Soil Mapping Units of the Yampa River Basin in Colorado and Wyoming

Map symbol	Composition: Percent	1949 Great Soil Group or Land Type	1986 Great Group, Subgroup or Land Type	Percent of basin	Dominant elevation (feet)	Mean annual precipitation (inches)	Mean annual temperature (F°)	Frost free period (days)	Dominant parent materials	Dominant upland slope gradients (percent)	Irrigated cropland (acres)	Nonirrigated cropland (acres)	Major land uses	Erosion problems	Sediment yield
1.0	55	Lithosols Shale 40 Sandstone 15	Torriorthents (Thin over shale and sandstone)	20.8	5,400-7,000	7-12	40-43	80-95	Shale and sandstone	5-25	5,300	0	Range and wildlife	Gullying and piping along drainageways, streambank cutting	High
	25	Desert & Sierozem soils, Regosols	Camborthids & Haplargids, Torripsamments												
	5	Brown soils	Haplargids & Camborthids												
	3	Solonetz soils	Natrargids												
	2	Alluvial soils	Torrifluvents												
	10	Land Types: Shale Badlands	Land Types, Shale Badlands												
2.1	60	Lithosols	Ustorthents (Thin over shale and sandstone)	5.3	6,000-7,000	9-15	40-43	80-95	Sandstone, shale and windblown deposits	10-60	0	400	Range and wildlife	Gullying and streambank cutting	Moderate
	30	Brown soils	Haplargids and Camborthids												
	3	Alluvial soils	Ustifluvents												
	2	Solonetz soils	Natrargids												
	5	Land Types, Rock Outcrop	Land Types Rock Outcrop												
2.2	55	Brown soils	Haplargids and Ustorthents	4.2	6,500-7,500	9-15	40-43	75-95	Shale and sandstone	5-30	0	700	Range and wildlife	Gullying and piping along drainageways	Moderate
	15	Chestnut soils	Argiustolls and Haplustolls												
	25	Lithosols Sandstone and Shale	Ustorthents (Thin over sandstone and shale)												
	2	Alluvial and Solonetz soils	Ustifluvents and Natrargids												
	3	Land Types Rock Outcrop	Land Types Rock Outcrop												
2.3	65	Brown soils	Haplargids and Camborthids	12.2	6,000-7,000	9-15	40-43	75-95	Windblown deposits, sandstone and shale	5-15	20,200	20,000	Range and wildlife	Sheet erosion on cropland and streambank cutting	Moderate
	40	Chestnut soils	Argiustolls and Haplustolls												
	12	Lithosols Sandstone and Shale	Ustorthents (Thin over sandstone and shale)												
	3	Alluvial and Solonetz soils	Ustifluvents and Natrargids												
2.4	65	Regosols	Ustipsamments	1.6	5,900-6,400	9-12	40-43	75-85	Windblown sands, outwash and sandstone	3-15	2,000	1,100	Range and wildlife	Wind erosion on rangeland	Low
	15	Brown soils	Haplargids and Camborthids												
	15	Chestnut soils	Argiustolls and Haplustolls												
	3	Alluvial soils	Ustifluvents												
	2	Solonetz soils	Natrargids												
3.0	40	Lithosols Sandstone and quartzite 20% Limestone 15% Shale 5%	Ustorthents (Thin over sandstone, quartzite, limestone or shale)	6.2	5,400-9,000	9-20	35-43	30-95	Sandstone, quartzite and limestone	15-75	0	0	Recreation, wildlife, and range	Gullying in valleys	Moderate
	30	Land Types: Rock Outcrop and Canyons*	Land Types, Rock Outcrop and Canyons												
	15	Chestnut soils	Argiustolls and Haplustolls												
	10	Chernozem soils	Argiborolls and Argiudolls												
	5	Brown soils	Haplargids												
	2	Alluvial soils	Ustifluvents												

Table 7.--Composition and characteristics of Soil Mapping Units of the Yampa River Basin in Colorado and Wyoming (Cont.)

Map symbol	Composition: Percent	1949 Great Soil Group or Land Type	1966 Great Group, Subgroup or Land Type	Percent of basin	Dominant elevation (feet)	Mean annual precipitation (inches)	Mean annual temperature (F°)	Frost free period (days)	Dominant parent materials	Dominant upland slope gradients (percent)	Irrigated cropland (acres)	Nonirrigated cropland (acres)	Major land uses	Erosion problems	Sediment yield
4.0	30	Chernozem soils	Argiborolls and Haploborolls	7.3	6,200-7,200	15-25	39-43	50-85	Shale, sandstone, windblown deposits, and outwash	5-25	51,500	149,000	Range, wildlife, and cropland	Sheet erosion on cropland and streambank cutting	Moderate
	55	Chestnut soils	Argiudolls and Hapludolls												
	5	Brown soils	Argiustolls and Haplustolls												
	5	Lithosols	Haplargids and Camborthids												
	5	Alluvial soils (Inclusion of Solonetz soils)	Lithic Haploborolls and Lithic Cryoborolls Haplaquolls and Cryaquolls (Inclusion of Natrargids)												
5.1	46	Chernozem soils	Argiborolls and Haploborolls Argiudolls and Hapludolls	17.6	7,000-8,500	15-30	35-40	45-75	Sandstone, shale, outwash, and valleyfill	10-60	20,700	10,500	Range and wildlife	Sheet erosion on cropland, gullying on range	Low
	5	Chernozem-Gray Wooded Intergrade soils	Boralfic Cryoborolls												
	30	Chestnut soils	Argiustolls and Haplustolls												
	15	Lithosols	Lithic Haplustolls												
	2	Alluvial soils	Haplustolls and Haplaquolls												
	2	Land Types: Rock Outcrop	Land Types Rock Outcrop												
5.2	38	Lithosols	Lithic Haplustolls and Lithic Ustorthents	2.6	7,500-8,500	15-20	35-40	55-75	Sandstone, quartzite, shale, and outwash	15-75	500	0	Range and wildlife	Gullying along drainageways	Moderate
	15	Brown soils	Haplargids and Camborthids												
	15	Chestnut soils	Argiustolls and Haplustolls												
	15	Chernozem soils	Argiudolls and Hapludolls												
	5	Gray Wooded soils	Cryoboralfs												
	5	Chernozem-Gray Wooded Intergrade soils	Boralfic Cryoborolls												
	2	Alluvial soils	Haplustolls												
	5	Land Types: Rock Outcrop	Land Types: Rock Outcrop												
5.3		Chernozem-Gray Wooded		9.5	8,000-9,500	20-40	35-40	Frost every month	Sandstone, shale, basalt, and outwash	10-50	2,000	1,000	Range, timber, recreation, and wildlife	Gullying along roads and trails	Low
	55	Intergrade soils	Boralfic Cryoborolls and Cryoborolls												
	15	Gray Wooded soils	Cryoboralfs												
	20	Lithosols	Lithic Cryoborolls												
	5	Chernozem soils	Argiborolls and Argiudolls												
	3	Alluvial soils	Haplaquolls and Cryaquolls												
	2	Land Types: Rock Outcrop	Land Types: Rock Outcrop												
6.0	52	Gray Wooded soils	Cryoboralfs	6.5	8,000-11,000	20-60	25-35	Frost every month	Basalt, granite, shale, sandstone, and glacial deposits	25-75	0	0	Timber, recreation, watershed, and wildlife	Gullying along roads and trails	Low
	15	Chernozem-Gray Wooded Intergrade soils	Cryoborolls												
	20	Lithosols	Lithic Cryoborolls												
	5	Chernozem soils	Argiborolls and Argiudolls												
	3	Alluvial soils	Cryaquolls												
	5	Land Types: Rock Outcrop	Land Types Rock Outcrop												
7.0	55	Alpine Turf soils	Cryorthods and Cryumbrepts	0.4	11,000-12,500	30-60	25-30	Frost every month	Basalt, granite, shale, sandstone, and rocky colluvium	10-90	0	0	Watershed, recreation, and wildlife	---	Low
	15	Alpine Meadow soils	Cryaquods and Cryaquepts												
	5	Alpine Bog soils	Histosols												
	10	Lithosols	Lithic Cryorthents												
	15	Land Types: Rock Outcrop	Land Types Rock Outcrop												

Source: USDA Field Party

The landscape is composed of rugged steep mountain slopes broken by headwaters of perennial streams. High, broad divides between major streams are interspersed with rolling, open areas.

Dominant within unit 6.0 are acid forest soils. They have a surface litter of needles and twigs. The underlying dark colored A_1 horizon is less than 4 inches thick and at many places is absent. Light colored, ashy A_2 horizons range from 5 to 30 inches in thickness and tongue into blocky subsoils. Surface soil layers are loamy. Subsoils are permeable and generally deep. They range in texture from sandy loam to clay and at many locations are gravelly or stony.

Soil Mapping Unit 7.0: Dark colored soils of the alpine region

This is the smallest unit on the general soil map. The three small delineations are in Colorado.

The alpine region is a steep, windswept, rocky grassland above timberline with a landscape composed of high rugged mountain peaks with intervening ridges and valleys.

Soils of this unit can be divided into those that are well drained and those that are poorly drained. Highly organic and peaty soils are in many depressions where water accumulates. Bog soils are conspicuous although their total area is not large.

Well drained turf soils occupy most of that portion of the landscape where soils have formed. Surface soils are dark colored and high in organic matter. They are moderately sandy to loamy in texture, have an acid reaction, and are usually gravelly or stony. Subsoils are gravelly or stony sandy loams and loams that are mildly acid in reaction and readily permeable. Underlying gravelly or rocky parent materials are generally at depths of 10 to 30 inches.

Alpine Meadow soils are in association with Alpine Turf and Bog soils and occupy cirque basins and poorly drained areas. Often low growing willows serve to identify areas of Alpine Meadow soils.

Land Ownership

Private ownership of land within the Yampa River Basin varies from 41 percent in Colorado to about 20 percent in Wyoming with an average for the basin of about 35 percent (table 3). About 6 percent of the land is owned by State and local government units with the remaining 59 percent owned by the Federal Government. Details of the land ownership pattern are shown on the Land Ownership Map following page 24. A graphic presentation of distribution in land ownership is given on the Land Resource Frontispiece.

Table 3.--Land ownership by counties, Yampa River Basin in Colorado and Wyoming, 1964

Counties	Private	State lands: State and local Government 1/	State lands: State Game, Fish & Parks Department	Federal lands: Bureau of Land Management 2/	Federal lands: Forest Service 2/	Federal lands: National Parks	Total
	Acres	Acres	Acres	Acres	Acres	Acres	Acres
Yampa River Basin in Colorado							
Garfield					35,200		35,200
Grand					5,600		5,600
Moffat	1,034,100	190,200	2,200	1,297,000	41,700	146,500	2,711,700
Rio Blanco	64,200			12,300	142,400		218,900
Routt	664,600	65,800	2,800	49,400	546,000		1,328,600
Total-Colorado	1,762,900	256,000	5,000	1,358,700	770,900	146,500	4,300,000
Percent	41.0	6.0	.1	31.6	17.9	3.4	100.0
Yampa River Basin in Wyoming							
Carbon	258,100	75,900		479,600	160,100		973,700
Sweetwater	100,200	21,600		703,500			825,300
Total-Wyoming	358,300	97,500		1,183,100	160,100		1,799,000
Percent	19.9	5.4		65.8	8.9		100.0
Total-Yampa River Basin	2,121,200	353,500	5,000	2,541,800	931,000	146,500	6,099,000
Percent	34.7	5.8	.1	41.7	15.3	2.4	100.0

1/ Other than those administered by the Colorado Game, Fish and Parks Department.

2/ Bureau of Reclamation and other withdrawal land included.

Source: USDA Field Party

The 2.1 million acres of private land are generally concentrated in the irrigated and dry farmland areas that have higher precipitation. In general, the private land is in the eastern or higher elevation portions of the basin. The notable exception is the checkerboard pattern of private and Federal ownership found in the extreme northern part of the basin, resulting from the land grants to the Union Pacific Railroad.

Most of the 353,500 acres of state and local government land is school land. In the Colorado portion of the basin there are 245,300 acres of state school land of which all but about 11,000 acres are leased for grazing or agricultural crop production. The remaining 10,700 acres of state and local government land in the Colorado portion of the basin is municipal or county land. The State land is generally found in blocks as a result of an exchange program conducted with the Bureau of Land Management. The Colorado Game, Fish and Parks Department administers approximately 5,000 acres within the basin.

The 160,100 acres of national forest land in Wyoming is all within the Medicine Bow National Forest. The 770,900 acres in Colorado are largely in the Routt National Forest with small acreages in the White River National Forest. National forest lands are confined to the eastern part of the basin and are generally above 8,000 feet in elevation. The majority of the 2,541,800 acres administered by the Bureau of Land Management is found in the western portions of the basin. The Colorado portion of Dinosaur National Monument contains approximately 152,800 acres (74 percent) of the total acreage of 205,961 in Colorado and Utah. Of the acreage in Colorado the National Park Service administers approximately 146,500 acres and the remaining 6,300 acres are still private land. This private land is being acquired by the National Park Service.

Land Use

Almost the entire basin is used for some form of agricultural production. Primary land uses are grazing (or a combination of timber and grazing), timber production, irrigated or dryland crop production, and recreation. Frontispiece 2 provides a graphic illustration of the generalized land use in the basin and the Land Use Map (Figure 6) following page 24 shows the general pattern of land use. Table 4 shows acreages of land use by ownership. Land uses are generalized and these lands may have several other uses.

The irrigated cropland (100,200 acres) occupies less than 2 percent of the land area, but this cropland constitutes the economic heart of the farms and ranches in the basin. The acreage of irrigated land has grown slightly during the study period. During the 1943-60 period an average 80,000 acres were irrigated in the Colorado portion of the basin and 16,500 acres in the Wyoming portion for a total of 96,500 acres. By 1965 this had grown to 82,600 acres in Colorado and 17,600 acres in Wyoming

U. S. DEPARTMENT OF AGRICULTURE

002936

SOIL CONSERVATION SERVICE

LOCATION MAP

LEGEND

- CITIES AND TOWNS
- RESERVOIR
- BASIN BOUNDARY
- COUNTY LINE
- STATE LINE
- NATIONAL FOREST BOUNDARY

MEDICINE BOW NATIONAL FOREST

ROUTT NATIONAL FOREST

ROUTT NATIONAL FOREST

ROUTT NATIONAL FOREST

DINOSAUR NATIONAL MONUMENT

WHITE RIVER NATIONAL FOREST

SWEETWATER COUNTY, Wyoming
MOFFAT COUNTY, Colorado

CARBON COUNTY, Wyoming
MOFFAT COUNTY, Colorado

DUCHESNE COUNTY, Utah
MOFFAT COUNTY, Colorado

MOFFAT COUNTY
RIO BLANCO COUNTY

ROUTT COUNTY
GARFIELD COUNTY

ROUTT COUNTY
GRAND COUNTY

JACKSON COUNTY
GRAND COUNTY

LAND OWNERSHIP STATUS

- LANDS ADMINISTERED BY THE BUREAU OF LAND MANAGEMENT: WITHDRAWALS AND RESERVATIONS PRIMARILY UNDER B. L. M. JURISDICTION AND VACANT PUBLIC LANDS.
- PRIVATELY OWNED LAND, PATENTED, R. R., MINING AND SMALL HOLDING CLAIMS, CORPORATIONS, CITIES, ETC.
- NATIONAL FOREST LANDS ADMINISTERED BY THE U. S. FOREST SERVICE
- STATE OWNED LANDS, EXCEPT THOSE UNDER CONTROL AND TITLE OF STATE FISH AND GAME DEPARTMENTS.
- COLORADO GAME, FISH AND PARKS DEPARTMENT LANDS.
- LANDS ADMINISTERED BY THE NATIONAL PARK SERVICE.

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FIGURE 5
LAND OWNERSHIP MAP
YAMPA RIVER BASIN
COLORADO AND WYOMING

S.R- 20,336

002937

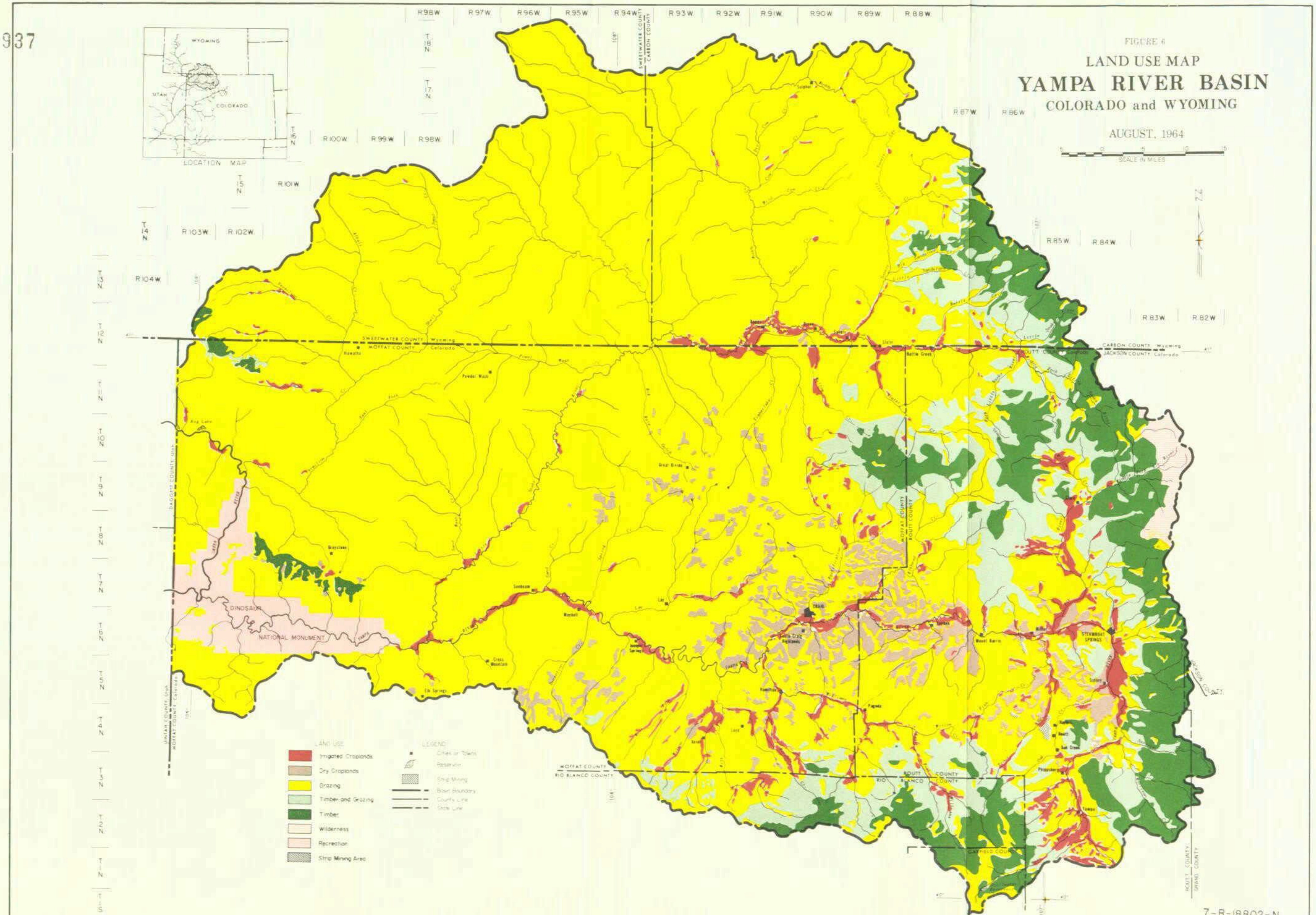

FIGURE 6
LAND USE MAP
YAMPA RIVER BASIN
COLORADO and WYOMING
AUGUST, 1964

7-R-18802-N

Table 4.--Land use by ownership, Yampa River Basin in Colorado and Wyoming, 1964

Ownership	Cropland: Irrigated	Cropland: Dry farm	Grazing	Timber and grazing	Timber	Wilderness	Recreation	Other 1/	Total
	Acres	Acres	Acres	Acres	Acres	Acres	Acres	Acres	Acres
Yampa River Basin in Colorado									
Private Land	82,600	179,600	1,322,900	101,900	22,700	0	4,500	48,700	1,762,900
State Land									
State and Local Government	0	7,700	215,200	8,700	2,600	0	0	21,800	256,000
Game, Fish and Parks Department	0	0	2,900	1,000	0	0	1,000	100	5,000
Federal Lands									
Bureau of Land Management	0	0	1,286,800	1,100	14,100	0	7,500	49,200	1,358,700 4/
Forest Service	0	0	45,700	400,300	271,600	29,300 2/	500 3/	23,500	770,900 4/
National Park Service	0	0	0	0	0	0	146,500 5/	0	146,500
Total-Colorado	82,600	187,300	2,873,500	513,000	311,000	29,300 2/	160,000	143,300	4,300,000
Percent	1.9	4.4	66.8	11.9	7.2	.7	3.7	3.4	100.0
Yampa River Basin in Wyoming									
Private Land	17,400	1,400	330,000	4,000	1,900	0	300	3,300	358,300
State Lands									
State and Local Government	200	0	88,400	5,000	2,000	0	0	1,900	97,500
Federal Lands									
Bureau of Land Management	0	0	1,156,000	2,600	4,000	0	100 3/	20,400	1,183,100 4/
Forest Service	0	0	27,600	80,000	31,000	0	100 3/	21,400	160,100 4/
Total-Wyoming	17,600	1,400	1,602,000	91,600	38,900	0	500	47,000	1,799,000
Percent	1.0	.1	89.0	5.1	2.2	0	0	2.6	100.0
Total-Basin	100,200	188,700	4,475,500	604,600	349,900	29,300	160,500	190,300	6,099,000
Percent	1.7	3.1	73.4	9.9	5.7	.5	2.6	3.1	100.0

1/ Includes town sites, rights-of-way, mineral lands and other miscellaneous uses.

2/ Grazing is permitted on 18,000 acres of the Mt. Zirkel Wilderness Area.

3/ Includes only developed or designated recreation areas. All national forest and Bureau of Land Management lands are available and used for recreation.

4/ Bureau of Reclamation and other withdrawal lands included.

5/ Grazing is permitted on approximately 82,200 acres.

Source: USDA Field Party from data furnished by the Soil Conservation Service, Forest Service, National Park Service, Bureau of Land Management, and the States of Colorado and Wyoming.

for a total of 100,200 acres being irrigated. Almost all of the irrigated cropland is used for pasture or winter feed production for livestock. The land resource of the basin is generally better suited to livestock production than for cash crop production. This is largely due to climatic factors which limit crop production at higher elevations principally to hay or pasture. At lower elevations the growing season is long enough for production of small grains and corn.

Dry cropland (188,700 acres) occupies about 3 percent of the total land area of the basin. With the exception of about 1,400 acres, all of this land is in Colorado. During the 1943-60 study period, the average acreage of dry cropland was about 150,000 acres. Throughout the study period there has been a rather steady increase in the total acreage of dry cropland being used for crops or planted pastures. Wheat is the most important dryland crop with an average 51,000 acres being harvested each year during the study period. Nonirrigated hay is the next most important crop with an average of about 24,000 acres being harvested each year, followed in importance by barley and oats. Summer-fallow is generally necessary for nonirrigated small grain production. During the 1943-60 period, an average of 47,000 acres were summer-fallowed each year.

Approximately 85 percent of the land in the basin is used for grazing by domestic livestock and wildlife. Included in the timber and grazing lands are areas with predominately aspen cover or open forest stands which provide good grazing. Grazing is permitted on 18,000 acres of the Mount Zirkel Wilderness, Routt National Forest, and approximately 82,200 acres of Dinosaur National Monument. These lands are also important as watershed lands, wildlife habitat, and for recreational uses such as hunting, fishing, camping, and sightseeing. Commercial timberland occupies about 6 percent (349,900 acres) of the basin.

The 29,300 acres devoted to wilderness use are located in the headwaters of the basin in the Mount Zirkel Wilderness. It includes the headwaters of the Little Snake and Elk rivers. These lands are administered to preserve and enhance the wilderness resource and are managed in near-natural condition. They provide opportunities for an unconfined type of recreation and contain ecological, geological, and other features of educational, scientific, and scenic values. 1/

The Yampa River Basin is famous for its mountain scenery and most of it provides some form of recreation. Of the 160,000 acres of developed or designated recreational lands, 146,500 acres are in Dinosaur National Monument under the jurisdiction of the National Park Service. This

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1/ The grazing of livestock, where established prior to September 3, 1964, is permitted to the extent consistent with the objective of the maintenance or improvement of soil, vegetative cover, and wilderness values.

Monument contains some of the most spectacular canyon land in the National Park system. The 4,800 acres of private recreational lands are mostly used for mountain home sites, guest ranch facilities, fishing ponds, etc. The Colorado Game, Fish and Parks Department has about 1,000 acres used solely for recreation in developed areas such as Ralph White Lake, Finger Rock Rearing Unit, Pearl Lake, the Hubbard property on Service Creek, and access road rights-of-way. The Browns Park Management Unit and the Indian Run Management area are used primarily for big game winter ranges. The Ralph White Reservoir, Finger Rock Rearing Unit, Hubbard property, and Pearl Lake are used primarily for fishing.

Recreation lands under the jurisdiction of the Bureau of Land Management (7,600 acres) include all designated or planned recreation areas. These are not highly developed and consist mostly of streams, natural recreation sites, hunter camps, or historic sites. The 600 acres of national forest shown as recreational lands comprise only developed campgrounds and picnic sites. Under multiple use management almost the entire area of national forest and Bureau of Land Management lands is available and used for some form of recreation activity.

Lands administered by the Forest Service and the Bureau of Land Management are managed under principles of multiple use to produce a sustained yield of products and services as authorized and directed by the Multiple Use Acts of June 12, 1960, and September 19, 1964, respectively. The multiple use principle provides for management of the resources of these public lands so they are utilized in the combination that will best meet the needs of the American people. The Acts provide for "harmonious and coordinated management of the various resources, each with the other, without impairment of the productivity of the land, with consideration being given to the relative values of the various resources, and not necessarily the combination of uses that will give the greatest dollar return or the greatest unit output."

Public lands furnish about 46 percent of rangeland grazing for domestic livestock, most of the range and habitat for big game and wildlife, and most of the outdoor recreation opportunities. The national forest lands include the high-elevation areas that are the primary sources of water.

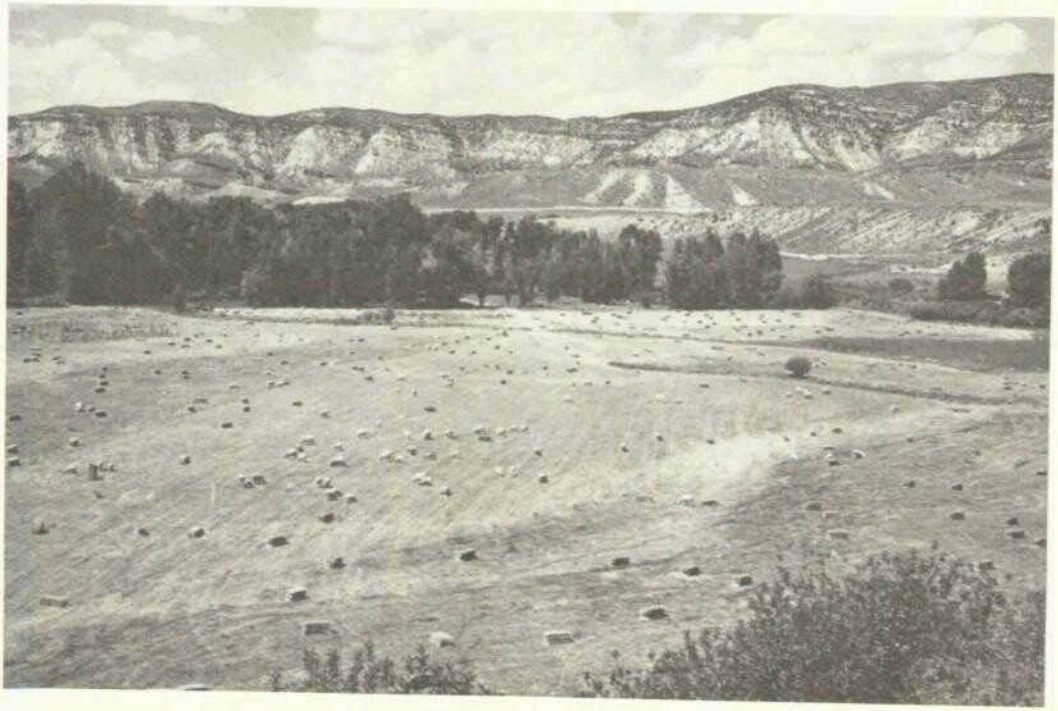
Cover Conditions and Management

Cover conditions vary from dense virgin forest to nearly barren desert areas. Watershed runoff and total water production follow the same pattern and are generally related to the same factors of elevation, exposure, and climate that produce the variations in cover. In general, sediment production is low and the total stream load is small. However, there are some areas having poor vegetative cover that produce relatively high sediment yields. Most of these areas are in soil mapping unit 1.0 of the desert lands. The Vermilion Creek and Lower Snake River drainages

are the most significant from the standpoint of sediment production and dissolved salt load of the river. Some areas of irrigated and dry cropland are eroding and producing excessive amounts of sediment. Figure 6 - Land Use Map following page 24 indicates the general location of land use in relation to the soil mapping units shown on Figure 4 - General Soil Map following page 12. To facilitate the description of cover conditions and management, land use was broken into vegetative zones corresponding to groupings of the soil mapping units (table 5).

Irrigated Cropland

Over half of the 100,200 acres of irrigated cropland is located in the rolling hills and valleys vegetative zone (soil mapping unit 4.0). Many of these lands are composed of old natural meadows on alluvial floodplains, seeped areas, and the adjacent mesas and slopes along the main tributaries and mainstem of the Yampa River. The mountain and foothills vegetative zones account for an additional 43 percent of the irrigated lands. These lands are usually scattered along the floodplains and terraces and frequently have a short water supply. Many small areas with short irrigation water supply are being abandoned. Additional areas of natural meadows have been destroyed by gullies caused by excessive runoff resulting from depleted cover of watershed lands.



Irrigated hay meadow with aftermath grazing
(soil mapping unit 4.0)

Table 5.--Land use by vegetative zones, Yampa River Basin in Colorado and Wyoming, 1964

Vegetative zones	Soil mapping units	Cropland: Irrigated	Cropland: Dry farm	Grazing	Timber and grazing	Timber	Wilderness	Recreation	Other 1/	Total
		Acres	Acres	Acres	Acres	Acres	Acres	Acres	Acres	Acres
Yampa River Basin in Colorado										
Saltdesert	1.0	2,900	0	562,800	0	0	0	2,700	17,600	586,000
Foothills	2.1, 2.3, & 2.4	9,500	27,300	1,023,200	0	0	0	12,500	36,500	1,109,000
Canyon lands	3.0	0	0	201,800	0	37,800	0	125,600	11,800	377,000
Rolling hills and valleys	4.0	51,500	149,000	226,000	0	0	0	1,300	17,200	445,000
Mountain	5.1, 5.2, & 5.3	18,700	11,000	839,700	420,000	96,600	0	17,400	47,600	1,451,000
Timber and alpine	6.0 & 7.0	0	0	20,000	93,000	176,600	29,300	500	12,600	332,000
Total-Colorado		82,600	187,300	2,873,500	513,000	311,000	29,300 2/	160,000 3/	143,300	4,300,000
Yampa River Basin in Wyoming										
Saltdesert	1.0	2,400	0	1,023,000	0	0	0	0	24,600	1,050,000
Foothills	2.1, 2.2, & 2.3	10,700	900	291,000	0	0	0	200	12,200	315,000
Canyon lands	3.0	0	0	0	0	0	0	0	0	0
Rolling hills and valleys	4.0	0	0	0	0	0	0	0	0	0
Mountain	5.1, 5.2, & 5.3	4,500	500	274,000	61,000	0	0	200	7,800	348,000
Timber and alpine	6.0 & 7.0	0	0	14,000	30,600	38,900	0	100	2,400	86,000
Total-Wyoming		17,600	1,400	1,602,000	91,600 4/	38,900	0	500	47,000	1,799,000
Total-Basin		100,200	188,700	4,475,500	604,600	349,900	29,300 2/	160,500 5/	190,300	6,099,000

1/ Includes town sites, rights-of-way, mineral lands and other miscellaneous uses.

2/ Grazing is permitted on 18,000 acres of the Mt. Zirkel Wilderness Area.

3/ Grazing is permitted on approximately 82,200 acres of the Dinosaur National Monument.

4/ Includes approximately 41,000 acres of open coniferous cover which provides good grazing.

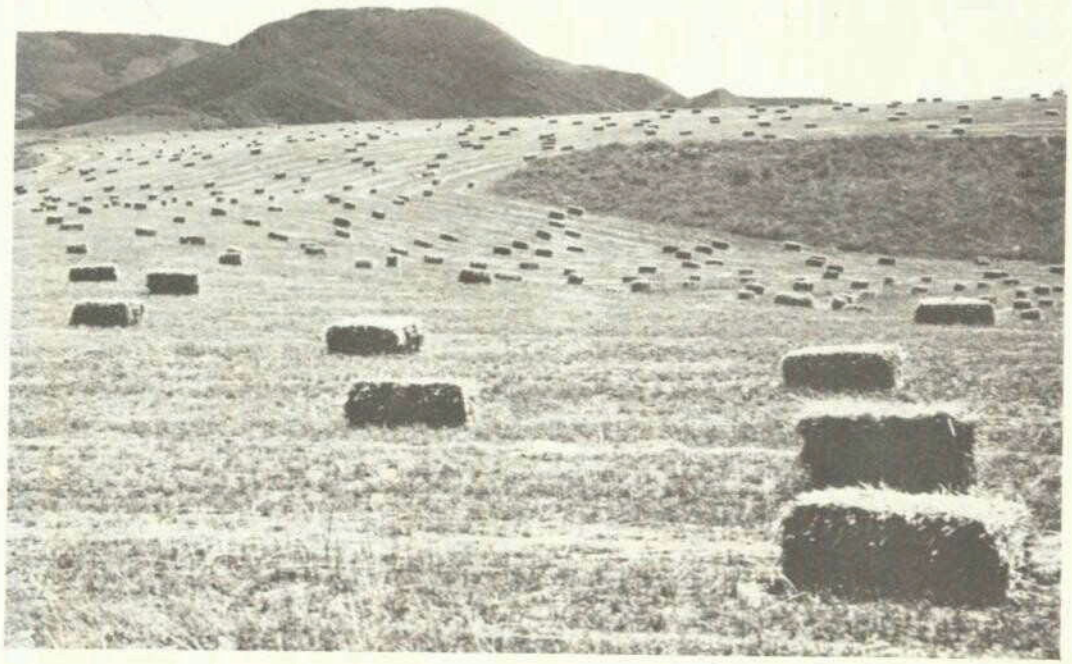
5/ Includes only developed or designated recreation areas. All national forest and Bureau of Land Management lands are available and used for recreation.

Source: USDA Field Party from data furnished by the Soil Conservation Service, Forest Service, National Park Service, Bureau of Land Management, and the States of Colorado and Wyoming.

The principal management problem of irrigated areas is related to a short supply of late season irrigation water. This has limited production and prevented the operator from making needed improvements to provide better irrigation water management. In some areas overirrigation when water is plentiful has resulted in seep spots and salt accumulation. In general, irrigation developments such as land leveling, proper spacing of irrigation laterals, water control structures, and other water management aids are progressing slowly because of the water shortages and the attendant low crop yields.

Dry Cropland

Approximately 80 percent of the 188,700 acres of dry cropland is in the rolling hills and valleys vegetative zone of soil mapping unit 4.0. The predominant cultivated use is production of winter wheat by the summer-fallow method. During the 1943-60 period approximately 69,000 acres of small grains were harvested each year. An additional 24,000 acres of dry cropland are used for hay and approximately 12,000 acres are planted to pasture. Dry cropland in the rolling hills and valleys vegetative zone has an annual precipitation of from 15 to 20 inches and produces well. Dry cropland in the foothills vegetative zone is less productive and many areas have been planted to either temporary or permanent pasture.



Dry cropland near Clark
(soil mapping unit 4.0)

Most of the dry cropland conservation problems are from sheet, rill, and gully erosion that are quite prevalent on the wheat and fallow lands. Much of this land is steep and has poor protection against erosion in comparison to hay or planted pasture lands. Wind erosion is also a problem on some of the sandy soils during the early spring months. The most effective practice to control erosion on the more critical areas is to plant them to pasture or range grasses. Small grains are increasingly being farmed with a system of stubble mulch on fallow lands, cross slope cultivation, and in some cases fall chiseling. Alternate strip cropping of grass-legume hay in rotation with wheat and fallow lands has proven effective in reducing erosion on the dry cropland. Grassed waterways are also very effective in controlling gully erosion on cropland.

Rangeland

The natural vegetation of the Yampa River Basin includes a number of grasses, forbs and shrubs that produce varying amounts of forage depending on the climate and soils of any particular area. Climate exerts the greatest influence of the environmental factors that affect plant growth.

Extremes in climate provide for marked differences in the kinds and amounts of native plants. Soil is also very important in providing varied forms of vegetation.

Salt desert zone ——— This rangeland (1,585,800 acres) is referred to as saltdesert shrub and sometimes Northern desert shrub or Intermountain shrub. The general aridity and salinity of the soils limits plants to those best adapted to these environmental features. Plants of the uplands are Gardner saltbush, mat saltbush, shadscale, fourwing saltbush, bud sage, galleta grass, Indian rice grass, and black sagebrush. Lowlands have greasewood, rabbitbrush, big sagebrush, saltgrass, alkali sacaton and western wheatgrass as the principal plants.

This zone (soil mapping unit 1.0) is used largely by migratory bands of sheep for grazing or browse in the winter season. Some of the sheep use is in the fall and spring as they move through the zone. Antelope are the main resident game animals. Mule deer make considerable use of the zone during the winter. Cattle are grazed but not as extensively as sheep.

The soils in this zone are highly susceptible to deterioration and can be very erosive. Careful range use is essential. The balance between an adequate plant cover and exposed bare ground is delicate and can be

thrown off balance by overgrazing, fire, or other excessive disturbances. The Bureau of Land Management classifies some of this zone as "Frail Watershed Land." 1/

This arid land is naturally low in plant production and stocking rates are necessarily low. Stocking rates may range from 35 acres per animal unit month on poorly covered shale lands to 3 acres per animal unit month on favorable soils in excellent range condition.

Range management practices being used include control of stocking and degree of use, and an improved system of grazing that will incorporate nonuse during critical plant growth periods. Such a system helps maintain or restore range plant vigor, and aids in establishing new reproduction.

Additional fencing and stock watering places are being developed to improve distribution of livestock and reduce overgrazing on parts of the range while other parts remain ungrazed.

Foothills zone ——— There are over 1.3 million acres of grazing land in the foothills vegetative zone. Conditions for plant growth are considerably better in this vegetative zone (soil mapping units 2.1, 2.2, 2.3, and 2.4) than in the saltdesert zone. However, except in areas benefiting from a watertable or overflow, conditions for plant growth are still limited because of insufficient soil moisture, physical soil conditions or combinations of these factors.

Most of this zone has big sagebrush cover. Production of native wheatgrass, needle and thread grass, blue grasses, and other palatable plants, is high and usually depenable, particularly if the range receives proper use of the desirable plants and periodic deferment. In addition, pinyon pine and Utah juniper woodland, or pygmy forest, are found in this zone along with mountain mahogany, Indian rice grass, and wheatgrasses.

Livestock operations in this zone are sheep or beef cattle, both yearlong and spring-fall seasonal. Antelope are found in appreciable numbers. Mule deer use the range chiefly in the winter.

Canyon lands zone ——— The canyon lands (soil mapping unit 3.0) are mostly in and adjacent to Dinosaur National Monument. These lands are richly endowed in the magnificent natural beauty of colorful canyons and mesas, and the main use is for recreation. Almost one-third of the zone

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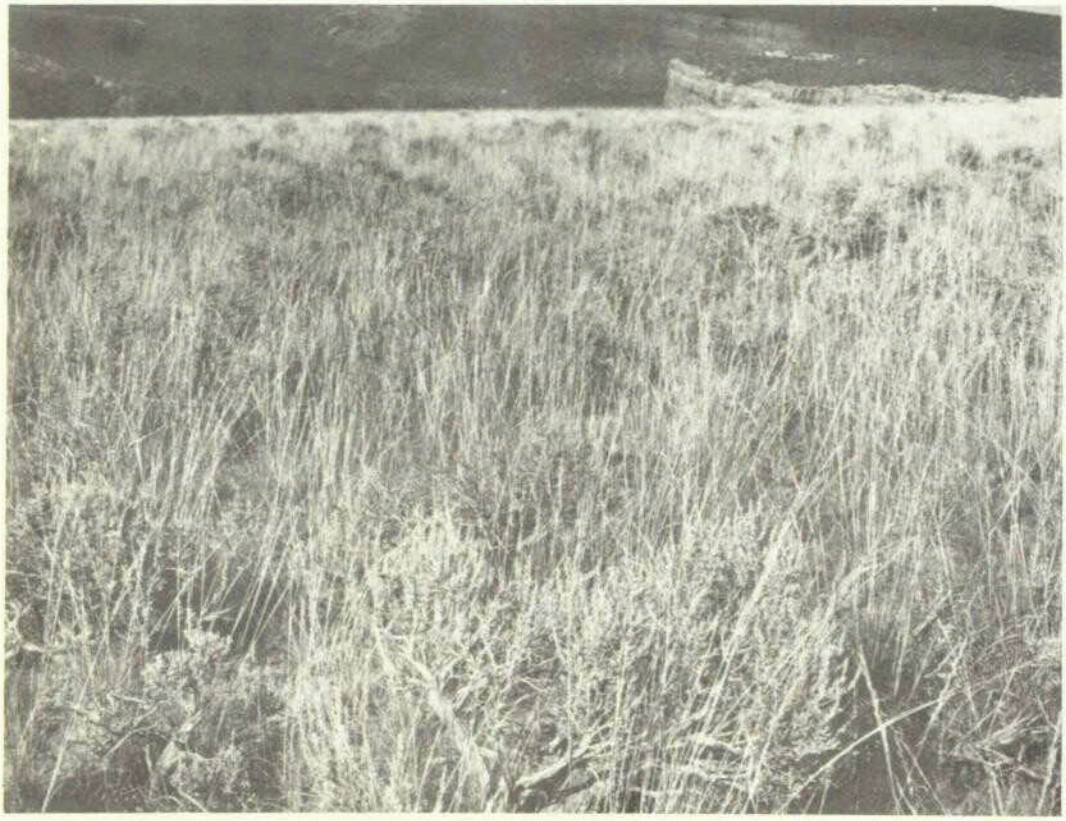
1/ Frail watershed lands as described by the Bureau of Land Management in their report, "A Preliminary Study and Report on Frail Watershed Lands" are those lands that, because of one or more factors, such as steepness of slope, nature of soil, plant-cover condition or possibly other factors, are highly susceptible to erosion.

is rock outcrop and much of the remainder is limited in its ability to produce forage on a sustained basis because of steepness of slope, shallow soil, low precipitation and other factors affecting plant growth. There are limited acreages of good rangeland, but this acreage makes up little more than 25 percent of the zone.



Deferred grazing land
(soil mapping unit 3.0)

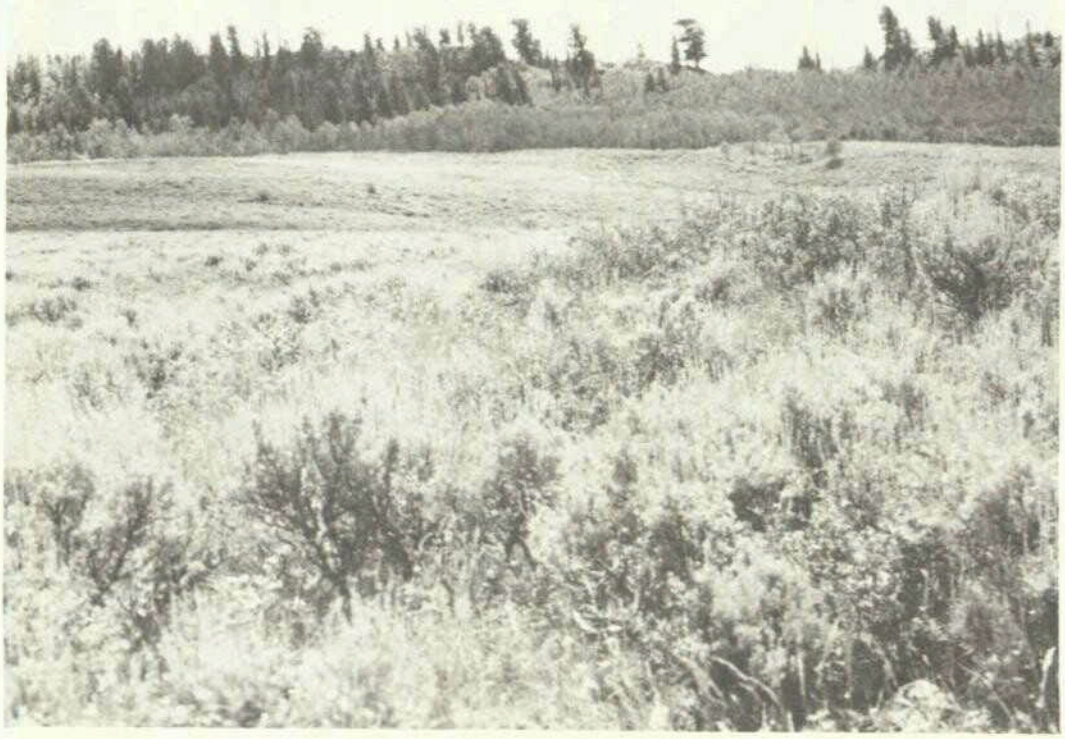
Rolling hills and valleys zone ——— Most of this zone is in soil mapping unit 4.0 and represents the best land for agricultural purposes. Favorable features of this vegetative zone include deep productive soils, moderately high precipitation, and a frost-free period suitable for crop production. These factors have resulted in extensive use of this land for grain crops, irrigated hay, and planted pasture.

The same features make these lands high producers of native range forage. Range in this zone (226,000 acres) has high to moderately high carrying capacity for livestock grazing. In addition, some dry cropland is

planted to introduced grasses and legumes for pasture. These pastures are generally used for early or late season grazing, calving, or lambing pastures.

Wheatgrasses, bluegrasses, bromegrasses and needlegrasses form much of the forage of these lands. Browse plants are important, too. Among these are sagebrush, bitterbrush, mountain mahogany, chokecherry, serviceberry, rabbitbrush, snowberry, and oakbrush. These plants make this an important wildlife area. These rangelands respond favorably to improved management practices such as brush control, range and pasture seeding, stock water development, and fencing for better livestock distribution.

Mountain zone ——— Soil mapping units 5.1, 5.2, and 5.3 are grouped into the mountain vegetative zone. Much of this zone is within the boundaries of the national forests. Native plant cover of this zone is a luxuriant combination of grasses, forbs, shrubs, and aspen trees. Forage and browse production is dependable. Ranchers and game managers do not have the problem of serious fluctuations in forage production common to many rangelands of the west.



Mountain vegetative zone grazing land near Toponas
(soil mapping unit 5.3)

A desirable plant cover is maintained on rangelands of this zone where proper range management practices are followed. Fencing and development of stock water have helped to provide uniform grazing use and are a means of improving livestock production. Range production averages from 2 to 8 acres per animal unit month of grazing on the majority of the rangeland.

Brush control has been applied on specific areas of big sagebrush, rabbitbrush, and oakbrush where they reduced forage production. In general, brush does not become a serious problem where grazing is managed in keeping with sustained plant growth requirements.

Timber and alpine zone —— This vegetative zone includes soil mapping units 6.0 and 7.0. It is practically all within national forest boundaries and is the highest water yielding area. Range condition is from fair to excellent and provides considerable grazing.

The forest areas (215,500 acres) are very good to excellent spruce-fir timber sites. In 1948 an Engelmann spruce beetle epidemic killed most of the merchantable Engelmann spruce. These areas now have an excellent stand of young spruce and alpine fir reproduction. This timber will not reach merchantable, pulpwood size before the year 2000. Many of the stands of aspen in this zone are the result of past fires and are growing on good to very good spruce-fir timber growing sites.

Precipitation is high (20-60 inches annually) within this vegetative zone and most of it occurs in the form of snow. Late season snowmelt provides a sustained streamflow. The major part of the water yield and streamflow comes from this zone.

This zone is used extensively for recreation. It is the summer habitat for large numbers of elk and deer and provides important summer range for sheep and cattle which graze under permit. Included within this zone are 29,300 acres of the Mount Zirkel Wilderness.

Water Resources

Water Supply

Most of the water yield is produced by the melting of winter snowpacks on the high mountain slopes. Summer precipitation augments this water supply in minimal amounts. There is considerable variation in watershed yield, reflecting climatological differences throughout the basin. Water yield ranges from more than 40 inches from the high alpine zones to negligible amounts in the saltdesert vegetative zone. An average annual water yield map (Figure 7) for the 1943-60 period follows page 36. Approximately 64 percent of the annual stream discharge on the Yampa River near Maybell occurs in the months of May and June.

High mountain snowpack, U. S. Highway 40

Total undepleted water supply 1/ at the Colorado-Utah state line averaged about 1,605,000 acre-feet annually for the 1943-60 study period. Onsite depletions by forests, native pasture, range vegetation, natural lake evaporation and wildlife are excluded from this total. The basin was divided into three hydrologic areas for water resource evaluation. These divisions, shown on the Water Resources Frontispiece, are the Yampa Main Stem Subbasin, the Little Snake River Subbasin, and the Vermilion Creek Subbasin. About 86 percent of the water supply comes from Colorado and the remaining 14 percent from Wyoming.

1/ Total undepleted water supply is used herein in the sense of the aggregate natural runoff before diminishment by man-related depletions.

002944

LEGEND

Contour lines showing 1943–60 average annual water yield, in inches

Contour interval

- Below 1 inch
- 1 to 5 inches
- 5 to 10 inches
- 10 to 20 inches
- 20 to 30 inches
- 30 to 40 inches
- Above 40 inches
- ▲ Streamgaging Stations

FIGURE 7

1943-60 AVERAGE ANNUAL WATER YIELD MAP

YAMPA RIVER BASIN

COLORADO AND WYOMING

MAY 1967

M7-S-18989 A-N

The Yampa Main Stem Subbasin provides 74 percent of the water supply, all originating in Colorado. Twenty-four percent of the water is produced by the Little Snake River Subbasin (46 percent of this comes from Colorado and 54 percent from Wyoming) while the Vermilion Creek Subbasin adds the final 2 percent (88 percent from Colorado and 12 percent from Wyoming). The 1943-60 average annual discharge at the Utah-Colorado state line is estimated at 1,502,900 acre-feet. Of this the Little Snake River Subbasin contributes 379,300 acre-feet and Vermilion Creek Subbasin 35,200 acre-feet.

In national forest boundaries are 87 natural lakes and 111 small reservoirs developed as recreation, fishing, stock water, and irrigation facilities. The Bureau of Land Management has 347 stockponds. There are about 5,000 small reservoirs on private land used for irrigation, fishing, stock watering, and recreation. In addition, there are 8 reservoirs of 500 acre-feet or greater capacity for municipal water supply or irrigation water storage.

Ground water provides a very minor amount (less than 1 percent) of the water used on irrigated lands in the basin.

Water Quality

Three factors generally associated with water quality are dissolved solids, suspended sediment, and pollution by industrial or human contaminates. In all of these the main rivers and streams of the area have a good rating. Although their water yield is a small part of the basin total, the intermittent streams at the lower elevations produce most of the dissolved solids and suspended sediments that leave the basin. The high elevation headwaters portion of the basin produces most of the water yield in the form of snowmelt runoff of high quality.

Industrialization and high population densities have not developed to date, thus this type of associated contamination is limited. Also, base flows of the rivers and streams have been maintained which is another important factor in maintaining water quality.

Another indicator of good water quality is the presence of a healthy trout population. The mountainous water producing part of the basin has excellent trout fishing.

Water Rights 1/

The doctrine of prior appropriations was first adopted in the State of Colorado by local customs. It was later reaffirmed

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1/ This statement was prepared by the Colorado Water Conservation Board and the Wyoming State Engineer's Office for inclusion in this report.

by the Colorado Constitution and by certain statutes adopted pursuant to the Constitution. The doctrine states that the first person to use the water has the first right to the water. The doctrine also provides that the unappropriated water of any natural stream of the state is subject to appropriation for beneficial use.

Usually as a first step in the procedure for acquiring a water right, the prospective appropriator either commences surveys for or starts actual construction of necessary water use facilities. Thereafter the appropriator should file a statement of a claim in the office of the State Engineer for the use of water. An appropriation is completed when the water is applied to a beneficial use. The appropriator may then have the water right established by an adjudication proceeding in the proper District Court. The District Court then enters a decree for the water right.

The Colorado State Engineer, along with his duly authorized representatives, administers the distribution of water in accordance with decrees. It is his duty to see that waters of the state are preserved for the use and benefit of the citizens and inhabitants of the state, and are not wasted.

The Constitution of the State of Wyoming provides that water may be obtained for beneficial use under the doctrine of prior appropriation. The right to deny an appropriation is set forth. The Constitution also creates a Board of Control, composed of the state engineer and the superintendents of the water divisions.

In order to obtain a water right in the State of Wyoming, a claimant must make application to the State Engineer for the water he proposes to use. If the State Engineer determines that there is surplus water, the water right normally will be granted. If, however, the State Engineer determines that there is no surplus water, or that the proposed use of water would not be in the public interest, there will be a denial of the water right.

The Wyoming State Engineer and the superintendents of the water divisions administer the distribution of water in accordance with the appropriation dates of the water users, the first in time being the first in right.

The Yampa River originates within the States of Colorado and Wyoming. During the flood period of the year, which occurs in the spring, the Yampa River and its tributaries carry quantities of unappropriated water. There exists, therefore, an

opportunity to establish new water rights by constructing more reservoir storage facilities on the Yampa River and its tributaries to capture unappropriated water and place it to beneficial use. Beneficial use may be affected by releases and diversion of stored water or by exchange for direct flow diversions upstream.

The Upper Colorado River Basin Compact

The consumptive use of water of the Little Snake River, a tributary to the Yampa, and the consumptive use of water to the Yampa River itself, are governed to a certain extent by the terms of the Upper Colorado River Basin Compact of 1948.

Article XI sets forth the apportionment of water of the Little Snake River between the States of Colorado and Wyoming. The first part of Article XI sets forth procedures for the use of water under rights existing prior to the Compact. The second part of the Article sets forth the procedures for the initiation of water rights subsequent to the signing of the Compact.

Article XIII apportions the water of the Yampa River between the States of Colorado and Utah. Essentially, that Article provides that the State of Colorado will not cause the flow of the Yampa River at the Maybell gaging station to be depleted below an aggregate of 5 million acre-feet for any period of ten consecutive years.

Water Use

The average annual depletion of the basin's water supply during the 1943-60 period was about 102,100 acre-feet (table 6). Onsite depletions by forests, native pasture, range vegetation, natural lake evaporation, and wildlife are not included in this amount. In this report, water resource depletions are estimates of water consumptively used by man's activities and do not represent the total amount of water diverted from natural stream flows.

Irrigation is the major use of water within the basin. Net consumptive use on irrigated land 1/ accounts for about 70 percent of the total water depletion. More than 96 percent of the irrigated land is used to produce hay and irrigated pasture. Geographically, the major water depletion (nearly 74 percent) is in the Yampa Main Stem Subbasin. Wyoming use

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1/ Net consumptive use on irrigated land is the amount of water, excluding effective precipitation, used in evaporation and transpiration by a crop during its growing season.

Table 6.--Average annual water depletion, Yampa River Basin in Colorado and Wyoming, 1943-60

Water depletions	Colorado 1/			Wyoming 1/		
	Yampa Main Stem Subbasin	Little Snake River Subbasin	Vermilion Creek Subbasin	Little Snake River Subbasin	Vermilion Creek Subbasin	Total
	Acre-feet	Acre-feet	Acre-feet	Acre-feet	Acre-feet	Acre-feet
Consumptive use:						
Irrigated crops 2/	50,500	6,700	900	12,800	500	71,400
Riparian vegetation, nonbeneficial phreatophytes, seeped lands, and incidental areas 3/	14,900	1,400	400	1,600	300	18,600
Industrial, municipal, domestic and livestock use, and reservoir evaporation	7,500	700	100	1,000	0	9,300
Total consumptive use	72,900	8,800	1,400	15,400	800	99,300
Export:						
Water transported out of Basin	2,800	0	0	0	0	2,800
Total depletion	75,700	8,800	1,400	15,400	800	102,100

1/ See Water Resource Frontispiece for basin divisions.

2/ 96,500 acres of irrigated land, 80,000 acres in Colorado, 16,500 acres in Wyoming (1943-60 average).

3/ Estimates of water depletion resulting from riparian vegetation and nonbeneficial phreatophytes may in some instances include consumptive water use due to natural conditions that are impossible to separately identify and differentiate from man-related developments.

Source: USDA Field Party

amounts to about 16 percent of the total depletion, most of which is related to agriculture. The Blaney-Criddle procedures, based upon climatic records and average crop acreage distribution for the 1943-60 period, were used to compute the net consumptive use by irrigated crops. Adjustments were made to compensate for variations in adequacy of water supplies.

Other uses included consumptive use on noncrop water-using areas incidental to irrigation development, use by riparian and nonbeneficial phreatophytic vegetation and seeped lands, industrial, municipal, domestic and livestock water use, and evaporation losses from reservoirs. These uses amounted to over 27 percent of total depletions. Estimates were made using available data and appropriate procedures.

The average population of the basin during the 1943-60 period was about 14,800 people, with a related domestic and municipal water use of about 1 percent of the total depletion.

During the 1943-60 period the Egeria Creek Diversion exported an average 2,800 acre-feet annually, from the Bear River in the Upper Yampa Main Stem to Egeria Creek in the Colorado River Basin, via the Stillwater Ditch. This export is about 3 percent of the total annual depletion.

Increases in depletions from the 1943-60 study period to the present are relatively small for irrigated crops. Based on the 1964 irrigated acreage (table 4) the increase in consumptive use of water on irrigated land amounts to 2,300 acre-feet (4 percent) in Colorado and 1,500 acre-feet (11 percent) in Wyoming. The major increase in depletion has been for municipal and industrial use. The steam power generating plant at Hayden began operations July 1, 1965, and its consumptive use of water is 3,300 acre-feet. The Hog Park Diversion is a basin export which diverted 7,800 acre-feet from the Little Snake River to Cheyenne, Wyoming, beginning in 1967. These depletions are included in the 1980 projections (table 26).

Recreation Resources

Natural Features

The basin is composed of about 36 percent mountains, 6 percent canyon lands, and 20 percent foothills all of which provide superb scenic values. There are approximately 1,000 acres of fishing reservoirs and lakes, 700-800 miles of streams suitable for fishing, and about 100 miles suitable for boating.

The east and southeast part of the basin are mountainous with about 931,000 acres in national forest (Figure 5 - Land Ownership Map). The mountain areas both inside and outside of the national forest furnish tremendous opportunities for recreation. The mountainous area ranges from about 7,000 feet elevation above sea level to over 12,000 feet.

This is a part of the Colorado Rocky Mountains which is considered as being a national playground. The natural attractiveness and resources have been augmented by construction of reservoirs, campgrounds, and picnic sites. It is also a desirable area for those who wish to have a second family home in the mountains.

The lower elevations and desert country provide mesas, sagebrush slopes, juniper hills, and canyon lands. Geologic history is exposed for viewing in the canyon lands. Rivers are increasingly used for boating, viewing formations, and fishing.

Winter sports include skiing, bobsledding, cutter races, tobogganing, snowmobiling, and ice skating. Mountain areas provide deep snow, cold weather, and steep slopes to enhance these sports. They can be reached by improved highways, railroad, and by air.

An important natural feature of the basin is Dinosaur National Monument. The Monument's headquarters is at Dinosaur, Colorado, but it has a visitor center and dinosaur quarry near Jensen, Utah. The Monument covers 206,000 acres (146,500 in Colorado) and provides opportunities for archeological study, viewing fossils, geologic formations, sandstone cliffs, boating on rapid water, camping, picnicking, and fishing. The main recreation center within the Monument is Echo Park which is at the junction of the Yampa and Green rivers. About twenty-one miles of the Green River and 48 miles of the Yampa River are within the Colorado part of Dinosaur National Monument. Boating and rafting are growing recreation enterprises on parts of both rivers. Camping and picnic areas are arranged for boaters and highway travelers.

The Mount Zirkel Wilderness, part of the Routt National Forest, is located along the northeastern extremity of the Continental Divide in Colorado. This wilderness area is one of spectacular mountain scenery in an almost natural state. Recreational pursuits include hunting, fishing, hiking, horseback riding, and camping.

Wildlife

Wildlife varies according to available habitat. Mountains provide food and cover important to elk, deer, bear, mountain sheep, mountain lion, beaver, eagles, hawks, blue grouse, snowshoe rabbits, rockchucks, coyotes, waterfowl, chipmunks, ground squirrels, and others.

Foothills, canyons, and desert areas provide food and cover for deer, mountain sheep, antelope, sage and sharptail grouse, jackrabbits, cottontail rabbits, coyotes, bobcats, waterfowl, pheasants, ground squirrels, hawks, magpies, and songbirds. Wildlife numbers within the basin are still plentiful. Game animals such as deer, elk, antelope, and sage grouse provide considerable hunting opportunities.

Water Based Recreation

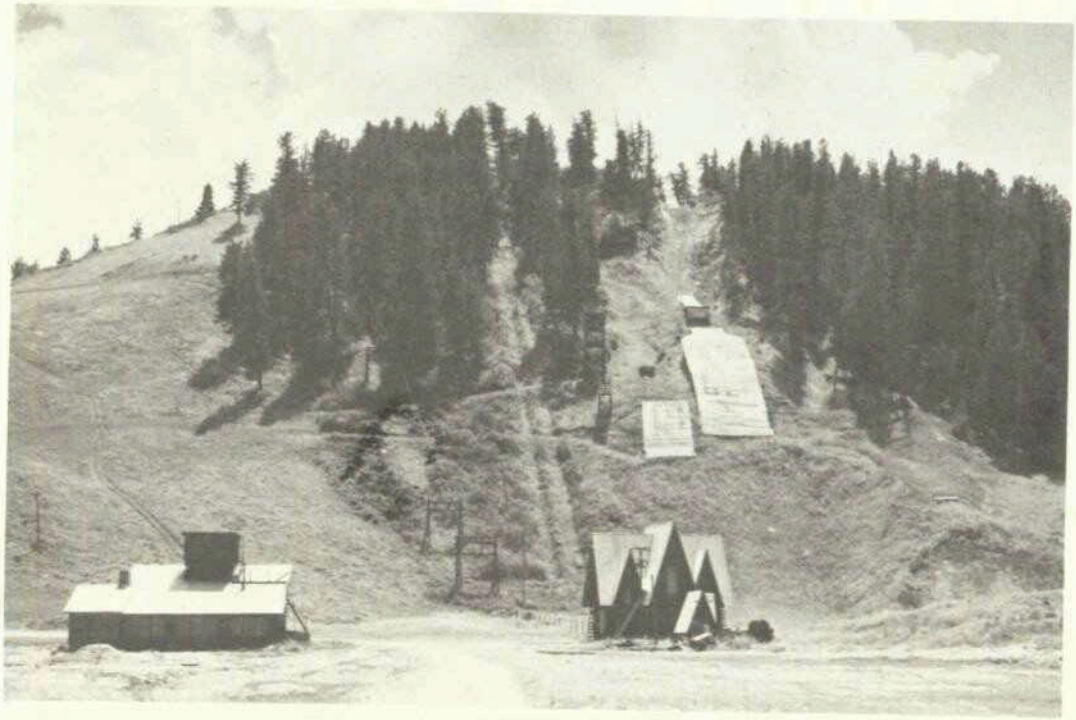
Fishing is the most important water based recreation. The majority of the streams and lakes are stocked with trout. The principal stocked trout are rainbows, but there are lakes and streams with native cutthroat, brown and brook trout, and white fish. Lower reaches of the Yampa River and that part of the Green River within the basin have catfish.

Boating is primarily in conjunction with fishing or rapid running. Few of the lakes are large or warm enough for water skiing. Float and rapid running trips down the Yampa and Green rivers are popular.

Swimming is quite popular but is provided mainly by city pools. Steamboat Springs and Juniper Springs have natural hot-water pools. Practically all of the natural lakes are too cold for swimming.

Winter Sports

The mountain area around Steamboat Springs is excellent for skiing. Within the city limits Howelson Hill Ski Jump has been in operation for over 50 years. Recently a ski area has been developed at Mt. Werner (formerly called Storm Mountain). Snowfall at Steamboat Springs averages 12 to 15 feet per year. Excellent skiing conditions for a long season exist because low temperatures keep the snow at optimum condition.



Howelson Hill ski area

IV. ECONOMIC DEVELOPMENT

Historical Development

Indian lore of this area is not well recorded. The headwaters of the Yampa River were in the Ute territory, but the Yampa River Basin was the meeting ground for the mountain tribes such as the Arapahoes, the Gros Ventres, and the Sioux and Cheyenne Indians of the Great Plains. They were attracted to the basin by the abundance of big game and fish. In addition, the basin was accessible from the Laramie plains, the Red Desert, the Arkansas, and Colorado rivers, all natural wilderness routes, which contributed to the use of the basin.

The basin was visited and explored by many famous mountain men such as William Ashley, Peg Leg Smith, William and Milton Sublette, Thomas Fitzgerald, Gene Gerbais, Jim Bridger, Jim Baker, William Craig, Kit Carson, and others during the fur trapping period from 1825 to 1845. These fur seekers were followed by the market hunters of the late 1800's, but the real settlers of the area were the farmers and stockmen.

Early resource development history of the area was mainly a reflection of the physical characteristics. The Continental Divide tended to make this area inaccessible from the east. In 1862 the Overland Trail stage line was established through the northern part of the basin. The main pioneer trails for commerce and travel were generally north of the basin in Wyoming or south through the southern plains. Most of the immigrants who entered the western part of the United States completely missed this area.

The basin was included in Spanish claims from 1540 to 1836, in Mexican claims from 1836 to 1848, and in the Utah territory from 1850 until it became a part of the Colorado territory, and finally a part of the State of Colorado in 1876. The year 1876 is significant because it was the central date for early development of the area. It was at this time that the Ute Indians were removed from the Meeker area following their depredations, and gold was discovered at Hahns Peak in Routt County.

The first major settlements took place during the period between 1876 and 1900. Steamboat Springs was well enough established to have a post office as early as 1875. Settlement of Axial Basin, south of Craig, was in 1878. Settlement of Craig began in 1883 and the town had a population of 50 people by 1893. Coal mining began in the late 1880's. The first sawmill was operating in 1886. During this period cattle ranching on a large scale was the major activity within the area.

Settlement was rather slow between 1874 and 1910. The settlers who came into this country to take up homesteads generally filed on subirrigated or irrigable land along the rivers and creeks. The Denver, Salt Lake

and Pacific Railroad (now the Denver and Rio Grande Western Railroad) reached Steamboat Springs December 13, 1908, and was completed down the Yampa Valley to Craig, its western terminus, in 1913. The availability of a reliable form of transportation created an influx of homesteaders, especially around Craig and Steamboat Springs. Most of these small homesteaders took up holdings in the dryland areas. The peak year for homestead filing was about 1925. Thus, the building of the railroad marked the beginning of the end for the huge cattle ranches characteristic of the area before this time.

Only a few of the homesteaders stayed, most of them leaving because of the uncertainty of producing crops on the dryland. In later years drought and soil erosion created so many problems that the Great Divide Soil Erosion District (now the Moffat Soil Conservation District) was formed in January 1938. This district was the first in Colorado and the sixteenth in the United States. This district was successful in its operations and today nearly the entire basin is included in Soil Conservation Districts.

The advent of the railroad also signaled the exploitation of the coal reserves of the basin. Another industry was born in 1924 when oil was struck at a depth of 3,800 feet on the Hamilton Dome 15 miles south of Craig. Coal, oil, and gas production remain very important factors in the economy. The Craig area has also been important as a rail shipping point for gilsonite. In recent years there has been some activity in uranium claim development and a mill for the treatment of uranium ores was built near Maybell in 1957. This mill has since closed and the remaining known resources would not justify any local mill operations.

Skiing in Routt County had its start when Carl Howelson, a professional ski jumper from Denver, helped organize the Steamboat Springs Ski Club in 1914 and built the first ski jump.

Routt County comprised all of the present day Moffat and Routt counties until 1912 when it was divided. Moffat County was created from the western two-thirds of Routt County because the homesteaders found the need for a closer government seat. It was named after David Moffat, railroad builder. Craig, founded as a trading center, (first called Yampa) was named the county seat. Craig is an important shipping point even today. It is the nation's largest wool shipping point (3.5 million pounds) and one of the largest sheep and cattle shipping points in the United States. For a considerable period after the railroad reached Steamboat Springs the Steamboat Springs stockyard was the largest cattle shipping point in the United States.

Agriculture remains as the main land and water using industry with sheep, cattle, wool, and winter wheat being the main exports. Recreation is growing as an industry and it is expected that it will be more important in the future development of the basin.

General Description

Population and Employment

About 13,160 people were living in the basin in 1960 (table 7). The population increased rather consistently between 1900 and 1940, as the area was being settled and developed. Subsequent to 1940, there was a loss in population largely as a result of closing the coal mines in Routt County. Recent developments, such as the coal-fired electric power generating plant at Hayden, have reversed this trend and estimated population was 13,400 in July 1967.

Table 7.--Population by counties, Yampa River Basin in Colorado and Wyoming, 1930-60

Counties	1930	1940	1950	1960
	Number	Number	Number	Number
Yampa River Basin in Colorado				
Garfield 1/	0	0	0	0
Grand 1/	0	0	0	0
Moffat 1/	4,670	4,880	5,490	6,600
Rio Blanco 1/	100	80	50	40
Routt 1/	9,080	10,160	8,670	5,690
Total-Colorado	13,850	15,120	14,210	12,330
Yampa River Basin in Wyoming				
Carbon 1/	800	880	820	780
Sweetwater 1/	50	80	60	50
Total-Wyoming	850	960	880	830
Total	14,700	16,080	15,090	13,160

1/ Estimated for portion of county within the basin.

Source: U. S. Census of Population

Approximately 94 percent of the 1960 population lived in the Colorado portion of the basin, with about half of the people in Moffat County and the balance in Rio Blanco and Routt counties. Records do not indicate any permanent resident population in the Garfield and Grand counties

portions of the basin. In 1960, 56 percent of the people in the Colorado portion of the basin lived in the four main towns - Craig (3,984), Hayden (764), Steamboat Springs (1,843), and Yampa (312).

The population of the Wyoming portion of the basin has remained relatively constant at about 850 people since 1930. In 1960 this area was estimated to have a population of 830 people, with 199 in Baggs and 108 in Dixon. No population estimate is available for the community of Savery.

The only urban center, Craig, had a 1960 population of 3,984 people accounting for about 30 percent of the basin population. There is a trend towards an increasing percentage of the population in the dependent age groups - the young and the old. There is a particular trend toward an increase in the number of persons over 65 years and a decrease in the number of young adults who form a major part of the working population. This is primarily the result of a large out migration from 1950 to 1960.

Total 1960 employment in Routt and Moffat counties was about 4,700 people (table 8). Approximately 89 percent of the area of both of these counties is in the Yampa River Basin, and their 1960 population of 12,961 is close to the estimated 13,160 people in the basin. Therefore, employment in Routt and Moffat counties was used to indicate employment in the basin.

Agriculture was the largest employer with 906 people (19.3 percent) of the labor force. This was a considerable reduction from 1950 when 1,514 people (26.1 percent) were employed by agriculture. This reduction was consistent with State and national trends. There was also a loss of 216 people employed in mining during this period. Gains in other sectors failed to compensate for these, and with other losses the total employment was reduced by 1,114 jobs.

Major Types of Economic Activity

Because of its size and the variables in elevation and terrain the economy of the Yampa River Basin is extremely diverse. Livestock grazing and mineral production (petroleum and coal) are important to most of the basin. Certain areas are important for lumber production.

Information on Routt and Moffat counties provides the best measure of the economic activities since only small portions of these counties are outside the basin. Also, no reliable statistics are available for the portions of Carbon and Sweetwater counties in the Wyoming portion of the basin.

Table 8.--Employed labor force characteristics, Routt and Moffat counties, Colorado, 1960

Employment	Moffat County	Routt County	Total	Percent of total
TOTAL EMPLOYED PERSONS IN LABOR FORCE	2,686	2,000	4,686	100.0
Men	1,949	1,498	3,447	73.6
Women	737	502	1,239	26.4
OCCUPATION				
Professional & technical	270	248	518	11.1
Farmers & farm managers	219	300	519	11.1
Managers, officials, & prop.	340	137	477	10.2
Clerical	216	170	386	8.2
Sales workers	178	93	271	5.8
Craftsmen & foremen	398	231	629	13.4
Operatives	468	267	735	15.7
Private households	32	26	58	1.2
Service workers	249	192	441	9.4
Farm laborers & foremen	171	170	341	7.3
Laborers, except farm & mine	80	87	167	3.5
Occupation not reported	65	79	144	3.1
CLASS OF WORKERS				
Private wage & salary workers	1,547	1,090	2,637	56.3
Government workers	427	372	799	17.0
Self-employed workers	620	510	1,130	24.1
Unpaid family workers	92	28	120	2.6
INDUSTRY				
Agriculture & forestry	399	507	906	19.3
Mining	402	187	589	12.6
Construction	263	126	389	8.3
Manufacturing	102	63	165	3.5
Transp., comm., & pub. util.	173	169	342	7.3
Wholesale trade	60	30	90	1.9
Retail trade	525	291	816	17.4
Finance, ins. & real estate	46	46	92	2.0
Business & repair service	81	52	133	2.8
Personal services	194	112	306	6.5
Educational services	163	180	343	7.3
Other services	126	96	222	4.8
Public administration	96	77	173	3.7
Industry not reported	56	64	120	2.6

The retail trade industry with gross sales of 20.6 million dollars (table 9) is the largest industry in the basin in terms of gross sales. Retail trades employed a total of 872 employees and proprietors in 1963 and had an annual payroll of over 2 million dollars. The closely related wholesale trade industry had gross sales of 11.2 million dollars in 1963 and employed 120 people for a payroll of about $517,000.

In 1963 the mineral industry had sales of approximately 17.4 million dollars, and employed 452 people. Annual wages amounted to about 2.7 million dollars. The mineral industry also spent approximately 6.8 million dollars on supplies and new machinery purchased or installed. The value added by mining amounted to almost 13.9 million dollars so mining is by far the most important economic activity in northwestern Colorado.

Table 9.--Selected measures of economic activity in Routt and Moffat counties, Colorado, 1963

Industry	Gross sales	Employment		
		Employees	Proprietors	Total
	$1,000	Number	Number	Number
Retail trade	20,633	670	202	872
Mineral industries	17,438	452	0	452
Wholesale trade	11,216	99	21	120
Agriculture 1/	10,038	445	634	1,079
Selected service industries	3,062	240	170	410
Manufacturers	1,043	132	0	132
Total	63,430	2,038	1,027	3,065

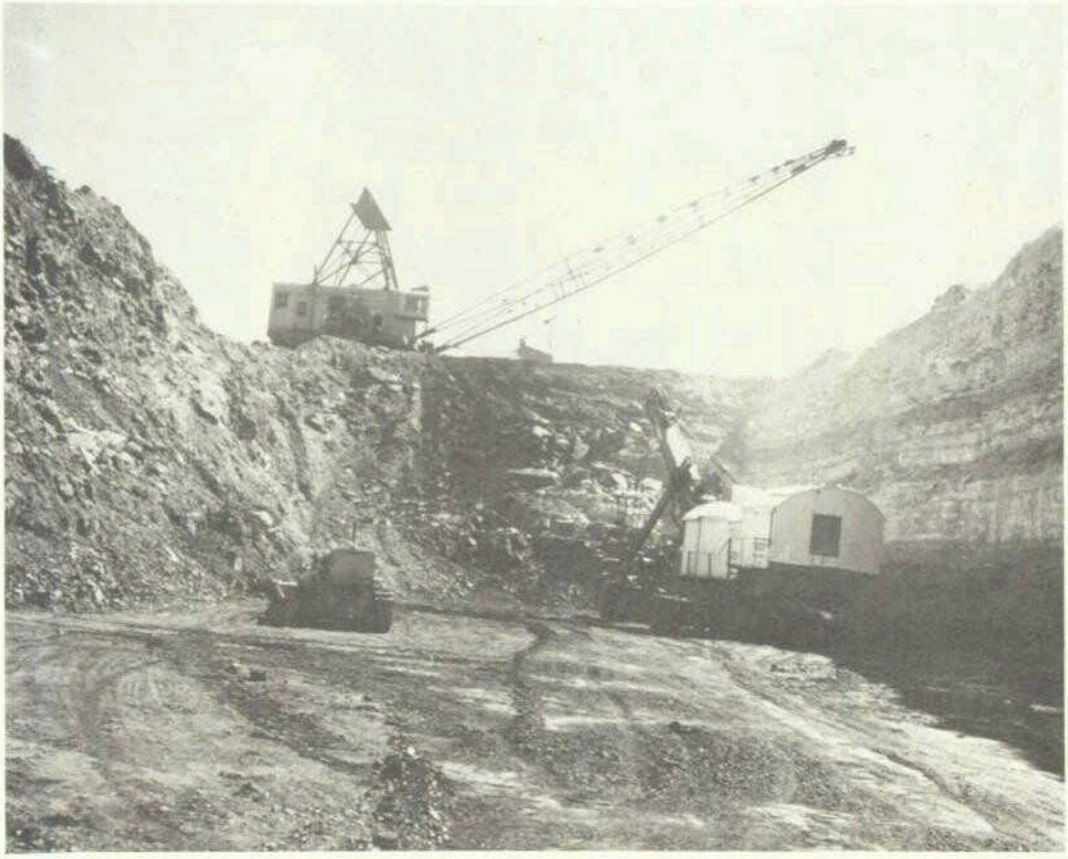
1/ Information on agriculture is for 1964.

Source: 1963 Censuses of Business, Manufacturing, and Mineral Industries and the 1964 Census of Agriculture.

Oil and gas extraction accounted for 5.9 million dollars of the gross sales by the mineral industry. The oil and gas production of the basin is largely exported to Wyoming and Utah by pipeline where refining plants are available, or to connections for further transport to the Pacific Northwest. Considerable amounts of the local gas production is also used to recharge the oil fields of the area. Exploration for new oil fields in the basin has declined in recent years and the probability of major new discoveries appears slight. Therefore, it is probable that oil and gas production will be less important in the future of the basin.

Another important mineral industry is coal mining. It generally has been a declining industry in recent years; however, it is showing a sign of resurgence due to the development of steam-electric generating plants such as at Hayden. State of Colorado officials foresee a tripling of coal production in the next 10 years. Further in the future and into the realm of speculation is the possibility of construction of a slurry line to the West Coast. This would greatly expand the potential market for coal. It would also greatly increase the water requirements of the industry.

Coal from the Oak Creek area is largely shipped by rail directly to the coal burning steam generators of the Public Service Company of Colorado. The coal mined near Hayden is consumed locally by the Hayden steam generating plant. This 30.5 million dollar power facility was built by the Colorado Ute Electrical Association which is a central organization composed of membership Rural Electrical Associations. The power produced is on the Colorado River Storage Project power grid system. This plant is presently producing 165 megawatts.



Coal strip mine near Hayden

During recent years uranium was a major mineral product. The milling operation at Maybell produced about 600,000 pounds of uranium oxide in 1960 with a value of approximately 4 million dollars. The mineable uranium deposits were exhausted and there is little probability of future operation. The uranium industry was one of the largest industrial water users and when in operation the annual consumptive use was about 500 acre-feet.

The 1964 census of agriculture lists sales of slightly over 10 million dollars for Routt and Moffat counties. A total of 1,079 people were employed in agriculture of which 634 were operators and 445 were employees. The production of livestock, both sheep and cattle, is the major agricultural activity and agriculture is the main user of water and land resources of the basin.

Service industries had gross sales of approximately 3.1 million dollars in 1963 and employed approximately 410 people as proprietors or employees. There were approximately 162 establishments providing services of which 55 were hotels, motels, or tourist courts, 37 provided personal services and 44 provided auto repair or miscellaneous repair services. The balance provided miscellaneous business or recreation services.

There were 21 manufacturing industries in Routt and Moffat counties with approximately 1 million dollars in gross sales. Of this number 8 produced lumber or wood products, 4 were printing and publishing companies, 4 were food and kindred products producing companies, and the balance produced machinery or fabricated metal products.

Transportation

The basin is served by U. S. Highway 40 that bisects the basin in an east-west direction (Figure 8 - Transportation and Recreation Area Map following page 66). This is a main route between Denver and Salt Lake City. Traffic counts average 1,700 cars per day between Steamboat Springs and Craig, 1,250 cars per day between Craig and Maybell, and 1,025 cars per day between Maybell and Blue Mountain. Thus, an average of more than 1,000 cars per day traverse the basin via U. S. Highway 40. Two state all-weather highways cross the basin from south to north. Colorado Highway 789-13 extends from Interstate 70 through Craig on north through Baggs (Wyoming Highway 789) to Interstate 80. Highway 789 is a north-south Canada to Mexico route. This highway averages 500 cars per day. State Highway 131 extends from Interstate 70 through Toponas, Phippsburg, and Oak Creek to Steamboat Springs (500 cars per day) at its junction with U. S. Highway 40.

The Yampa Valley is serviced by a branch line of the Denver and Rio Grande Western Railroad, with its western terminus at Craig. This railroad is an important link between the coal fields of the Upper Yampa and

Denver, the major market for coal from this area. The Denver and Rio Grande Western Railroad has been trying for years to abandon passenger service on this line, and has recently received approval to do so.

Air service to Hayden, approximately halfway between Craig and Steamboat Springs, has recently been inaugurated by Frontier Airlines. This is on the Denver-Salt Lake City route.

Transportation facilities are adequate to meet the present farm ranch, industrial, town, and community needs of the basin. State and county roads are maintained to fulfill the existing needs of mail routes, school routes, and farm to market roads.

The Agricultural Industry

Information on the agricultural industry is presented for only the Colorado portion of the Yampa River Basin. Report material on the portion of the basin in Wyoming is included only where required for evaluation purposes. Colorado county statistics were interpolated to provide an estimate of the agricultural economy of the Colorado portion of the basin. Sources of data for the 1943-60 period consist primarily of Colorado Agricultural Statistics annual reports, U. S. Census of Agriculture and Irrigation, and agricultural technicians familiar with the area.

Livestock production dominates the agricultural industry of the basin in Colorado. Wheat is the important dryland crop. The major portion of all crop production is for livestock forage. The land base for agricultural production consists of approximately 82,600 acres of irrigated cropland, 187,300 of dry farmland and about 3.8 million acres of grazing and timber and grazing land. The economic heart of most of the ranches is the irrigated cropland. The 1959 and 1964 Censuses of Agriculture reveal over 60 percent of the farms and ranches in the Colorado portion of the basin has some irrigated land. This indicates the importance of water as a resource to the agricultural industry.

The Resource Base

Number and Size of Farms and Ranches

The number of farm and ranch operating units declined from 924 in 1944 to 666 in 1959 for a loss of 258 farms and ranches (28 percent), (table 10). The largest reduction occurred in farms of intermediate size with 50 to 999 acres. This reduction in numbers of farms and ranches has been accompanied by a corresponding increase in size, value of land and buildings per farm, and average acreage irrigated. Census data show that average farm size increased from 1,900 acres in 1944 to 2,900 acres in 1959. During the same period the average value of land and buildings per farm increased from 15,000 to 70,000 dollars. This trend toward larger farm sizes reflects the national trend of attempting to spread fixed costs over larger acreages.

Table 10.--Number and size of farms, Colorado portion of the Yampa River Basin, 1944-59

Size of farm	1944	1949	1954	1959
	Number	Number	Number	Number
Under 50 acres	59	57	65	24
50 to 179 acres	100	87	75	52
180 to 999 acres	465	388	353	254
1,000 acres and over	300	309	353	336
Total	924	841	846	666

Source: U. S. Census of Agriculture

The value of farm products sold is often a more appropriate measure of farm and ranch size. In this respect, 41 percent of the farms and ranches had gross sales of over $10,000 in 1959 (table 11).

Table 11.--Farms by class of farm, Colorado portion of the Yampa River Basin, 1949-59

Class of farm	1949		1954		1959	
	Number	Percent	Number	Percent	Number	Percent
Commercial farms						
Value of farm products sold:						
$10,000 or more	237	28.2	214	25.6	274	41.2
$2,500 to $9,999	389	46.3	349	41.7	254	38.1
$50 to $2,499 1/	122	14.5	158	18.9	38	5.7
Total	748	89.0	721	86.2	566	85.0
Other farms						
Part-time	34	4.0	44	5.3	51	7.7
Part-retirement or residential	58	6.9	71	8.5	24	3.6
Unclassified	1	.1	0	0	25	3.7
Total	93	11.0	115	13.8	100	15.0
All farms	841	100.0	836	100.0	666	100.0

1/ Provided the farm operator met census definition of a commercial farmer.

Source: U. S. Census of Agriculture

Operators of these farms control sufficient land and capital resources to produce relatively large outputs of agricultural products. Of the 274 farm operators with farm income in excess of $10,000 in 1959, 19 percent had gross sales of over $40,000 and 36 percent had gross sales of from $20,000 to $39,999. In 1959, the U. S. Census of Agriculture classified 85 percent of the farms and ranches in the Colorado portion of the basin as commercial as against 79 percent in the State of Colorado. Information on net farm income is not available, but data for Colorado indicates that the realized net income per farm in relation to gross income was about 20 percent in 1959. Thus a farm and ranch operator has to gross in excess of $10,000 to make a minimum living for his family.

Types of Farms and Ranches

During the 1943-60 period, livestock ranches increased from approximately 50 percent to about 55 percent of all farms and ranches (table 12). There has been a significant decrease in all types of farms and ranches except those classified as miscellaneous or unclassified. This trend will probably continue. However, since the resources of this basin are best suited to extensive operations such as livestock operations the percentage of livestock farms and ranches will increase.

Table 12.--Number of farms or ranches by type of farm, Colorado portion of the Yampa River Basin, 1944-59

Type of farm	1944	1949	1954	1959
	Number	Number	Number	Number
Field crop	162	175	168	141
Vegetable	13	9	8	0
Poultry	23	0	6	0
Dairy	62	19	47	23
Livestock 1/	461	413	409	369
General farms	104	121	83	33
Miscellaneous and unclassified	99	104	115	100
Total	924	841	836	666

1/ Other than poultry and dairy farms.

Source: U. S. Census of Agriculture

In 1959, 399 farms (60 percent) were classified as irrigated farms, while in 1944, 490 farms (53 percent) were classified as irrigated. There was a loss of only 19 percent of the irrigated farms compared to a loss of 38 percent of the nonirrigated farms in the basin.

While part of the basin receives sufficient moisture for production of crops on dry cropland, production is often variable and fails to provide a reliable feed and forage supply for livestock. Since the resources of the area are generally suited to the production of livestock, there is a trend towards operations which have enough irrigated land to provide a reliable supply of winter feed.

Census data for 1959 shows 41 percent of the 666 farm and ranch operators worked off-farm during the year. Twenty-one percent worked off-farm more than one hundred days during the year, and 140 farm operators had off-farm income exceeding the value of farm sales. The number of farm operators working off-farm has remained relatively stable with between 275 and 344 operators having off-farm employment.

Farm and Ranch Tenure

In 1959, 43 percent of the farmers and ranchers were owner-operators and 46 percent were part owners. The trend has been toward fewer managers and tenants while the number of part owners has remained relatively constant. In 1959, 89 percent of the farms and ranches were fully or partially owned by the operator. In comparison, 79 percent of the farms and ranches in Colorado were in this category.

Agricultural Investment

Total investment in private land and buildings was about 45 million dollars in 1959. This amounts to about $70,000 per farm or $24.00 per acre for all privately owned land. In 1944 total investment was about 13.8 million dollars and the average value of land and buildings per farm was about $15,000 per unit or $8.00 per acre. Part of this increase in value per farm is a result in change in the average size of operating unit from 1,900 to 2,900 acres. On the basis of 1960 real estate values for Colorado, 65 percent of the increased investment in land and buildings was a factor of increased prices. The relatively low average value per acre for private lands results from over 82 percent of the land in farms or ranches being used for grazing or timber and grazing. Even this low value of private land and building reflects some capitalized values of grazing leases or permits on Federal rangeland.

Markets

Livestock, livestock products, and wheat are the major agricultural exports. Some hay is also exported to the Red Desert and Uinta basins for winter feeding of livestock.

Marketing patterns for livestock have changed in recent years. There has been a rapid increase in the number of sheep and cattle marketed at decentralized markets and country points and a decline in the number marketed at the Denver terminal market. Direct country contract or auction sales to livestock feeders, and contract or order buyers, now constitute the major market for livestock. Most cattle are sold as steers or heifers followed in numbers by calves and cull cows. Calves and long yearlings are usually sold to contract or order buyers. Cull cows are often sold at auction in Craig or other nearby auction markets. A considerable number of the cattle from this basin move to West Coast markets.

Most of the lambs produced go directly to packers or are sold to feeders in northeastern Colorado and the Arkansas Valley. The area produces approximately 3½ million pounds of wool which is warehoused, graded, and shipped from Craig.

Wheat is generally marketed through country elevators. It is then either shipped by rail to the east or by truck lines to the west. Most of the wheat trucked out is sold to flour mills in Salt Lake City or Ogden, Utah.

Any surplus hay is generally sold to sheep and cattle operators for local use or to the Red Desert and Uinta basin winter sheep areas.

Agricultural Production

Associated with the increase in size of farms and ranches is an increase in the acreage of forage crops and irrigated pasture. The use of larger machinery has also created a trend toward larger acreages for wheat farms. There is also a definite trend away from general farms or specialized vegetable farms and toward operations which specialize in livestock or wheat production. The trend toward livestock operations strongly indicates that livestock operators have a comparative advantage over general farms, as do the large acreage wheat farmers.

Irrigated and Dryland Crops

Irrigated acreage averaged 80,000 acres and dry cropland 150,900 acres during the 1943-60 period (table 13). Total cropland harvested increased throughout this period and in 1964 irrigated acreage in the Colorado portion of the basin is estimated at 82,600 acres and dry cropland 187,300 acres.

Table 11.--Average acreage, total production and gross value of principal irrigated and dry farm crops harvested, Colorado portion of the Yampa River Basin, 1943-51, 1943-60, and 1952-60

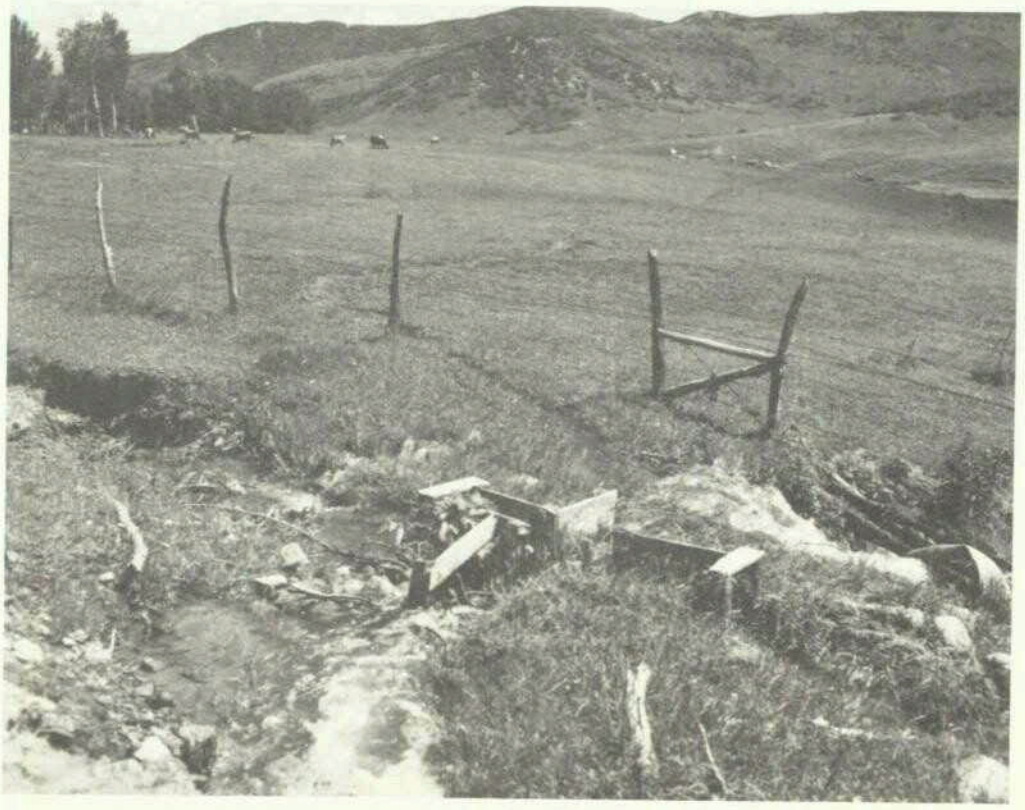
Crop	Unit	1943-51 Average			1952-60 Average			1943-60 Average		
		Irrigated land	Dry farmland	Total	Irrigated land	Dry farmland	Total	Irrigated land	Dry farmland	Total
Corn										
Harvested	Acres	58	162	220	46	58	104	53	110	163
Production	Bu. 1/	1,851	2,206	4,057	1,609	853	2,462	1,729	1,530	3,259
Value	Dol.			5,877			3,673			4,775
Winter wheat										
Harvested	Acres	250	31,986	32,236	335	46,520	46,855	293	39,253	39,546
Production	Bu.	6,528	705,262	711,790	9,850	858,221	868,071	8,189	781,742	789,931
Value	Dol.			1,270,948			1,548,629			1,409,788
Spring wheat										
Harvested	Acres	466	8,913	9,379	472	13,221	13,693	469	11,068	11,537
Production	Bu.	13,493	156,305	169,798	15,400	209,633	225,033	14,447	182,969	197,416
Value	Dol.			309,147			410,389			359,768
Oats										
Harvested	Acres	935	9,235	10,170	640	8,115	8,755	788	8,675	9,463
Production	Bu.	40,231	282,415	322,646	25,201	247,308	272,509	32,715	264,862	297,577
Value	Dol.			251,787			213,534			232,660
Barley										
Harvested	Acres	739	7,097	7,836	275	14,322	14,597	507	10,710	11,217
Production	Bu.	28,892	172,849	201,741	10,663	349,959	360,592	19,763	261,405	281,168
Value	Dol.			214,268			337,072			275,669
Rye										
Harvested	Acres	NA	NA	1,043	NA	NA	726	NA	NA	884
Production	Bu.			11,650			6,547			9,099
Value	Dol.			13,185			7,096			10,141
Potatoes										
Harvested	Acres	173	525	698	79	147	226	127	335	462
Production	Cwt.	11,626	21,459	33,085	8,593	6,447	15,040	10,110	13,953	24,063
Value	Dol.			76,866			29,298			53,082
Alfalfa										
Harvested	Acres	NA	NA	18,295 2/	NA	NA	21,143 2/	NA	NA	19,720 2/
Production	Tons			26,819 2/			28,339 2/			27,578 2/
Wild hay										
Harvested	Acres	NA	NA	12,104 2/	NA	NA	6,883 2/	NA	NA	9,493 2/
Production	Tons			14,419 2/			7,574 2/			10,996 2/
All hay										
Harvested	Acres	NA	NA	64,205	NA	NA	68,567	NA	NA	66,386
Production	Tons			94,471			91,111			96,790
Value	Dol.			1,602,327			1,740,924			1,671,626
Vegetables										
Harvested	Acres	1,279	14	1,293	156	8	164	717	11	728
Value	Dol.			110,931			22,687			66,809
Fruit orchards										
Harvested	Acres	16	12	28	3	6	9	9	9	18
Value	Dol.			2,058			728			1,393
Total harvested cropland										
Harvested	Acres	43,919	83,189	127,108	47,386	106,310	153,696	45,654	94,750	140,404
Value	Dol.			3,857,394			4,314,030			4,085,711
Cropland pasture	Acres	9,943	7,092	17,035	14,447	19,918	34,365	12,194	13,505	25,699
Other crop, pasture and idle land	Acres									64,797
Total cropland	Acres							(80,000)	(150,000)	230,900

1/ Converted to grain at the approximate rate - 1 ton silage = 5 bushel grain.

2/ Included in "All hay".

Source: Colorado Agricultural Statistics and U. S. Census of Agriculture.

Hay of all kinds accounts for over 47 percent of the cropland harvested. About 68,000 acres of hay are harvested each year. The U. S. Census of Agriculture records indicate 66 percent of the hay acreage was on irrigated cropland. Alfalfa hay acreage has been increasing and currently amounts to over 20,000 acres or about 30 percent of all hay land. The basin presently produces about 90,000 tons of hay per year with an average value of about 1.7 million dollars. The 1943-60 average yield of all hay grown was 1½ tons per acre and yield has been decreasing slightly. This low yield is partially a result of climate but it indicates a low level of management and points out the need for additional late season water supplies, fertilization, and irrigation water management.



Low efficiency irrigation methods

Cropland pasture averaged about 25,700 acres or 11 percent of the total cropland acreage during the 1943-60 period. Irrigated cropland pasture averaged about 12,200 acres and there was an average of about 13,500 acres of dry cropland pastures during this period. In addition, there was an average of about 14,000 acres of noncropland irrigated pasture. This includes natural overflow areas, rough pastures, irrigated range or timberland, and areas irrigated only with high waters in the spring. Use of irrigated pasture has grown rapidly in the recent years. Acreage allotments, the soil bank, and other conservation programs have increased the acreage of dry cropland planted to pasture.

Recent estimates indicate there are over 33,000 acres of irrigated and subirrigated pasture (including noncropland areas in the Colorado part of the basin). A considerable portion of this irrigated pasture is on poor quality land, land with a short water supply, or fields that are small and irregular. Dry cropland pasture was estimated at 30,000 acres in 1964.

Wheat acreage increased considerably during the late 40's and early 50's. This was primarily a factor of high prices from the end of World War II and through the Korean War. Reestablishment of wheat acreage allotments has tended to stabilize the acreage of wheat at about 60,500 acres. There has been a considerable increase in the acreage of irrigated oats and barley harvested for grain. This has largely been offset by an increased acreage of oats harvested for hay and an approximate doubling of dryland barley production.

No high value crops are produced. Gross values of all crops harvested averaged about 4.1 million dollars (table 13) during the study period. Average value per crop acre harvested was $29.00 in comparison with average values of $30.00 per acre for the White River Basin and $60.00 per acre in the Colorado River Basin in Colorado.

Range and Pasture Lands

The 1,287,900 acres of land suitable for grazing administered by the Bureau of Land Management in the Colorado portion of the basin provide approximately 175,700 animal unit months of grazing per year (table 14, page 60). These lands are all a part of the Craig District. About 106,100 acres are found in isolated tracts (Section 15 lands) outside the boundary of the grazing districts. In 1964 there were 194 individuals with licenses or permits for 30,483 head of cattle or horses for 80,500 animal unit months of grazing, and 139 operators with licenses or permits for 329,000 head of sheep for 95,200 animal unit months of grazing. Bureau of Land Management administered lands provide about 34 percent of the rangeland grazing in the Colorado portion of the basin.

Approximately 464,000 acres of the 770,900 acres of national forest lands in the Colorado portion of the basin are suitable for grazing by domestic livestock. These lands are largely within the Routt National Forest except for about 31,400 acres within the White River National Forest. They provide approximately 57,000 animal unit months of grazing annually. In 1964, 61 permittees had permits for 4,926 head of cattle and horses for a total of 14,500 animal unit months, and 85 permittees had permits for 103,263 head of sheep for a total of 42,900 animal unit months of grazing. Average length of grazing season is 4 months for cattle and 2½ months for sheep. Dense timber and brush, steep slopes, rock, unstable soils, scanty forage production, or lack of water make the remaining area unsuitable for grazing by domestic livestock.

Table 14.--Grazing use by livestock, Colorado portion of the Yampa River Basin, 1964

Source	Acres	Grazing (Animal Unit Months)
Rangeland		
Bureau of Land Management lands	1,287,900	175,700
National forest lands 1/	464,000	57,000
National Park Service lands	82,200	2,800
State land 2/	227,800	38,000
Private	1,424,800	237,500
Total rangeland	3,486,700	511,000
Cropland		
Irrigated pasture and cropland grazing	82,600	88,900
Dry cropland and planted pastures	128,600 3/	55,100
Total cropland	211,200	144,000
Total	---	655,000

1/ Forest Service animal months converted to animal unit months.

2/ State school lands 223,900 acres and Colorado Game, Fish and Parks Department 3,900 acres.

3/ Summer-fallow lands not included.

Source: USDA Field Party from data furnished by the Bureau of Land Management, Forest Service, and Soil Conservation Service.

Grazing is permitted on 82,200 acres of Dinosaur National Monument (until 1985). Twelve operators have allotments which provide about 2,800 animal unit months grazing on the Monument lands. The major portion of this grazing (89 percent) is by cattle with small numbers of horses and sheep.

Domestic livestock carrying capacity of the 1,652,600 acres of private or State-owned grazing land is estimated to be 275,400 animal unit months of grazing annually. In contrast to some other areas of the west these private and State lands may provide all or the major portion of the grazing available for many operators. Therefore range improvement practices are extremely important. In addition to rangeland grazing it is estimated that under present conditions livestock obtained about 95,000 animal unit months from pasture (irrigated or dryland) and about 49,000 animal unit months of grazing from crop aftermath. If livestock production is to expand irrigated pasture and cropland grazing (early spring

crop aftermath and field residues) will have to be a major source of the increased forage. Conversely, if the irrigated acreage is expanded to any extent a large percent of this acreage will have to be devoted to irrigated pasture to balance the livestock forage supplies.

Livestock

Historically the livestock industry has been the means of marketing much of the crop and pasture production. Census data for the 1944-59 period provide an indication of trends in livestock numbers and the use of crop and pasture by various kinds of livestock (table 15).

Table 15.--Livestock numbers, Colorado portion of the Yampa River Basin, 1945-59

Livestock	1945 (Jan. 1)	1950 (April 1)	1954 (Fall)	1959 (Fall)
	Number	Number	Number	Number
Cattle and calves	43,763	43,822	60,991	56,685
Cows including heifers that have calved	23,735	21,743	27,503	25,093
Milk cows	3,916	2,974	2,696	1,944
Horses and/or mules	7,755	6,053	4,398	3,360
Hogs and pigs	2,716	1,323	1,891	1,189
Sheep and lambs	163,606	171,480	186,944	237,630
Ewes	151,990	158,798	148,706	203,519
Chickens 4 months old and over	48,114	35,920	39,285	27,203

Source: U. S. Census of Agriculture

The data are not completely comparable because the 1959 and 1954 censuses represent fall inventories, the 1950 census was as of April 1 and the 1945 census was as of January 1. Sheep and cattle numbers have been relatively stable during the study period. The 1959 census, however, revealed approximately 200,000 ewes on ranches headquartered within the basin, which was an increase of approximately 50,000 from previous inventories. There was a considerable decrease in the numbers of milk cows, horses, hogs, and chickens during the study period.

During the 1943-60 period an average of about 72,000 animal units of livestock were on ranches headquartered within the Colorado portion of the basin. This livestock used an estimated 594,000 animal unit months of grazing plus an estimated 270,000 animal unit months of winter feed produced on the irrigated and dry cropland. The balance of grazing

available (61,000 animal unit months) was used by livestock operators headquartered outside the basin. This use was mostly by migratory bands of sheep which winter in the Red Desert of Wyoming or the Uinta Basin in Utah and migrate to the high mountain pastures in the summer.

Agricultural Income

In 1959 agricultural income from sale of all farm products amounted to about 10.4 million dollars (table 16). Income from the sale of all livestock products amounted to about 8 million dollars or 77 percent of the agricultural income. In 1944, income from sale of livestock products was 83 percent of total sales (5.2 million dollars). Average sales per farm increased from $5,610 in 1944 to about $15,560 in 1959. During this period there was a considerable decline in income from the sale of vegetables as the commercial vegetable farms near Toponas and Yampa were discontinued because they could no longer meet competition. There was also a considerable decline in income from the sale of poultry and poultry products.

The value of farm products sold and selected farm expenses were converted to 1960 dollars to remove the factor of inflation. In terms of 1960 dollars the value of sales has increased from 8.4 million dollars to 10.1 million dollars (20 percent increase) while the value of selected farm expenses remained at about 2 million dollars in terms of constant dollars. In terms of 1960 dollars the value of sales per farm increased from $9,100 in 1944 to $15,230 in 1959. Thus, while actual dollar income approximately doubled the increase in terms of constant dollars was only 20 percent.

The value of field crops sold averaged about 1.9 million dollars during the study period. During this period the average value of all crop production was about 4 million dollars (table 13). The difference of approximately 2 million dollars or 53 percent is a measure of the value of crops fed to livestock on farms where they were raised. The major part of this was hay which had a value of approximately 1.7 million dollars.

In 1959 the all-family median income for Moffat County was $4,920 and $4,416 for Routt County while the farm-family median was $4,067 for Moffat County and $4,713 for Routt County. Recent studies for similar area beef ranches in northern Nevada 1/ indicate that to produce annual operator earnings of even $3,500 requires gross sales of about $17,000 and an investment capital of approximately $100,000.

1/ Resource Requirements on Farms for Specified Operator Incomes, Agricultural Economics Report No. 5, USDA, Economics Research Service.

Table 16.--Selected income and expense data, Colorado portion of the Yampa River Basin, 1944-59 dollars and 1960 constant dollars

Item	1944	1949	1954	1959
	Dollars	Dollars	Dollars	Dollars
Value of farm products sold by source:				
Field crops	789,528	2,280,301	1,940,559	2,386,482
Vegetables	95,908	126,156	35,807	9,380
Fruits and Nuts	1,637	2,478	593	864
Total crops	887,073	2,408,935	1,976,959	2,396,726
Poultry and poultry products	121,956	100,537	136,642	48,229
Dairy products	295,724	231,585	273,603	319,881
Livestock and livestock products 1/	3,903,019	5,767,066	5,811,461	7,591,328
Total livestock and livestock products	4,320,699	6,099,188	6,221,706	7,959,438
Forest products and hort. specialties	3,655	2,676	7,522	6,433
Total farm products	5,211,427	8,510,799	8,206,187	10,362,597
Sales per farm	5,610	10,110	9,820	15,560
Selected farm expenses 2/	NA	2,007,249	1,101,949	2,041,172
Expenses per farm	NA	2,380	1,320	3,060
	1960 Dollars	1960 Dollars	1960 Dollars	1960 Dollars
Value of farm products sold by source in terms of 1960 dollars:				
Total crops, for. prod. & hort. spec.	962,900	2,262,100	1,827,700	2,496,900
Total livestock and livestock products	7,500,700	6,221,200	7,416,300	7,649,000
Total farm products	8,463,600	8,483,300	9,244,000	10,145,900
Sales per farm	9,110	10,080	11,050	15,230
Selected farm expenses in terms of 1960 dollars 2/	NA	2,234,100	1,144,900	2,033,000
Expenses per farm	NA	2,650	1,370	3,050

1/ Other than poultry and dairy products.

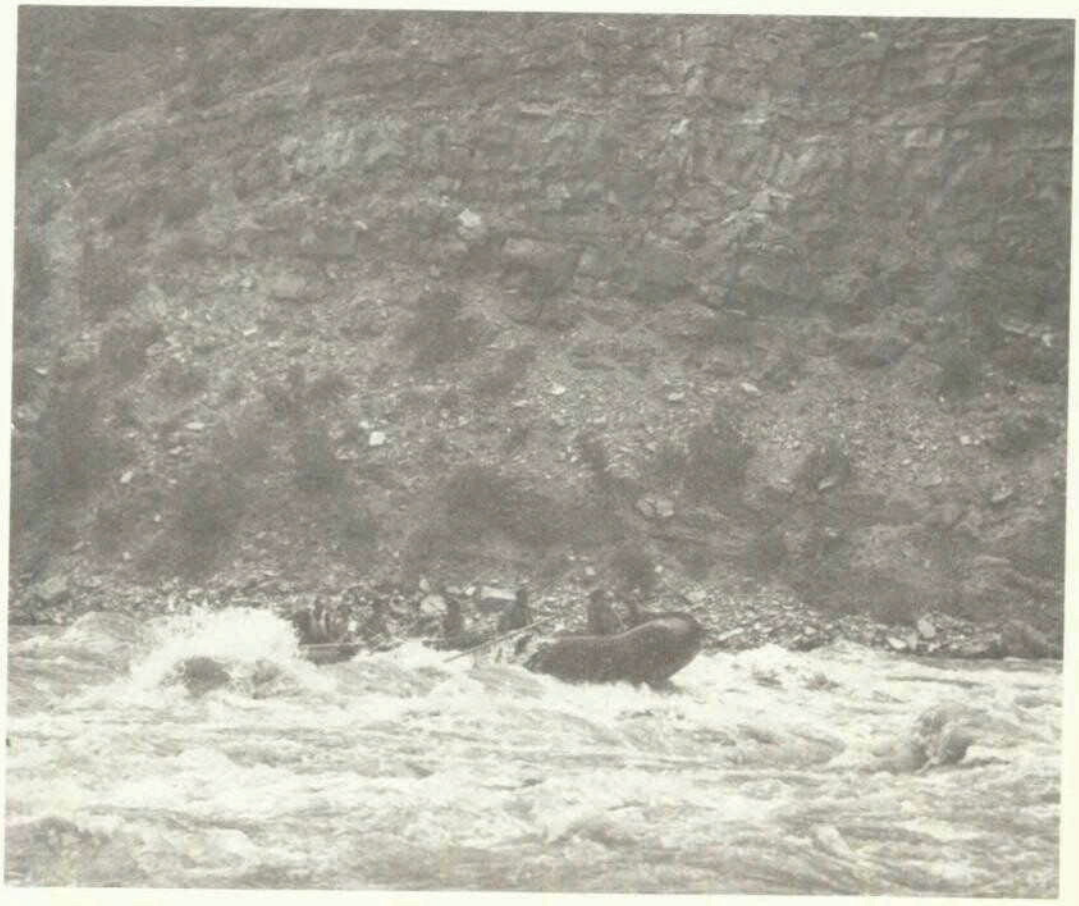
2/ Feed, livestock purchases, machine hire, hired labor, gas and fuel, seeds and plants--for 1954 livestock purchases, and seeds or plants are not included.

Source: U. S. Census of Agriculture and Statistical Reporting Service.

Recreation Industry

Recreation is an important and growing activity. Big game hunting in the basin ranks with the nation's best. Nonresident hunters come from all of the 50 States, Canada, Mexico, and the far parts of the world. The outdoor recreation resources and opportunities are adequate to meet present needs or demands. The potential for development of additional recreational facilities is high.

The need for accommodations is increasing. Federal agencies such as the Forest Service, National Park Service, and Bureau of Land Management are providing additional facilities and enlarging others as fast as budgets and personnel will permit. The State Division of Game, Fish and Parks has also been active in the development of recreation facilities in the basin and plans additional facilities in the future.



NATIONAL PARK SERVICE PHOTO

Running the rapids in Bear Canyon,
Dinosaur National Monument

The basin provides most of the types of outdoor recreation associated with the Western United States. These vary from recreation activities of the western desert to those associated with the alpine mountains. Overall the landscape is one of sharp contrast and scenic interest featuring a great variety of native vegetation.

Tourists

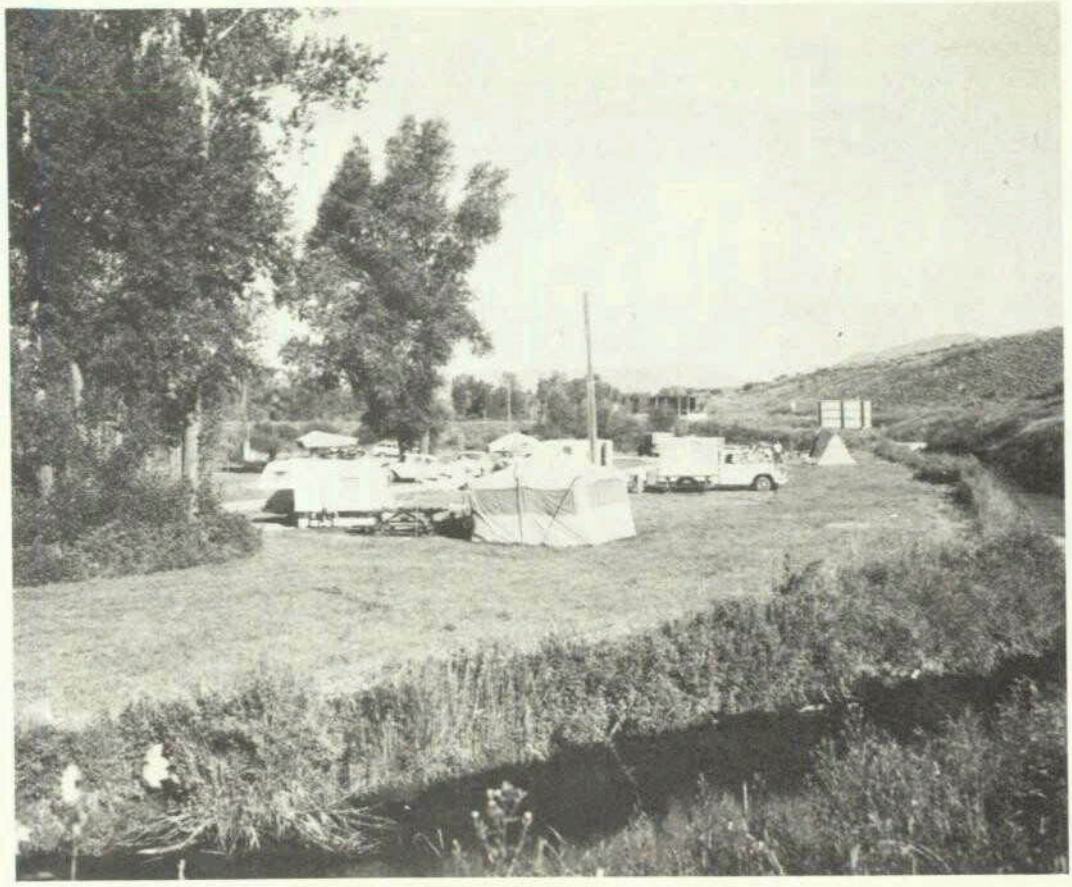
The basin is particularly attractive to summer tourist travel and camping. Camping facilities on public lands can be expanded many times and private facilities are increasing.

Tourists' use of hotel, motel, and camping facilities in the basin are estimated as 285,250 days in Colorado and 12,230 days in Wyoming.

The majority of future development should be in the upper reaches of the Yampa River and its tributaries because of the mountain scenery and availability of water based recreation. Tourists are interested in the types of recreation mountains provide. Canyon country, like Dinosaur National Monument, and other natural features such as Browns Park and Lodore Canyon, are of special interest. Boat trips down the Yampa and Green rivers accommodate 2,000 to 10,000 people per year.

Dinosaur National Monument located in the west end of the basin is one of the principal tourist attractions. It includes lands along the Yampa and Green rivers (Figure 8 - Transportation and Recreation Area Map following page 66). Facilities include campgrounds, boat launching ramps, and view points of archaeological and geologic history within the beautiful canyons. Visits to the Monument average 145,000 visitors per year. Overnight visitors to the Monument average 29,046 per year, with about 19,000 staying at Colorado campgrounds. Boat trips averaged 3,517 individuals yearly for the past five years on both the Yampa and the Green rivers. People come from all over the country for this activity.

Private development of camping and trailer parks, both inside and outside of municipal limits, has doubled recently. The KOA Campground east of Craig is a good example of this kind of development. Rural developments have increased on private land along highways, fishing streams, and access routes to public recreational areas. Several towns have initiated fees and are enlarging camp and trailer parks that are under their management. The Colorado State Highway Department has recently built an excellent roadside park near Hayden for picnicking or trailer camping, and has plans for other locations in the future.



Private campground development
near Steamboat Springs

State recreation areas presently have 33,000 visitations per year. This includes the Ralph White Recreation Area north of Craig, and Lester Creek and Steamboat Lake Recreation Areas north of Steamboat Springs. Facilities include campsites, restrooms, picnic tables, and boat ramps.

Guest Ranches and Resorts

There are about 16 guest ranches and resorts in the upper basin and 5 guest ranches in the lower basin in Colorado. There is one guest ranch in Wyoming. These resorts are year-round activities and the ranchers draw a large part of their income from this enterprise. These operators provide cabins, fishing, hunting, packtrips, and room and board during the summer and fall seasons. It is estimated that hunters and fishermen spend about 2,000 visitor-days in Colorado and about 100 visitor-days in Wyoming per year at guest ranches and resorts.

002960

FIGURE 8

TRANSPORTATION & RECREATION AREA MAP

YAMPA RIVER BASIN

COLORADO and WYOMING

AUGUST, 1967

SCALE IN MILES

LOCATION MAP

LEGEND

- Cities and Towns
- Reservoir
- Basin Boundary
- County Line
- State Line
- National Forest Boundary
- Highway, Hard Surface
- Improved Road
- Railroad
- Winter Sport Area
- Water Recreation Area
- Camping and Picnic Area
- Wilderness Area
- Resort, Dude Ranches, and Ranches with Recreation Income
- National Monument
- Proposed Recreation Development
- National Wildlife Area
- U.S. Highway
- State Highway
- County Road
- Forest Route

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In addition to full-time guest ranches and resorts there are about 50 ranchers in Colorado and 3 ranchers in Wyoming that guide, pack, furnish room and board, or otherwise accommodate hunters for pay during the big game seasons. They rent facilities and equipment such as horses, jeeps, bunkhouses, line camps, and their knowledge of the hunting conditions to both within-State and out-of-State hunters. Additional income from this source has been important to many of the ranchers. It is estimated that about 2,500 hunter-days in Colorado and 150 hunter-days in Wyoming are furnished to hunters yearly by these ranchers. The number of ranchers accommodating hunters has also increased. Many of these operators are improving hunting facilities by building semi-permanent camps, cabins, and improving access routes.

Nearly all ranchers adjacent to hunting, fishing, or wilderness areas have begun accommodating hunters. Many of them are developing fish ponds, cabins, and other resort facilities. These installations add to and supplement the commercial resorts. It is anticipated that two to three times as many commercial resorts could do well under future demands. There is ample private and public land in proper locations to supply all future needs provided adequate public access to public land is acquired and maintained.

A large increase in the use of guest ranches and resorts can be expected. The natural features of the basin lends themselves to outdoor recreation and it will be profitable to provide facilities to meet the demand. Public land agencies cannot provide many of these accommodations.

Hunting

People come from all over the United States to hunt in the basin. The majority come for big game hunting, including elk, deer, antelope, mountain lion, and bear. Small game includes ptarmigan, sage, blue and sharptail grouse, chukar partridge, cottontail rabbits, snowshoe rabbits, ducks, geese, and doves.

Big Game

The number of big game hunters has increased about 8 percent per year for the last 20 years. Records for the Colorado portion of the basin show that big game hunter-days increased from 53,200 in 1958 to 110,600 in 1964. Multiple deer licenses, either sex areas, and in some cases two deer per license for both resident and nonresident hunters have encouraged hunters. In recent years deer kill ranged from 11,300 in 1960 to 23,000 in 1963 and elk from 825 in 1958 to 1,555 in 1964 (table 17).

Table 17.--Big game hunting, Colorado portion of the Yampa River Basin, 1964

Type of license	Hunters	License	Kill	Hunter expenditure 1/		
				License	Other 2/	Total
	Number	Number	Number	Dollars	Dollars	Dollars
Deer						
Resident	11,495	13,877	7,545	98,122	685,671	783,793
Nonresident	7,483	13,693	8,369	345,894	1,983,948	2,329,842
Total	18,978	27,570	15,914	444,016	2,669,619	3,113,635
Elk						
Resident	4,189	4,189	1,192	41,890	521,238	563,128
Nonresident	1,212	1,212	363	60,600	493,006	553,606
Total	5,401	5,401	1,555	102,490	1,014,244	1,116,734
Antelope						
Resident	707	707	635	7,070	24,575	31,645
Bear	-	-	97	-	-	-
Total	- 3/	-	-	553,576	3,708,438	4,262,014

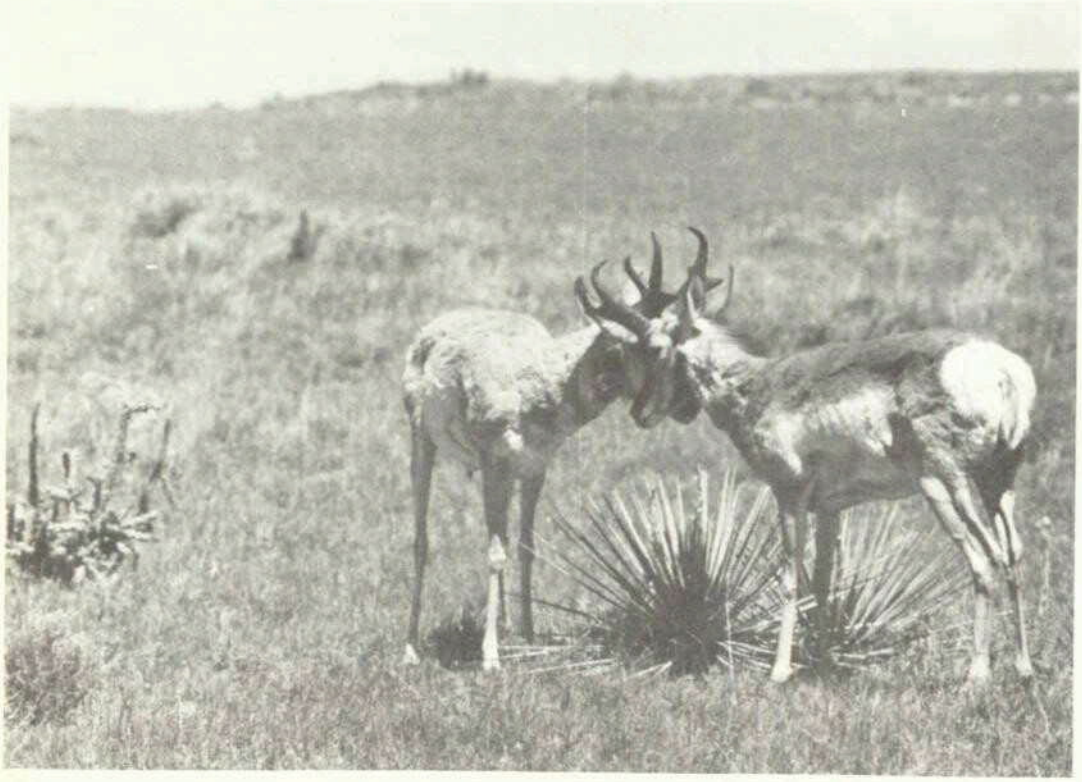
1/ Estimated expenditure in the State of Colorado by hunters that hunted within the Colorado portion of the basin.

2/ Approximately 40 percent spent for clothing and equipment and 60 percent spent for meals, lodging, travel, entertainment, etc.

3/ Duplication exists in hunter numbers since most elk hunters also hunt deer. Bear may be taken on all big game licenses or on special spring licenses.

Source: Developed from data furnished by Colorado Game, Fish and Parks Department.

Antelope hunting is gaining in popularity in the basin. Most antelope hunting is in the western or desert part of the basin. It is estimated that 2,120 hunter-days in Colorado and 2,550 hunter-days in Wyoming were spent on this activity in 1964.



COLORADO GAME, FISH AND PARKS DEPARTMENT PHOTO

Antelope in Moffat County

Estimated expenditures in Colorado by hunters increased from $203,116 for licenses and $1,448,577 for other needs in 1958, to $553,576 for licenses and $3,708,438 for other expenditures in 1964 (table 17). In 1964 expenditures averaged about $27 for licenses and $183 for other items for a total of $210 per hunter.

The big game hunting season regularly overflows available hotel, motel, campground, and trailer court facilities. About 75 percent of the ranchers are accommodating the overflow by providing room, board, campgrounds, and trailer parking, as well as guide service.

Big game populations are increasing. In spite of hunter success, greater game harvests in some areas are needed to protect the forage resources and tree reproduction. Most big game areas are stocked to capacity, and

further increase in game numbers would be detrimental to watershed values. Combined overuse by cattle, sheep, and big game is more of a threat than overuse by big game alone. Game harvest, the most important single factor in game management, is under State regulation. The Federal agencies and the game departments of both Colorado and Wyoming cooperate closely. Together they have a common task of fully convincing people that the animal population must be balanced with available forage.

Because the management of big game winter range is of primary importance to most agencies, big game range analysis is being done cooperatively by the Forest Service, Bureau of Land Management, and state game, fish and park departments.

Small Game

Small game hunting is popular but is primarily by local people. Small game in the basin could sustain a much greater hunting pressure. In the upper basin, particularly in the timber areas, are blue grouse, cottontail rabbits, and snowshoe rabbits. Cottontail rabbits, sage and sharptail grouse, chukar partridge, and doves are hunted in the sagebrush, hills, and canyon areas.

Migratory ducks and geese are hunted along the lower Yampa River and native ducks are hunted in the upper basin before they migrate southward. The Greater Canada Goose along the lower Yampa and Green rivers needs to be carefully managed to encourage a larger population. Intensive habitat and nesting site improvements are being conducted.

Furbearers include beaver, marten, mink, muskrat, fox, coyote, badger, bobcat, weasel, and a few lesser species. Little trapping is done in the basin, primarily due to low fur prices and many inaccessible areas.

Pests and predators such as prairie dogs, Wyoming ground squirrels, rockchucks, jackrabbits, bobcats, badgers, and coyotes are hunted extensively. Small game hunter-days for 1960 are estimated at 15,400 in Colorado and 1,000 in Wyoming.

Fishing

Fishing is a popular sport in the basin. The Yampa, Bear, Little Snake, Elk, and Williams Fork rivers provide high quality stream fishing. Numerous smaller tributaries such as Trout, Fish, Morapos, Slater, Savery, and Elkhead creeks provide good small stream fishing. Numerous natural lakes, irrigation reservoirs, and private fish ponds accommodate large numbers of fishermen. Resorts have developed mostly along the main streams, and developed their own fish ponds. They provide rooms, cabins, pack trips, and fishing to the general public.

It is estimated that the Colorado portion of the basin provided about 100,000 fisherman-days annually for the 1943-60 period and about 11,250 fisherman-days annually for the same period in Wyoming. Fishing pressure in 1960 was about 135,000 fisherman-days in Colorado and 14,000 days in Wyoming.

The basin has many opportunities for developing private fishing facilities. Streams, lakes, and ponds now provide more fishing waters than is demanded, but demand is increasing rapidly.

The Colorado Game, Fish and Parks Department has recently developed several lakes for fishing, including Upper Stillwater (Yampa) Reservoir on Bear River, Steamboat Lake on Willow Creek, Pearl Lake on Lester Creek, Ralph White Lake on Fortification Creek, Freeman Reservoir on Little Cottonwood Creek, and Hahn's Peak Reservoir on Willow Creek.

Winter Sports

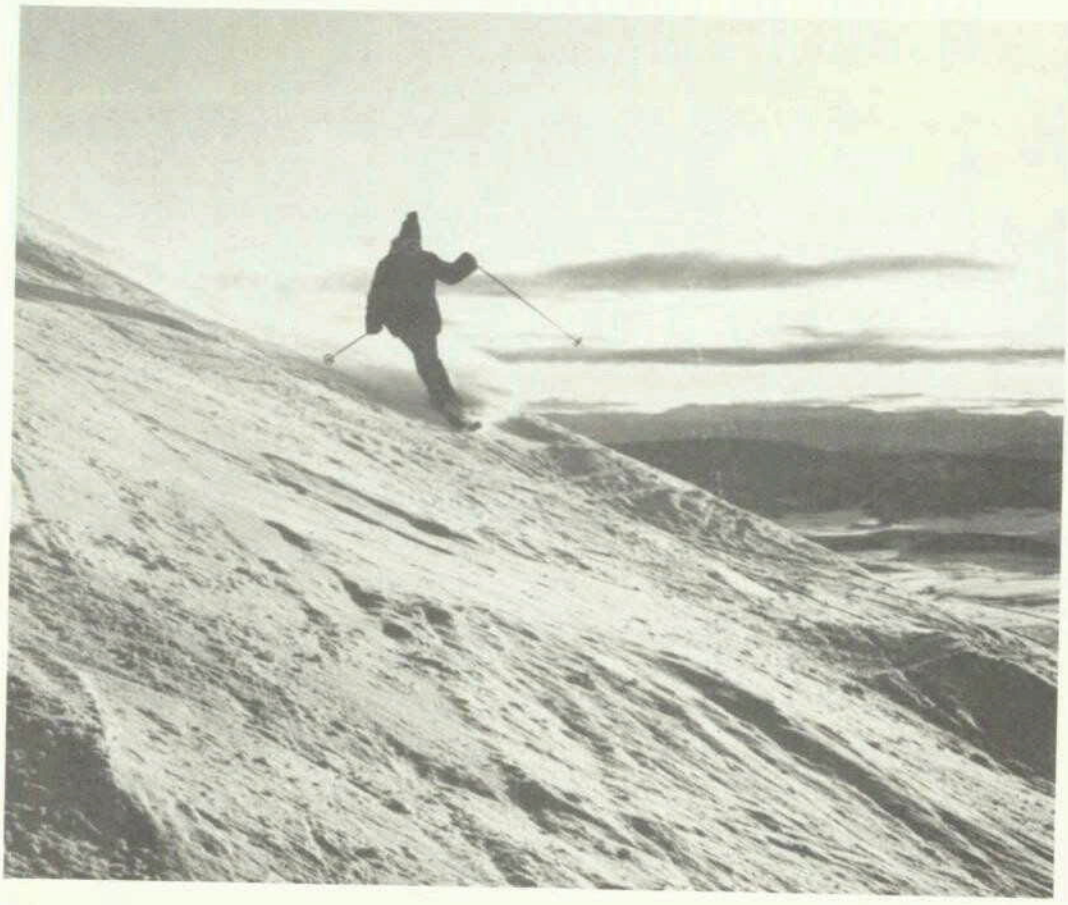
The Steamboat Springs area is widely known for the quality and quantity of its snowfall. A dependable ski season from mid-November until mid-April can be expected. The ski season on the upper slopes or top one-third of the mountain may extend into May.

The Howelson Hill ski area has had its famous Graham Ski Jump for over 50 years. Many Olympic champions have trained here and the North American ski jump distance record has been set seven times at Steamboat Springs ski meets.

The Winter Sports Club of Steamboat Springs sponsors the Winter Carnival each February. There are often as many as 500 contestants. The Club also sponsors as many as seven other ski meets per season. Skiing on Howelson Hill includes instruction and evening activities for those that work in the area. The area is within Steamboat Springs city limits and is lighted. Howelson Hill provides a ski lift, T-Bar, five jumps, slalom hill, and a skating rink.

The Mt. Werner Ski Area, two miles east of Steamboat Springs, has developed since 1962. Ski lifts include a Christie (double chair, monocable), a Thunderhead (double chair, monocable), Big Poma (platter-pull), and a Baby Poma (platterpull monocable). Present capacity is about 2,000 skiers per day. The area has a lodge, several condominiums with 12 to 20 units each, and about 50 residence sites.

The ski season at Mt. Werner comprises 150 to 180 days. The largest use has been about 500 people per day. Use of the Mt. Werner ski area increased from 2,971 skier-days in 1962-63 season to 21,459 in the 1965-66 season. This development, together with the one at the town of Steamboat Springs, is adequate to meet present needs.



Skiing on Mt. Werner

Many areas suitable for cross-country skiing are available in Routt National Forest. Other prospective sites, now undeveloped, will warrant consideration when the demand justifies. Snowmobiling is becoming an increasingly popular sport in the area and has a very high potential for development since there are extensive areas suitable for this sport.

Timber Industry

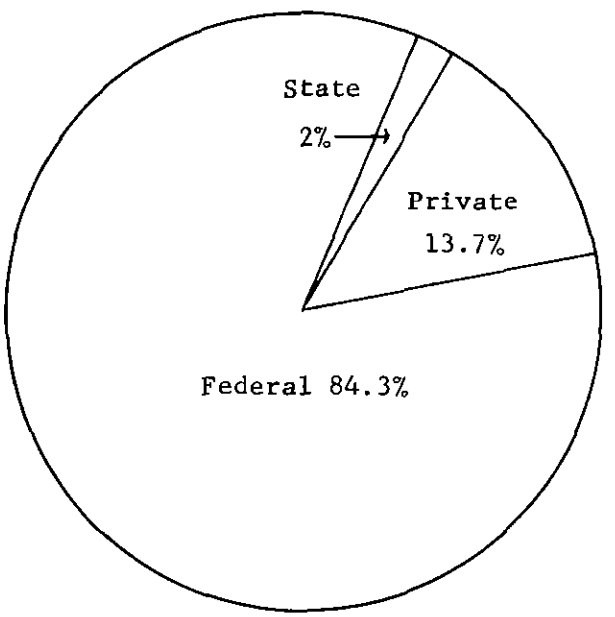
Extent and Nature of the Resources

Slightly less than one million acres of forest land lie in the Yampa Basin. Most of the basin's timber resources are located in the eastern portion where extensive holdings of the national forests predominate. Approximately 84.3 percent of the forest land is Federally owned while private and State holdings contain 15.7 percent. Of the 782,900 acres of national forest timberland, approximately 90 percent is classified as

commercial. Only 118,800 acres or 73 percent of the combined private-State area (149,800 acres) is commercial. In terms of volume, commercial timber stands in the basin contain about 2.7 billion board feet of sawtimber.

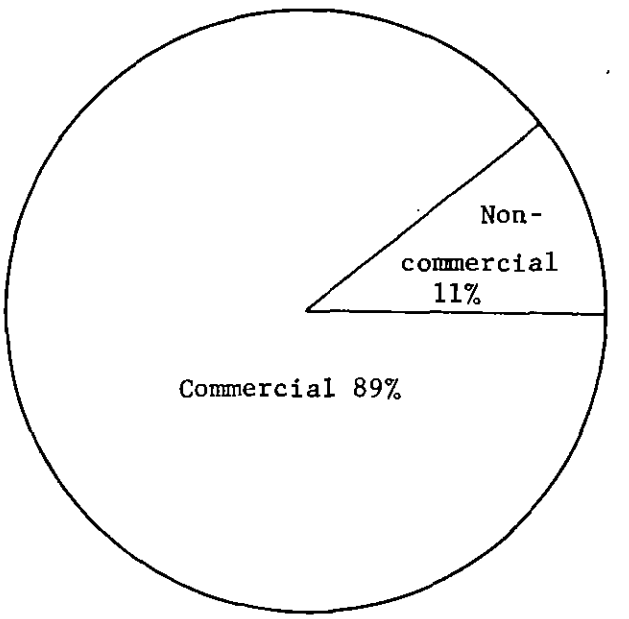
Acreages of commercial and noncommercial forest land by ownership class for the Yampa River Basin are shown in the following illustrations.

Forest ownership



954,500 acres

Commercial and noncommercial forest lands



954,500 acres

Table 18 shows the acreages for each timber type by stand-size class. The spruce-fir type comprises 61 percent of the sawtimber acreage, while aspen constitutes 62 percent of the poletimber acreage.

Table 18.--Commercial forest land by stand-size class, Yampa River Basin in Colorado and Wyoming

Forest type	Commercial forest				
	Saw-timber	Pole timber	Seedlings and sapling	Non-stocked	Total
	Acres	Acres	Acres	Acres	Acres
Yampa River Basin in Colorado					
Douglas fir	4,379	7,500	-	-	11,879
Lodgepole pine	91,066	84,709	3,091	918	179,784
Ponderosa pine	10,536	-	-	-	10,536
Spruce-fir	215,488	15,107	3,909	15,014	249,518
Aspen	20,729	209,809	49,796	-	280,334
Total-Colorado	342,198	317,125	56,796	15,932	732,051
Yampa River Basin in Wyoming 1/					
Douglas fir	-	-	-	-	-
Lodgepole pine	12,023	29,544	88	-	41,655
Ponderosa pine	-	-	-	-	-
Spruce-fir	13,950	8,768	485	1,411	24,614
Aspen	5,440	31,540	4,108	-	41,088
Total-Wyoming	31,413	69,852	4,681	1,411	107,357
Total-Yampa River Basin	373,611	386,977	61,477	17,343	839,408

1/ Includes only data for the 160,100 acres of national forest lands.

Source: National Forest, Bureau of Land Management, and Colorado State Forest Service records.

In addition to timber products, forested lands are important in providing recreation and wildlife habitat. Much of the recreational appeal stems from the natural beauty of timbered areas. The high quality and quantity of fishing, both stream and lake, are dependent on the maintenance of proper forest cover. Water yields are increased and timing of runoff may be improved by timber harvesting methods. Water quality is not impaired where adequate soil protection measures are taken during and after

logging operations. Such measures are required in all national forest timber sale contracts. Wildlife habitat and range capacities for domestic livestock also depend on proper timber management programs. Thus management methods of the timber resource materially affect other resources in the forests.

State and private commercial forest land in the basin is not extensive. Commercial forests in private and State ownership supports mostly pole-size aspen and lodgepole pine. Aspen is the major forest type with the commercial stands, 77,800 acres occurring on the better sites near 9,000 feet elevation. Lumber, excelsior, paneling, and novelties are the major uses of aspen. It is also suited for pulp and veneer. Presently, the pole-size aspen areas are best suited for livestock grazing. Since it is expected that the demand for aspen will increase, the cutting will be regulated.

Lodgepole pine ranks second in both volume and area (25,100 acres) on private and State lands in the basin. Individual stands are usually small in area. Most lodgepole pine areas are badly in need of commercial thinning. This thinning can be done if the proposed wood-using industry in or near the basin becomes a reality. Otherwise either a particle board plant or increased post and pole capacity are the only answers to the problem. Commercial thinning will be accomplished to the extent of the market for small roundwood.

The Douglas-fir and spruce-fir commercial forest types are the least extensive forest types on State and private land and occupy 15,900 acres. Engelmann spruce is a major lumber species; it is well suited for pulp. Its resistance to preservative treatment generally confines use to non-treated products. Douglas fir and alpine fir are used for lumber to a limited extent. Christmas trees and other yule decorations are also important uses of these coniferous species.

To attain the allowable cut will necessitate the establishment of additional industry.

Utilization

In 1966, 22 million board feet were cut from national forest land which is about 73 percent of the allowable cut. The principal reasons for not reaching the allowable cut were the lack of a lumber industry and lack of adequate transportation system. In recent years, sawlogs for lumber have comprised the bulk of the harvest of timber products. Posts and poles constitute about 5 percent of the harvest.

Due to the lack of demand, present use of the Bureau of Land Management forest resources in the Yampa River Basin is very limited. No timber

was sold during the 1967 Fiscal Year and the outlook for sales during the next five years is only fair. The highest potential use would be for pulpwood and pole production.

Spruce logging operations,
Routt National Forest

The trend toward fewer but larger and more efficient sawmills is occurring in the basin. In 1966 the 13 sawmills (table 19) cutting national forest timber produced 21 million board feet of lumber and the post and pole harvest yielded 1 million board feet. There are three post and pole yards; two of these are nonpressure treating yards.

During the past ten years an annual average of 61 national forest timber sales and permits were made.

Table 19.--Number and daily capacity of sawmills in the Colorado portion of the Yampa River Basin

Number of sawmills	Daily capacity (thousand board feet)
6	under 2
1	2 to 3.9
4	4 to 19.9
0	20 to 39.9
1	40 to 59.9
1	60 and over
Total 13	

Source: U. S. Forest Service

Current and Projected Growth

In general, timber stands on national forest lands are mature and in many instances overmature. Private and State lands contain predominately pole-size timber. The approximate annual sawtimber net growth is 31 million board feet. Current net growth for pole-size timber is estimated at 13 million board feet per year. This yields a total annual net growth of 44 million board feet. Growth as estimated here is based on an unmanaged forest. When the forest is placed under intensive and complete management, growth can be expected to be four or five times this amount.

Presently, over 24,000 acres of national forest lands need reforestation. In the past few years the following management practices have been accomplished on national forest lands:

(1) Timber cutting on an average of 65 timber sales each year

(2) Reforestation of 3,650 acres

(3) Thinning 179 acres of lodgepole pine

(4) Release work on 201 acres of lodgepole pine

(5) Spot seeding on 133 acres of burned areas

(6) 1,258 acres of infested lodgepole pine were treated for dwarf mistletoe

Under this intensified management program, it is estimated that the commercial forest land will produce about five times the present net growth volume or 220 million board feet per year.

On the Bureau of Land Management lands a majority of the Ponderosa pine is overmature and has little reproduction established. On the other hand, the lodgepole is overstocked, immature and stagnated. Stand improvement is one of the key factors in the management of the lodgepole pine in the Diamond Peak-Middle Mountain area.

Barkbeetle attacks in the late 1940's and early 1950's killed virtually all mature Engelmann spruce in the southeastern part of the basin. Insect populations are presently endemic, but because of the overage condition of the national forest timber, there is a constant threat of an epidemic.

The major disease threat is dwarf mistletoe in lodgepole pine. This disease is widespread in most of the older lodgepole pine stands. Other diseases, such as root rot, are less evident but greatly reduce net growth, particularly in overaged stands. In the Diamond Peak-Middle Mountain area a large outbreak of the Mountain Pine Beetle (Dendroctonus monticolae) threatens to kill all the sawtimber. This infestation is so extensive that there is only a small amount of sawtimber remaining. No suppression is planned.

Less than 10 percent of the estimated allowable cut for roundwood is harvested annually. Although expansion of the post and pole industry will demand an increasing share of the available resource, pulpwood consumption in the long run has the greater potential for total utilization of the resource.

Employment and Income

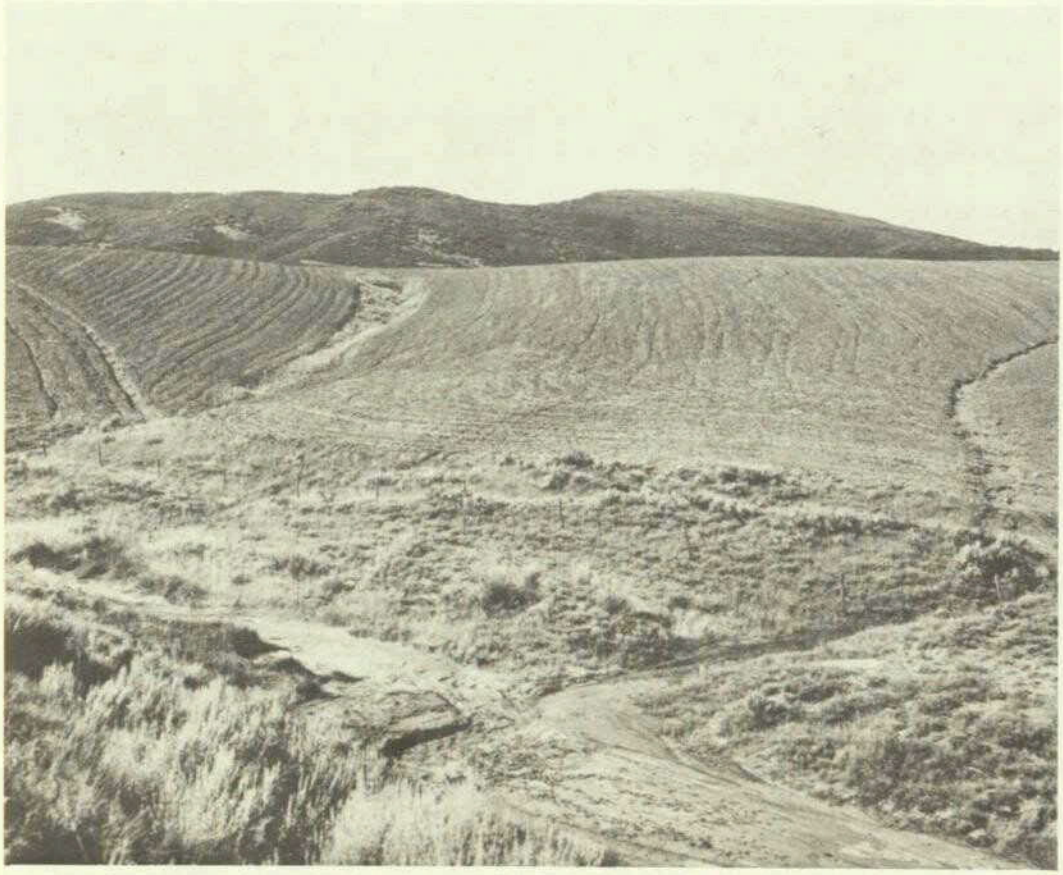
Lumber and wood industries are important contributors to the economy of the basin. The average annual production of lumber-and-timber products amounts to approximately 1.5 million dollars in product value and consists of 21 million board feet of lumber and an additional 1 million board feet equivalent in posts, poles, mine props, and other roundwood products. The 16 timber producers in the basin market about 20 million board feet per year on the general market in Colorado and other states and sell approximately 2 million feet per year to local markets. In 1966 lumber sold for an average price of $76.71 per thousand board feet. Some 220 man-years of employment were provided by the timber industry in 1966. This does not include employment in forest management and protection, nor does it include secondary manufacturing of timber products.

Assuming an average salary of $5,000 per year per employee, the estimated total payroll for these wood-industry employees was about $1,100,000. Employment could be nearly doubled if additional wood-using industries were established in or near the basin to fully utilize the available resource.

V. WATER AND RELATED LAND RESOURCE PROBLEMS

Erosion Damage

Much of the basin is subject to moderate erosion except for the wooded, brushy and mountain grassland areas where erosion is usually slight. Many shale lands on steep slopes have severe erosion. These areas are generally west of the 16-inch precipitation line (Figure 2) and in soil mapping units 1.0, 2.0, and 3.0 (Figure 4).



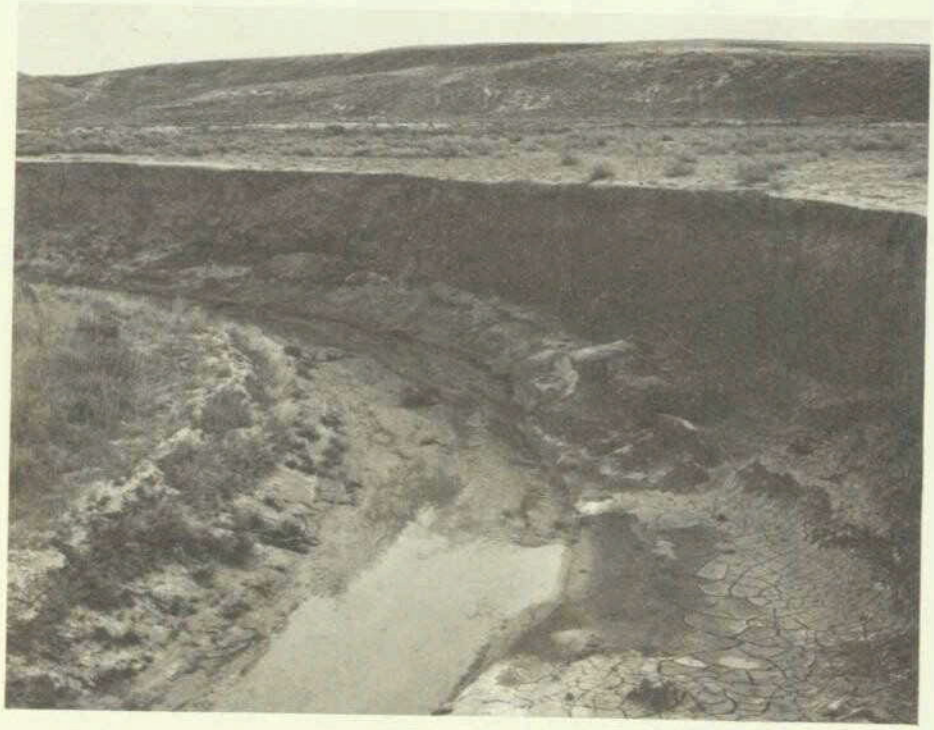
Dry cropland erosion in Moffat County

Land problems on State and private lands were inventoried during the 1966 Conservation Needs Inventory. Adjusted data for Routt and Moffat counties show some of the problems of the Yampa River Basin in Colorado. Most of the irrigated and dry cropland is in soil mapping unit 4.0. Of the 82,600 acres of irrigated land, 34,100 acres have inadequate

irrigation systems or inefficient water management. There are approximately 187,300 acres of dry cropland. Only 56,400 acres of the cultivated land has adequate erosion control measures. A total of 71,300 acres of dry cropland have inadequate erosion control measures and another 28,900 acres need a change in land use from cropland to some kind of permanent cover. Of the 1,590,800 acres of cropland, pasture and range, about 954,600 acres are being properly grazed. There are 430,400 acres of range that is overgrazed. Another 184,200 acres are in need of a brush control and improvement program. The remaining 21,600 acres need reestablishment of vegetative cover and in some cases brush control.

Since irrigation is concentrated along the rivers and streams of the area, land values are higher in the valleys where irrigation water is available or has been developed. Thus, streambank erosion and measures to protect these more valuable lands receive more immediate attention than does the sheet and gully erosion that occurs over the large acreage of range and dry croplands of the area.

Soils derived from the Mancos Shale or Wasatch Formations are subject to gullying and piping. These are soils with high silt content and montmorillonite clays that easily go into suspension with runoff water. On steeper slopes, or along streambanks where steep ground water flows can develop, soil piping is a common occurrence in these soils. Thus, streambank erosion is a common problem.



Streambank erosion along Little Muddy Creek, Wyoming

Agricultural Stabilization and Conservation Service records in Wyoming show about $10,000 per year has been spent on streambank erosion control on the Little Snake River or its tributaries since 1958. Much more temporary or non-cost shared work was undoubtedly done for which there is no record. This type of erosion control is usually by means of riprap, but includes rails, brush, trees, rock jetties, riverbed jetties, auto bodies, cable, steel-rail piling, rock, gravel, and any possible combination of items.

Downstream benefits from erosion control on the rangelands are a major consideration. For example, the town of Craig gets its municipal water from the Yampa River at the confluence of Fortification Creek. The sediment yield of the Fortification Creek Watershed is high, yet total water yield is low. As a result, the water treatment requirements are increased to reduce the high colloidal content of water from the Fortification Creek discharge. With complete treatment of the rangelands in the watershed, sediment yield would be materially lowered and costs of water treatment at the Craig facility would be reduced.

The dry croplands are usually subject to a moderate water erosion hazard. Wheat is the principal crop grown. A few areas of shale derived soils on steep slopes are subject to severe water erosion.

Sediment Damage

Most of the water yield is from the mountainous parts of the basin. The major part of the sediment discharge, however, is produced in the more arid lower elevations. Very little sediment comes from irrigated lands.

Vegetative cover begins to be sparse with ten inches or less of total annual precipitation. Good range management practices along with proper land use are necessary to maintain a good protective vegetative cover. The silty soils of Mancos Shale influence, and the erosive, dispersed clay soils of Wasatch Shale influence, easily go into suspension as colloidal matter and account for the high sediment yields of the Yampa River tributaries even though the total water yield of these lower elevation tributaries is low.

Table 20, page 85, shows a weighted average concentration of 196 p.p.m. of suspended sediment for the Yampa River near Maybell and 212 p.p.m. for Slater Creek near Slater in the upper reaches of the basin.

The Little Snake River near Lily, Colorado, has a weighted average concentration of suspended sediment of 1,790 p.p.m. This is a low elevation, more arid sector of the basin. Fortification Creek which joins the Yampa River near Craig also materially affects the sediment concentration of the Yampa River at times.

The Vermilion Creek drainage is in an area having relatively high sediment production. This stream is recognized as contributing substantial amounts of sediment to the Green River, although no actual measurements of either total volume or sediment concentration are available. Since the total discharge of Vermilion Creek is small in relation to the flow of the Green River at its confluence, the effect upon the water quality and the total sediment load of the Green River is not significant.

Floodwater Damage

Floodwater damage has been relatively unimportant in the basin because of the low population density and the absence of high damageable values. Only small individual areas have damages sufficient to justify the installation of flood control structures. Most of the flood and erosion prevention works have been applied by the affected individuals with the technical assistance and cost-sharing available under various State and Federal programs.

Floodwater damage is of two distinct types. The first is caused by snowmelt runoff in the early spring. Characteristically these floods produce large volumes of water over a period of several days or a week, but do not produce high peak flows. Occasionally, ice jams will increase the area of flooding and cause damage. These spring snowmelt floods cause streambank erosion, damaging scour and erosion to low lying fields, damage to crop stands on hayfields, and delay in crop growth. The second type of damage is caused by summer thunderstorms which tend to produce flash floods in localized areas with high peak flows but low total volume of water. The erratic random pattern of these intense summer thunderstorms results in local damage to cropland, other land and improvements, or to facilities such as roads, bridges, irrigation structures, and other improvements.

A total of about 42,900 acres are subject to floodwater and sediment damage. Of this total only 700 acres are urban lands. Most of the remaining 42,200 acres are agricultural lands subject to flooding and are on irrigated pasture, range, and native hay meadows. The Yampa River above Craig has over 16,000 acres of floodplain subject to damage with the largest areas along the Elk River (6,000 acres) and the Yampa River from Steamboat Springs to Hayden (3,000 acres). Over much of this area the spring floodwater serves as an early irrigation and the major floodwater damage is from streambank erosion. The other major area of flooding is along the Little Snake River (10,700 acres), over half of which is along Muddy Creek in Wyoming. The floodplain is not highly developed so damages are not sufficient to justify control measures.

There are two areas which have a higher flood damage history and potential: (1) The Dry Creek Watershed which includes the urban area of Hayden, and (2) Fortification Creek which causes damages to Craig.

The Dry Creek Watershed (44,500 acres) ranges in elevation from 8,740 feet to 6,340 at its confluence with the Yampa River. A total of about 840 acres of agricultural lands and 160 acres of urban lands are subject to floodwater and sediment damages. Spring snowmelt floods exceed the capacity of the channel from the county fairgrounds to the Yampa River, and the grade school and a number of houses are flooded. High water years were 1917, 1921, 1948, 1952, and 1962. Damage to urban property was estimated at over $5,000 for the 1948 flood, with some 30 basements being flooded. Damages have not been significant, however, since the U. S. Army Corps of Engineers aided in cleaning and realigning the channel in 1949.

The Fortification Creek Watershed (169,500 acres) has a history of flooding from snowmelt or a combination of snowmelt and rainfall. Ice jams at restrictions in the channel add to the flood damages, particularly in the town of Craig. The highest recorded peak flow on Fortification Creek at Craig was 840 cfs on March 23, 1947, but the peak flow was estimated to have been 940 cfs in March 1914. In 1948 the U. S. Army Corps of Engineers estimated historical average annual flood damages (1897-1947) at $4,300 and future average annual damage at $42,000 without protection. In 1949 the U. S. Army Corps of Engineers did some rectification work on the Fortification Creek channel. Since 1948, the Moffat County High School, about 20 houses, and several large commercial establishments have been built in the floodplain of Fortification Creek. Even if these areas were provided flood protection from the upstream areas there would still be some danger of flooding from ice jams.

There are numerous other locations in the basin where summer convective storms cause flood damages. In general, however, the occurrence of these damages is infrequent and control would be impractical on a watershed project basis. This would not preclude the installation of corrective measures by individual land owners.

Water Shortages

One of the basin's major problems is the need for a dependable irrigation water supply throughout the growing season. Present irrigated acreage averages about 100,200 acres. About 48,000 acres (48 percent) was short of late season water. The 82,600 irrigated acres in Colorado's portion of the basin had almost 37,000 acres (45 percent) of short supply land while Wyoming's 17,600 irrigated acres had inadequate supplies on almost 11,100 acres (63 percent). The loss of unstored excess water from spring and early summer snowmelt contributes to late season water shortages. A definite need exists for more and larger storage reservoirs to catch early runoff for release when needed.

Irrigated lands in the Yampa Main Stem Subbasin have a varied water supply. The Steamboat Springs-Yampa area generally has an adequate water supply while 60 percent of the Craig-Maybell irrigated area has a short

supply after June 15th. An estimated 30 percent of the area above Yampa is in short supply after the middle of July and 60 percent of the Williams Fork area land is short by June 15th. Elk River valley areas generally have adequate water supplies as do bottom lands near the Yampa River below Maybell where pump diversions are made throughout the growing season.

The Little Snake River Subbasin generally is short of irrigation water after the middle of July in over 50 percent of the irrigated area, most of which lies along the Colorado-Wyoming border. River bottom lands above and below the Two-Bar Ranch are served by pumping from the river and have adequate supplies.

The Vermilion Creek Subbasin has a short water supply after the middle of June on an estimated 80 percent of the irrigated acreage. Pumping from the Green River provides adequate amounts of water for lands adjacent to the river.

Water Quality Limitations

As pointed out in other sections of this report, most of the water comes from the mountainous parts of the basin. Most of the dissolved solids, however, come from the lower, more arid region. Arid soils of the area are generally high in salts, particularly gypsum ($CaSO_4$), in the areas where parent geologic formations are Mancos Shale. In addition the Mancos Formation is in the lower rainfall zones where the soils are undeveloped and not leached. The salts are readily available to go into solution and be transported to the water courses when the limited precipitation does occur.

Table 20 gives the data on sediment and dissolved solids at selected points in the basin.

Quality of the irrigation water is good. Most of the irrigation water use is from the Yampa River or its major tributaries near the mountainous parts of the basin. None of the major irrigation areas have water rated higher than medium salinity hazard and most would be rated low. Sodium hazard of the irrigation waters would generally be rated low. Some leaching of accumulated salts is required where land is irrigated with low salinity hazard water, but this occurs under normal irrigation practices except in soils of extremely low permeability. Medium salinity hazard water is suitable if a moderate amount of leaching occurs. If more than a moderate amount of leaching is required, and especially with poor permeability conditions, drainage and other special practices for salinity control are needed.

Table 20.--Concentration and discharge of dissolved solids and suspended sediment for streams in the Yampa River Basin. (Data represent annual average for the water years 1914-57 adjusted to 1957 conditions.)

Stream	Water discharge (thousands of acre-feet per year)	Dissolved solids			Suspended sediment		
		Weighted-average concentration (ppm)	Discharge		Weighted-average concentration (ppm)	Discharge	
			Thousands of tons per year	Tons per square mile per year		Thousands of tons per year	Tons per square mile per year
Yampa River near Oak Creek	63.	221	19.	84	-	-	-
Yampa River at Steamboat Springs	342.	74	34.	57	-	-	-
Elk River at Clark	258.	40	14.	67	-	-	-
Elk River near Trull	394.	47	25.	61	-	-	-
Fortification Creek near Craig	9.7	774	10.	298	-	-	-
Williams Fork at Hamilton 1/	158.	234	50.	148	-	-	-
Yampa River near Maybell	1,152.	140	219.	61	196	308	90
Little Snake River near Slater	188.	78	20.	70	-	-	-
Slater Fork near Slater	61.	101	8.4	52	212	18	109
Little Snake River near Lily	451.	196	120.	36	1,790	1,099	295

1/ For 1905-06, 1910-27 water years.

Source: U. S. Geological Survey

Nonbeneficial Phreatophytes and Seeped Lands

There are 13,190 acres of nonbeneficial phreatophytes 1/ and 1,210 acres of seep land in the Yampa River Basin (table 21). Of these amounts, 11,890 acres are in Colorado and 1,300 acres in Wyoming. Seep land was 1,110 acres in Colorado and 100 acres in Wyoming. The predominant types of phreatophytic vegetation are sedges, rushes, greasewood, willows, and cottonwoods. Sedges, rushes, and willows occur mostly where they have invaded wet hay meadows. Cottonwoods extend the full length of the streams generally in a narrow band but they do cover broad areas in between large stream meanders. Greasewood is confined to the warmer desert areas where underground water is present - usually at a junction of a tributary.

Table 21.--Nonbeneficial phreatophytes and seeped land acreage, Yampa River Basin in Colorado and Wyoming, 1964

Vegetative cover	Colorado	Wyoming	Basin total
	Acres	Acres	Acres
Very dense	300	50	350
Dense	5,805	145	5,950
Medium to light	5,785	1,105	6,890
Total	11,890	1,300	13,190
Seeped lands	1,110	100	1,210

Source: USDA Field Party

There are no widespread programs of control for nonbeneficial phreatophytes. Individual land operators are clearing lands for hay or pasture. Most recommendations for management of irrigated hay and pasture lands include practices which will remove or control encroachment of these plants on productive agricultural land.

Phreatophytes are important food and cover for wildlife. Eradication of nonbeneficial phreatophytes on parcels of land adjacent to larger areas with similar phreatophyte vegetation is not a critical factor in relation

1/ For this report, "nonbeneficial phreatophytes" are nonagricultural plants that obtain their water supply from the zone of saturation. They provide little or no apparent beneficial use such as erosion protection for streambanks, shade and cover for livestock, shade for picnic and campgrounds, and others.

to wildlife habitat. Under improved management, the nonbeneficial phreatophytes could be replaced with beneficial forage and crop plants. Part of the water that is being consumed by nonbeneficial phreatophytes could be salvaged for other use.

Consumptive use of water by nonbeneficial phreatophytes, riparian vegetation, seeped land, and other incidental areas has been estimated in table 6 on page 40.

Range and Forest Fires

Increased use of the land resources of the basin is resulting in an increase in fire control problems. Most range and forest fires in recent years have been small and control has been mainly through the use of aerial facilities and other modern methods, careful organization, and neighborhood awareness and cooperation. Fire prevention, suppression, and control are a cooperative effort of Federal and State agencies and the general public. Numerous cooperative agreements exist among the range and forestry agencies. This enables the prompt dispatch of skilled firefighters to most fires. Prevention or prompt suppression of potentially disastrous range or timber fires is now and will continue to be an important facet of resource and watershed management.

Fire damage frequently permits disastrous insect and disease invasion in forested areas. It also results in erosion damage, increased sediment and floodwater production, sediment deposition, and the destruction of forage production required for both wildlife and livestock. Serious economic losses are caused to forest industries, forest dependent communities, and range operators. The public is affected through loss of the resources and economic values, and by the loss of access to desirable streams, lakes, and other recreation areas.

There are serious problems in protecting the forest and range resources and watershed lands from fire. These problems are mostly related to increased use of the lands for recreational and other purposes. The importance of the water yielding areas makes fire prevention a factor of increasing importance, while the danger of fires caused by the rapidly increasing usage of the watershed lands will continue to mount.

Among the major fire control problems is the accumulation of debris from logging operations, reservoir and right-of-way clearing, and similar activities. A number of clear-cut areas, and piled slash in selectively cut areas, are burned each year when the fire hazard is low. Other areas of slash are receiving extra protection in lieu of burning. Management and control are proving to be the best protection.

No accurate information is available as to the numerous fires which swept the range and forest lands prior to 1880. Old settlers persist in the claim that the Indians burned off the oakbrush and other timbered areas

to make hunting better. It is quite possible that the Indians did some burning for the purpose of hunting, but it is more logical to believe that the majority of the early fires were started by lightning.

Early history shows that very extensive fires occurred in the late 1800's. Reports are that these fires were set. Pictures taken in spruce timber prior to 1900 indicate there was a barkbeetle epidemic in progress at that time. It is very likely this epidemic was widespread and the dead and down timber contributed to the extensive burns. Minor fires have occurred on the national forests within the basin since fire protection was initiated but as a whole, the occurrence record is low and there have been no extensive burns in the spruce timber for many years.

The national forest land in the basin has averaged only 14 fires per year with an average burned acreage of 31 acres per year for the five year period 1963-1967. During this period 49 fires were man-caused and 22 were lightning fires.

Recreation use during this period has increased considerably but fire occurrence has actually decreased. Reduction in grazing use and increased slash from timber harvest can be expected to increase the risk in the future. It is believed that fire occurrences will increase 50 percent by 1980 and double by 2000.

The small acreage burned during the past five years has caused practically no erosion and has had little or no effect on water quality. Use of heavy equipment in fire suppression is held to a minimum to prevent excessive damage to watershed values and vegetative cover. Where heavy equipment is used on fires the fire lines, access roads, tractor trails, etc., are drained and revegetated as an integral part of fire suppression on each fire.

Strip Mining Areas

Strip mining for coal is increasing along the Yampa River. This results from the increased demand for coal to power steam generating plants. About 1,300 acres have been strip mined. An additional 5,000 acres are owned or controlled by major coal companies who plan to strip the areas in the future. Most of the strip mining is in Routt County. On these lands the overburden is stripped to expose the coal for removal. The landscape is scarred with deep cuts and spoil banks of rocks and debris. Such cuts and spoil bank areas impair the beauty of the natural landscape, cause erosion, deposit sediment in stream channels, and pollute the water unless conservation measures are taken to return the land to its natural state.

Coal strip mine spoil piles near Hayden

Several years ago members of the White-Yampa Association of Soil Conservation Districts became concerned about the ugly scars of strip mining operations that were exposing hillsides to erosion and threatening to pollute streams. A strip mining committee was appointed in 1964 to take action on the matter. This committee worked with members of the State Legislature and were instrumental in getting legislative action on the problem.

The Legislative Council Committee on Strip Mining met in Craig with the major mine operators in 1965 and 1966 and toured the strip mines observing the problem and the reclamation efforts. The outcome has been a voluntary restoration action by the mining companies in Routt County. They have flattened the peaks of the spoil banks and reseeded them to grasses, legumes, and some trees. Bromegrass, intermediate wheatgrass, orchard grass, and alfalfa have done well. Chokecherry, serviceberry, and snowberry are native to the area and have shown good results. Conifers have been unsuccessful.

With the application of conservation measures these strip mined areas will be a problem only until sloping and reseeding can be completed.

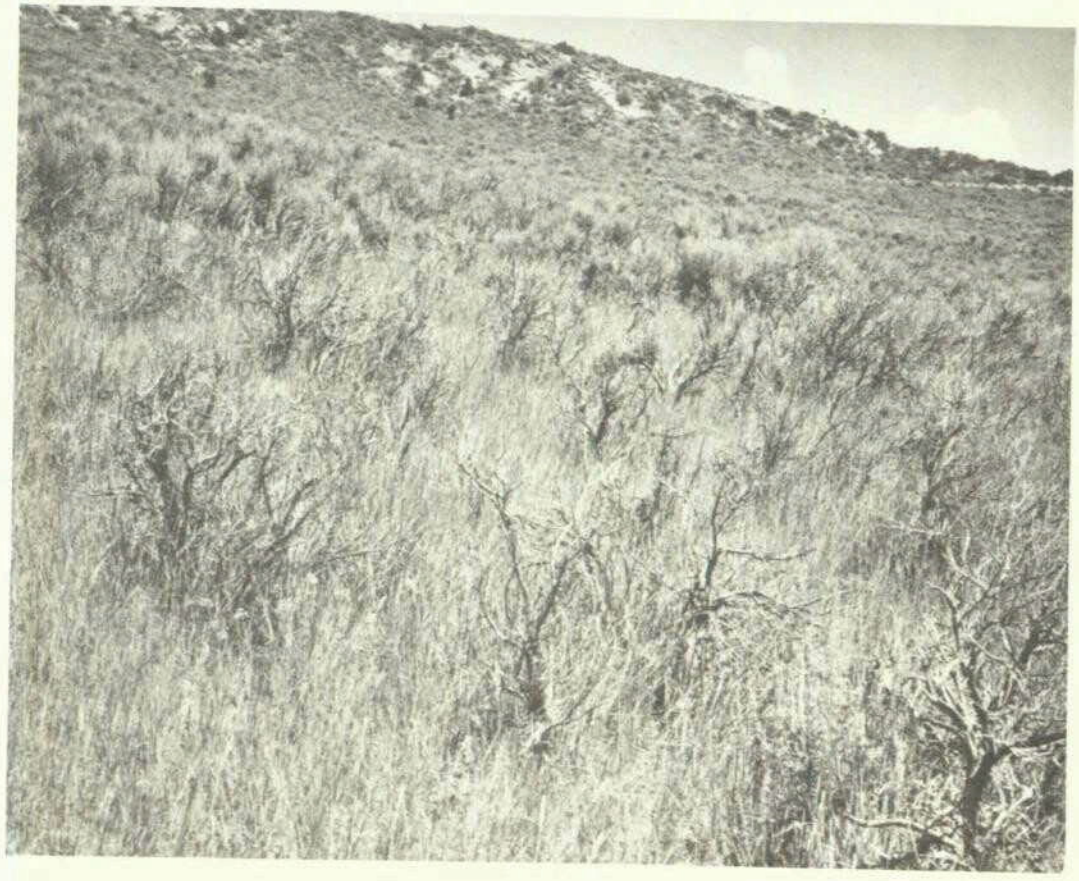
VI. PRESENT AND FUTURE NEEDS FOR WATER AND RELATED LAND RESOURCE DEVELOPMENT

Watershed Protection and Management

Irrigated lands make up about 1.7 percent of the basin, 3.1 percent is dry farmed, and 73 percent is considered to be nonforest grazing lands. Forest and miscellaneous lands make up the remainder.

In addition to the water used in the basin, the Yampa River contributes approximately one-eighth of the average streamflow to the Colorado River as measured at Lees Ferry, Arizona.

Practically all of the irrigated lands are used for hay or pasture. About 34,100 of the irrigated acres in Colorado (table 22) need better facilities for irrigation, drainage, and erosion control, as well as the installation of improved irrigation water management practices.



Brush control and range recovery near Craig

Table 22.--Conservation treatment needs on cropland, pasture, and rangeland, Yampa River Basin in Colorado, 1966

Land use	Treatment needed	Acres with no treatment needed	Acres with treatment needed	Total acres
Irrigated cropland	None	29,400		
	System improvement		8,500	
	Water management		25,600	
Subtotal		29,400	34,100	63,500
Dry farm cropland	None	56,400		
	Residue and annual cover		28,400	
	Stripping, terracing and diversions		42,900	
	Permanent cover			
Subtotal		56,400	100,200	156,600
Pasture and rangeland 1/	None	954,600		
	Protection only		430,400	
	Brush control and improvement		184,200	
	Reestablishment of vegetative cover		12,000	
	Reestablishment with brush control		9,600	
Subtotal		954,600	636,200	1,590,800
Total		1,040,400	770,500	1,810,900

1/ Totals include 19,100 acres of irrigated pasture and 30,700 acres of dry farm pasture.

Source: Conservation Needs Inventory (1966) - USDA data for Routt and Moffat Counties adjusted to the Yampa River Basin boundaries.

The Colorado dry farm cropland and dry farm pasture totals about 187,300 acres. About 71,300 acres need erosion control practices such as stubble mulch, chiseling, subsoiling, contour farming, strip cropping, and grassed waterways or outlets. Terraces have not proven satisfactory because snow runoff freezes in the terrace channels and causes subsequent runoff to top the terraces. Diversion type terraces perform more satisfactorily. Another 28,900 acres of the cultivated cropland should be seeded to permanent grass.

The rangeland is the main area in need of watershed treatment. The mountainous, high water yield zone produces water of good quality. Forest Service resource management policies in this area are particularly directed at maintaining and improving the hydrologic conditions of these important watersheds. The need is to protect the lower elevation watersheds and maintain the quality of the water as it moves across the basin.

The most commonly used rangeland practices are proper range stocking, deferred grazing, brush control, stockpond construction, and range reseeding. Approximately 60 percent of the grazing lands are considered to be adequately treated, and good progress is being obtained on most of the rest of the grazing lands. The level of management can be expected to continue to rise.

Silt resulting from streambank erosion will continue to be a problem in these semidesert range areas. Structural practices are difficult to justify on land used for grazing because of economic limitations imposed by low precipitation. However, future evaluations, which take into consideration the need for maintenance of water quality, will undoubtedly appraise the effects of streambank erosion. Most of the benefits are for improved water quality and the benefits are downstream.

Flood Prevention

Flood damage has been minor. The high water producing area is the mountainous headwaters of the basin, and snowmelt runoff is the principal source of water. The streams in this area are not deeply entrenched and the normal springtime flows spread out over considerable first bottom or floodplain areas. Since this is a normal annual occurrence, very little development has occurred on these floodplains. The farmers utilize these areas as wet meadows or pastures, or as feeding grounds during the winter.

Zoning is an important part of all flood control programs. As an example, Steamboat Springs has utilized the stream floodplains areas in their park program through zoning regulations. This type of development should be expanded and incorporated into zoning regulations for all the major communities in the basin.

Three streams traditionally produce high sediment yields when they flow at higher than normal depths. These are the Little Snake River, Fortification Creek, and Muddy Creek, a tributary to the Little Snake River in Wyoming. Streambank erosion as well as high sediment yields from the semidesert rangelands are quite pronounced. Control of these three watersheds would materially reduce the total sediment yield of the Yampa Basin.

In addition, Fortification Creek flows through Craig, Colorado. Historically, major floods of this creek have been the result of snowmelt or of a combination of snowmelt and rainfall. Ice jams at creek obstructions in the town of Craig have caused some of the problems. Some channelization under the direction of the U. S. Army Corps of Engineers has been done to provide for better flow conditions through Craig.

The town of Craig has had considerable urban expansion on the Fortification Creek floodplains in recent years, and the potential damage from even minor overflows would now be extensive. While it now appears that there is a potential for flood damage in Craig, past records indicate the probability at a low rate of occurrence.

Sediment Control

As pointed out earlier in the previous chapter under "Water Quality Limitations," the main water yield is from the more mountainous parts of the basin. The water quality, including suspended sediment, of the Yampa River is excellent.

All of the known proposed irrigation developments of the basin will help in control of sediment. The water storage features of these developments will entrap sediment. The potential PL 566 projects, with their land treatment measures, would also help in control of sediment and erosion.

The suspended sediment loads from the Yampa Basin are low as compared to the entire Upper Colorado Basin. Available data indicate that about 3½ times more suspended sediment comes from the Little Snake River Basin than from the Yampa River Basin above Maybell.

The Yampa River at Maybell, Colorado, produces 9.05 and 0.30 percentages respectively of the combined streamflow and combined sediment discharge as measured at Lees Ferry, Arizona, on the Colorado River. In contrast, the Little Snake River near Lily, Colorado, produces 3.54 and 1.06 percentages respectively of the combined streamflow and combined sediment discharge at Lees Ferry.

The combined suspended sediment yield at Lees Ferry, Arizona, from the Colorado and Paria rivers averages 103,955,000 tons per year, as reported by the U. S. Geological Survey. The entire Green River averages

27,875,000 tons annually; the Green River above the Yampa averages 3,677,000 tons; the Yampa River Basin averages 1,807,000 tons; between the Yampa and White rivers, including the White River Basin, the yield averages 7,339,000 tons; and there is an average yield of 15,051,000 tons from the Green River Basin below the White River.

Dry farm and irrigated croplands constitute only very small parts of the more arid part of the basin. The erosion problem is largely concentrated in the semidesert type rangelands. Sparse vegetation and soils derived from the Mancos and Wasatch shales are the principal problems. These soils are generally in an early state of development and this along with a sparse vegetative growth makes for erosive conditions.

Any appreciable reductions in sediment yield will have to come from better conservation measures on the rangelands. Management and land treatment measures will be the essential part of any erosion control program. Structural measures to prevent or retard erosion are economically difficult to justify.

About half of the grazing lands can be considered to be adequately treated. Conservation management practices are being applied on most of the rest of the grazing lands. However, research and field trials need to be continued. Adopted beneficial practices then need to be applied by the ranchers to further retard erosion. Experience has shown that the ranch operators will improve their ranges, thereby slowing down the erosion rate, when they learn it is to their advantage to do so.

Drainage Improvement

It is estimated that 30 percent of the irrigated lands, mostly hay meadow and pasture lands, need facilities to provide control of the underground water table and to provide for the removal of excess irrigation water. This would improve the quantity and quality of the harvest under the present level of irrigation and fertilizer practices. Along with drainage these irrigated lands should have practices such as land leveling, proper lengths of irrigation runs, canal and field lateral improvements, and other general irrigation system improvements installed.

Such facilities are essential as a first step to providing for higher level irrigation water management practices. Efficiency of fertilizer application and utilization is closely related to the level of irrigation water management that can be attained.

No new lands are expected to be brought into production as a result of these practices. Rather, they would provide a means to improve the quantity and quality of the grass and hay produced on the presently irrigated lands. Wildlife habitat would be improved by the creation of more water-surface area in open channels and grass cover provided by ditch banks and spoil areas.

Improved irrigated hay land in Routt County

The needed work can be accomplished by individual and small group action type projects. PL 566 projects, especially those for agricultural water management, should include provisions for water table control and excess irrigation water removal. The same applies for irrigated land management and treatment program for the individual farms or ranches.

Water Development Needs

Irrigation

Because late season water shortages occur almost every year in irrigated areas that obtain their water supply from small unregulated streams, more and larger water storage facilities are needed. A dependable water supply, provided by some type of project action, would help stabilize the production of winter feed supplies and help provide an economic stimulation for new developments and improved practices. Several

irrigated areas are geographically located so they can best be served by projects to satisfy the water deficiencies. Other areas, especially those that are small and isolated from potential projects, can best be served by individual or group action developments. In many instances water management practices need improvement to get the maximum production from the available water supply. Under present conditions the basin's irrigated land needs about 22 percent more available water to reach the ideal crop irrigation requirement. About one-third of the irrigated acreage is in pasture and range. A large portion of these lands are in short water supply areas. Pasture and range crops have been found to be the best adapted for short water supply areas. About 83 percent of the irrigated pasture and range lands are short of late-season water supply and are located along the smaller unregulated streams.

The agricultural productivity can be increased by providing additional water to lands which are suitable for irrigation but are presently in dry cropland and pasture. The expansion of irrigated acreage is needed to help stimulate the agricultural industry as well as improve the farm and related industry economy. Providing water to these lands will increase the forage base and support the livestock industry.

Many water management problems result from these seasonal water shortages. Overirrigation when water is plentiful results in seep areas and salt accumulation. Overirrigation with cold water in the spring also causes retardation in crop growth and production. It is estimated that 8,500 acres of the irrigated land in Colorado need improved irrigation systems and 25,600 acres need conservation water management. Improved irrigation systems are needed for proper application of irrigation water and to prevent soil erosion. This includes such measures as the reorganization of existing systems, land leveling, ditch lining, erosion control measures, and drainage. Conservation water management is needed to control water application in a way that insures higher crop yields without wasting water, soil, or plant nutrients. Irrigation systems range from simple temporary diversions and small natural channels to permanent concrete diversion and control structures with well maintained ditches. A few pumping systems with underground pipe distribution layouts are also in use. On the whole, however, the irrigation methods and the facilities for irrigation water management are not well developed and irrigation efficiencies are low.

Water development projects proposed by the Bureau of Reclamation would provide adequate water supplies to most of the short supply lands as well as water for new land. The availability of dependable water supplies should produce higher crop yields, which in turn will make improvement of the present irrigation and drainage facilities economically feasible.

Rural Domestic and Livestock Water Supply

Ground water is the principal source of rural domestic water supplies. Rural habitations in the basin are widely dispersed and water quantities are generally adequate. Most areas have moderately hard water but quality is good otherwise. Wells, which tap unconsolidated alluvial deposits along streams, are the major sources. Yields normally range from 25-500 gallons-per-minute. Wells are also drilled into consolidated rocks, principally sandstone, to tap confined water sources. Yields from these wells commonly range up to 50 gallons-per-minute. Present demands for rural domestic water are being satisfied and normal increases in future requirements can be met as needs develop.

Livestock water supplies are usually supplied by the development of surface water sources though some ponds have ground water augmentation. Increases in livestock numbers plus more intensive range management will create a need for development of additional supplies and facilities. Over 1,200 new stock tanks (23 percent increase) are projected for the basin by 2020.

Municipal and Industrial Water Supply

Municipal water is obtained from both ground water and surface water. The source of supply selected depends primarily upon availability and demand. Smaller communities generally depend on ground water because supplies are usually available and adequate. Also, ground water is cheaper to develop because it requires less treatment prior to use. Larger communities generally do not have adequate amounts of ground water nearby and must develop surface water supplies and facilities.

Maybell, Milner, and Phippsburg do not have community water systems but obtain their water from individually-owned wells. These present sources are adequate and normal increases in demand should be no problem.

Craig, Hayden, Oak Creek, Steamboat Springs, Yampa, Dixon, and Baggs have municipally-owned systems. Craig's water is taken from the Yampa River downstream from the Fortification Creek-Yampa River confluence. Peak water demands occur during the May-July period when Fortification Creek is very sediment-laden due to spring runoff. The heavy sediment and silt load overtaxes the plant filter capacity during peak demands and city service connections occasionally receive turbid water. Hayden has a similar problem. Water supplies for both towns are adequate for moderate increases in use but quality can be improved by relocation of intake facilities and/or larger filter systems.

Steamboat Springs water supply is taken from Fish and Spring creeks and supplies are adequate for future increases. The city distribution system, however, is unable to supply peak demands and will need additional capacity before 1980.

The town of Yampa has an immediate problem. Its source of water, the Yampa River, dries up during short periods of peak use because of the diversion of prior rights upstream. These shortages in the city's water supply could be alleviated by the construction of larger holdover storage facilities or development of new water sources.

Future demands for municipal water at Craig, Hayden, and possibly Milner are expected to be higher than average. Municipal growth is expected to be stimulated by the proposed thermoelectric generating plants to be located in these communities. Industrial water supplies for these new plants will have to be developed--probably from the Yampa River.

Recreation

The Yampa River Basin is popular as an outdoor recreation area. Demand for outdoor recreation facilities is increasing and this trend is expected to continue. The basin needs to be developed in all types of recreation activity to meet this demand. Some of the areas developed or partially developed are Mount Zirkel Wilderness, Dinosaur National Monument, Mt. Werner Ski area, Howelson Hill, Browns Park National Wildlife Refuge, the national forests, and many camping and picnic areas (Figure 9 - Transportation and Recreation Map).

Outdoor recreation development

Emphasis should be placed on developing the type of recreation the basin can supply in greatest quantity. To keep up with the demand for sightseeing, camping, picnicking, and hiking will require major expansion of facilities and development of new attractions.

Present and projected recreation visitor days by activity are estimated in table 23. Needs are discussed by each activity.

Table 23.--Present and projected recreation visitor-days, Yampa River Basin in Colorado and Wyoming, 1960-2020

Activity	Units	1960	1980	2000	2020
		Yampa River Basin in Colorado			
Hunting					
Big game	Hunter-days	57,000	90,000	130,000	150,000
Small game	Hunter-days	15,400	20,000	28,000	39,000
Fishing	Fisherman-days	101,000	200,000	260,000	300,000
Skiing	Skier-days	6,700	100,000	160,000	213,000
Camping	Visitor-days	148,800	429,000	814,000	1,000,000
Guest Ranches and Resorts	Visitor-days	4,500	9,000	13,500	18,000
Hotel and Motel use	Visitor-days	136,400	335,000	555,000	600,000
		Yampa River Basin in Wyoming			
Hunting					
Big game	Hunter-days	11,100	20,000	26,000	30,000
Small game	Hunter-days	1,000	1,300	1,800	2,500
Fishing	Fisherman-days	5,000	25,000	40,000	50,000
Camping	Visitor-days	20,000	58,000	89,000	116,000
Guest Ranches and Resorts	Visitor-days	250	1,000	2,000	4,000
Hotel and Motel use	Visitor-days	1,100	3,000	5,000	7,000

Source: USDA Field Party

Tourism

Present development of recreation sites is very modest. Increased development would attract more people. Tourist accommodations are divided between city accommodations such as hotel, motel, tourist rooms in private homes, and outdoor accommodations such as camping areas and trailer parks. Camping areas and trailer parks include those in towns, along main highways, on farms or ranches and Federal development in the national forests and on Bureau of Land Management land.

Proposed recreation developments are shown on the Transportation and Recreation Area Map (Figure 8) following page 66. There will be a need for more camping and recreation sites. Greater emphasis is being placed on clean, durable, attractive, properly spaced, and amply supplied facilities that preserve the natural surroundings. Priority should be given to the upgrading or replacement of existing recreation sites. Additional vista-points with adequate parking and more rest stops are needed. More trails through scenic areas are needed. There is a pressing need for many more nature trails for hikers and horseback riders. Visitor information facilities and other instructive developments for visitors are needed.

By 2000 it would appear necessary to develop all potential recreation reservoirs. Before that time, existing reservoirs and lakes should be fully utilized for camping, picnicking, hiking and water sports activities.

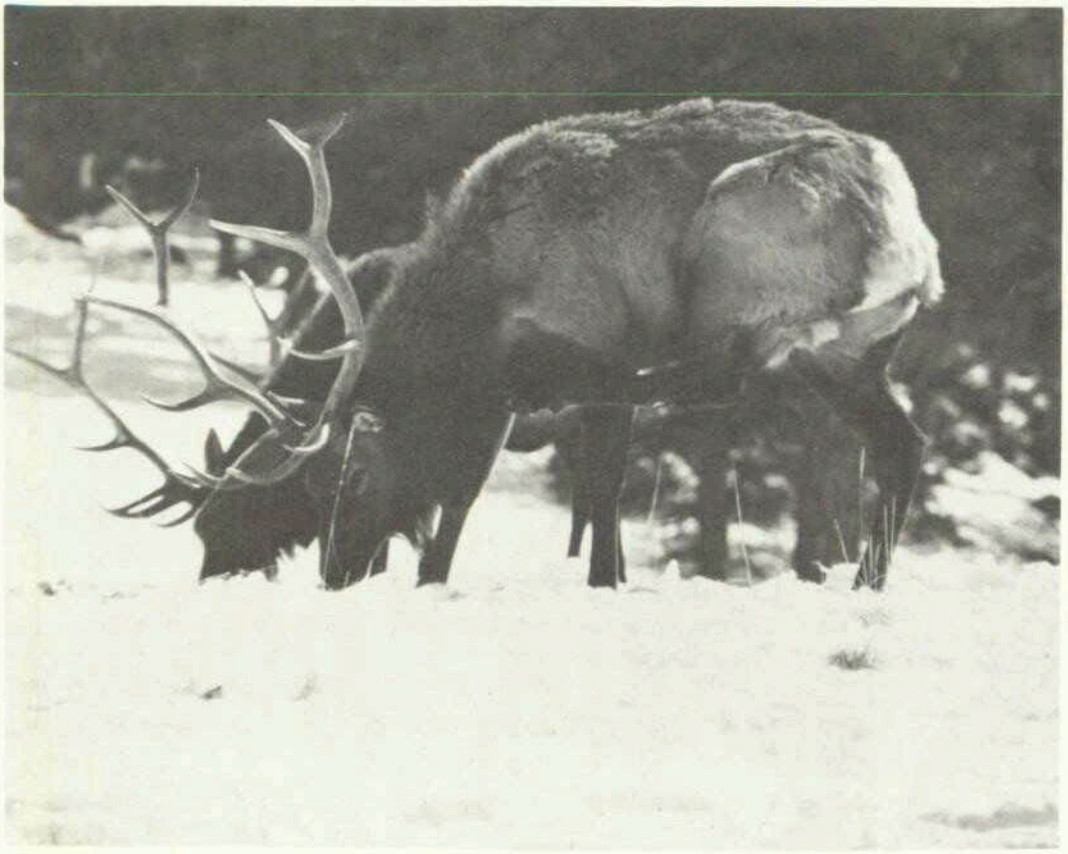
The future will see a need for more guest ranches and resorts with golf courses, swimming pools, shade, beaches and other sports facilities. Guest ranch operations have been common for years but the number and size of developments have been small. It has been a side-line operation for the ranchers. This is expected to expand into full time guest ranch operations and will help take care of the overflow from the Dinosaur National Monument, the Forest Service recreation areas, and other recreation areas both in and adjacent to the basin which are in need of increased living accommodations of this type.

Hunting

Big game hunting for both elk and deer is a very popular sport. The trend has been for an eight percent per year increase in this activity. Antelope hunting may increase but not to the extent of other big game hunting. Deer and elk hunting attract people from many states but antelope are generally hunted by resident hunters.

Present big game hunting capacity is estimated at 180,000 hunter-days annually. If present hunting quality is to be maintained, only moderate increases are possible in the basin's hunting capacity.

Small game hunting is a popular sport, mainly for local residents. It is anticipated that this type of hunting will increase but not as much as big game hunting.



COLORADO GAME, FISH AND PARKS DEPARTMENT PHOTO

Elk in Routt County

Fishing

There is an abundance of water area in the basin, particularly in Colorado. Stream and natural lake fishing, particularly in the national forest areas, is excellent and can accommodate many more fishermen than presently use the area. Nearly all of the irrigation projects planned will have recreation use that includes fishing. Other fishing lakes are being developed by the Forest Service and the Colorado Game, Fish and Parks Department and private developers.

It is anticipated that fisherman-days will increase from about 106,000 in 1960 to 350,000 in 2020. Therefore, large increases in the capacity will be needed to satisfy fishing demand unless improved management efforts can be stepped up to absorb the expected pressures for more fishing. Road improvement will bring better distribution of fishing pressure, but certain waters should remain inaccessible to vehicles. Other measures needed to meet the demand for fishing include: adding new waters,

fishing research leading to improved management of existing waters, water quality control, utilization of nongame species, educating the public toward wider acceptance of "fishing for fun" programs, and creating more interest in warm water fishing.

Natural lake fishing at Rainbow Lake

Winter Sports

Winter sports activities are increasing at a rapid rate. The Mt. Werner installation opened in 1962 now includes sites for about 50 homes, and 12 condominiums with from 12 to 20 units each. Ski facilities include two chair lifts and two pomalifts. A third chair lift will be installed in the near future. This winter sports development is at an excellent location and seems to be doing well. Additional facilities, especially weekend accommodations, and promotional projects will increase use.

Howelson Hill maintains a steady use by providing season tickets, night classes, and student lessons. No rapid expansion can be anticipated due to competition from Mt. Werner ski areas. A steady increase based upon population increase should be expected.

Water Quality Control

Except for municipal water supply for Craig, water quality control needs are minor. The basin's main flows originate from high altitude snowmelt and the major rivers and streams are relatively clean.

Many industries, if located in and near the mountains, could use the surface waters with little or no treatment.

For recreational use, particularly aesthetically and for hunting, the headwater areas are ideal.

The principal water use is for irrigation. Except for some intermittent streams, which would rarely be used for irrigation because they do not have dependable flows, the water is of good quality for irrigation.

Man's effect on water quality in terms of dissolved solids is generally related to irrigation. Twelve thousand acres of irrigated land above Steamboat Springs produce a dissolved solid increase equivalent to 0.15 ton per year per acre of irrigated lands. Eight thousand acres of irrigated land on the Elk River produce a dissolved solid increase equivalent to 0.4 ton per year of irrigated land. Four thousand acres are irrigated between Slater, Colorado, and Dixon, Wyoming, along the Little Snake River and produce a dissolved solid increase equivalent to 1.2 tons per year per acre of irrigated land. Of the dissolved solids attributed to the activities of man in the basin, Geological Survey Professional Paper 441 indicates that about 1,400 tons annually are caused by domestic and industrial uses of water and about 61,000 tons annually are caused by irrigation. This paper also reports that 22 thermal springs in the Yampa River Basin with a total discharge of 7 cfs and a dissolved-solids concentration of about 5,000 p.p.m. discharge about 34,500 tons of dissolved solids annually.

In addition to the present yield, dissolved solids on now irrigated land will be in the order of 0.15 tons to 1.2 tons per year per acre, depending upon the area of the basin in which it is located.

All of the known proposed storage features of irrigation developments of the basin will be helpful in control of water quality for water use in the basin. The storage features will be mainly for snowmelt runoff waters which are low in dissolved solids. The increase in dissolved solids content of the Yampa River water as it leaves the basin will be small. This will happen because more of the better snowmelt water is stored for

use and not available to dilute the lower tributary waters, and because the irrigation water on the new lands will leach out soil salts which will eventually return to the river with the return flows.

Future control of the suspended sediment load of the basin will be largely related to application of range management practices. Since the bulk of the sediment yield is from the arid portion of the basin, any material decrease or increase in water quality will be directly related to conservation practices in this area.

Water pollution control is not estimated to be much of a problem due to the limited industrial and population growth anticipated in the area. Future industrial expansion could include considerable growth of strip mining for coal in this area. Without proper control this could result in an increase of both the suspended sediment and dissolved solids yield of the basin. If the uranium mining industry should be reactivated there could be an increase of suspended sediment and dissolved solids and the possibility of radioactive contamination of water unless operations are carefully controlled.

Growth of the recreation industry will depend on maintenance of an abundance of clean water. Trout fishing in particular is a recreational activity with high potential for future growth. Recreational use could easily be the main source of water contamination unless measures are taken to reduce this potential hazard.

VII. WATER AND RELATED LAND RESOURCE DEVELOPMENT POTENTIAL

Availability of Land for Potential Development

Constraints imposed by ownership, legal and institutional factors, location, and water supplies will determine availability of land for future development. They require primary consideration in long range projections along with actual physical characteristics of the land.

Privately-owned lands are concentrated along the river valleys and major tributary streams. For the most part the increase in irrigated acreage will depend upon the location of proposed storage facilities and water distribution systems.

National forests encompass lands that have a short frost-free season. It is unlikely there will be any change in cropland acreage as a result of exchanges involving national forest lands.

Lands administered by the Bureau of Land Management are extensive in both Colorado and Wyoming. Much of the acreage consists of desert soils under a climate favorable for irrigated agriculture, however, lack of a water supply and shallow soils on rolling hills will limit development to a few areas where water can be diverted to deep, loamy, and clayey soils occupying gentle slopes.

Most lands to be placed under irrigation in the future within the basin will be at elevations below 7,500 feet and at locations where water can be supplied by some type of project action. These locations are outlined in later sections of the report. They are chiefly in soil mapping units 1.0, 2.3, and 4.0 on the General Soil Map. These lands have the most desirable combination of factors affecting irrigated crop production. In addition to a favorable climate the units have extensive delineations of deep loamy soils that occupy nearly level to rolling slopes.

In Colorado there is a concentration of land available and suitable for irrigation in northern Moffat County. It extends in a broad, irregular and broken arc from Slater Creek down the east side of the Little Snake River nearly to Bald Mountain. There are smaller areas in Browns Park near the Two-Bar Ranch and at the confluence of the Little Snake and Yampa rivers. Upland soils are deep and have good water holding capacities. Alluvial soils on the terraces and bottomlands are more variable in textural profile characteristics and at some locations are affected by salinity and alkalinity. Other areas of significant size in Moffat County are along Fortification Creek and northeast of Craig, south of Craig, along Milk Creek, in the Axial Basin, and near Maybell and Sunbeam.

In Routt County soils suitable for irrigation occupy benches and uplands in the vicinity of Hayden, Mount Harris, and Twenty Mile Park. These soils are generally clayey in texture and produce well as cropland. Other scattered lands suitable for irrigation extend up the Yampa Valley from west of Steamboat Springs to Toponas.

Availability of land for irrigation will also be determined in part by desires of the landowner. Some of the irrigable lands are presently farmed as nonirrigated cropland. The relative economic returns per acre as well as personal preferences of the owner will determine whether the lands are placed under irrigation.

The major area in Wyoming where suitable land is available for development borders the Little Snake River and extends from the Sweetwater-Carbon county line upstream to Slater. It encompasses terraces and benches occupied by deep, loamy, permeable soils that are productive when irrigated. There are significant acreages of desirable soils on the divides above Savery Creek, however they are at elevations above any planned water distribution system. Some alluvial soils along Muddy Creek and its major tributaries are suitable for irrigation. However, these areas are scattered, small in size and lack a water supply.

There are extensive areas suitable for recreation under Federal, State, and private ownership. Soil mapping units 3.0, 5.3, and 6.0 outline portions of the basin possessing rugged relief and spectacular scenery. The units also have timbered slopes and perennial streams that enhance their recreational value. Deep, well drained, and loamy soils suitable as sites for campground and reservoir construction are along water courses and in narrow valleys. Unit 2.0 is less scenic and has only a few perennial streams, however, there are even greater opportunities for pond and reservoir construction on favorable soil sites.

Impoundments

The basin's need for supplemental water supplies and additional holdover storage facilities has long been recognized. Many studies and reports have been made concerning proposed water and related land resource developments with State, Federal, and local agencies participating. Many of these water development proposals warrant further detailed analysis while others have become obsolete through changing water requirements and current developments. All known water development proposals involving a sizeable impoundment have been considered and those with realization probability are listed in table 24. Impoundment location is shown on the Project Location Map, Figure 9. The fourteen potential reservoirs would provide over 2,300,000 acre-feet of storage capacity with over 95 percent primarily for irrigation.

Table 24.--Potential impoundments, Yampa River Basin, Colorado and Wyoming

Name	Number 1/	Principal use of water released from storage 2/	Capacity acre-feet
Juniper Reservoir	9-A	Irrigation	1,970,000
Jubb Creek Reservoir	9-B	Irrigation	2,250
California Park Reservoir	9-C	Irrigation	36,000
Rampart Reservoir	9-D	Irrigation	7,500
Thornburgh Reservoir	10	Irrigation	22,500
Bear Reservoir	11-A	Irrigation	11,600
Dunkley Reservoir	11-B	Irrigation	56,900
Yamcola Reservoir	11-C	Irrigation	6,400
Savery Reservoir	12-A	Irrigation	18,600
Pot Hook Reservoir	12-B	Irrigation	65,000
Hinman Park Reservoir	13	Power	44,000
Trout Creek Reservoir	14	Power	24,300
Craig Reservoir	15	Power	44,500
Twenty Mile Reservoir	16	Irrigation	15,300
Total storage potential			2,324,850

1/ Project Location Map, Figure 9

2/ Multipurpose reservoirs include storage for irrigation, power (steam or hydroelectric), flood control, and sediment storage. All reservoirs would offer potential recreation benefits.

Total irrigation storage = 2,212,050 acre-feet
Total power storage = 112,800 acre-feet

Source: State, private, and Federal potential project reports.

Water Developments

Rural Domestic and Livestock Water Supply

Most rural domestic water and some livestock water supplies are obtained from ground water sources. There is an adequate supply of ground water for development to meet future projected demands and facilities will probably be provided on an individual need basis. New wells, tapping the basin's unconsolidated alluvial deposits along main drainages, will produce yields ranging from 25-500 gallons-per-minute and should be relatively shallow (less than 300 foot depth).

Livestock water demands will increase throughout the projection periods along with the expected increases in livestock numbers. (Greater than 60 percent increase by 2020). Though many stockponds have already been built, the basin has an ample supply of developable stockpond sites. Ground water developments, used in many instances to augment the surface water and maintain water levels in stockponds on ephemeral streams, can be adequately supplied by the existing resources.

Municipal and Industrial Water and Related Developments

Municipal and industrial developments in the basin will be stimulated by the installation of coal-fired thermoelectric generating plants. The abundance of coal, water, and space make enlargement of the Hayden plant a prime potential development. In addition, to fully exploit the available resources, new plant potentials exist at Craig and in the vicinity of Milner. These potential plants would also require large amounts of water. Demand for plant cooling water by the year 2020 is estimated at 70,000 acre-feet per year and needs could be satisfied by development of the Yampa River or other readily available water sources. Coal requirements will spur strip coal mining activities. Although coal mining operations have been carried on for many years in the basin, core drilling information indicates that large reserves are still available. One reserve that is strip-mineable is located in an area extending 4 to 5 miles both south and west of Craig. The mining rights on this strip-mine coal are primarily held by the Utah Construction Company. The Company produced no coal in Moffat County in 1967 and is probably awaiting development of proposed thermal power generating plants or other markets that would justify large scale mining operations.

Three additional power generation developments are considered potentially feasible. Consideration is being given for construction of a power service reservoir on Trout Creek west of Oak Creek, (Project Location Map, Figure 9). The reservoir would impound water for all purposes connected with hydropower generation. A similar development on Middle Fork of Elk River would provide water for uses related to thermopower generation. The third development, Craig Reservoir on the Yampa River near Craig, would supply plant cooling water for power generation and some domestic amounts for local areas.

Another development has recently been proposed. Plans call for the construction of pumped-storage hydroelectric and steam generating plants together with out-of-state transmission lines. The already mentioned Trout Creek facility would be integrated with four additional reservoirs to form a power generating network. Two new reservoirs, Lower Green and Main Green, would be built on Green Creek southeast of Steamboat Springs. Service Reservoir would be built adjacent to Service Creek and would be filled by stream diversion. The fourth dam is Blacktail Reservoir on the Yampa River east of Oak Creek. This reservoir would inundate the same

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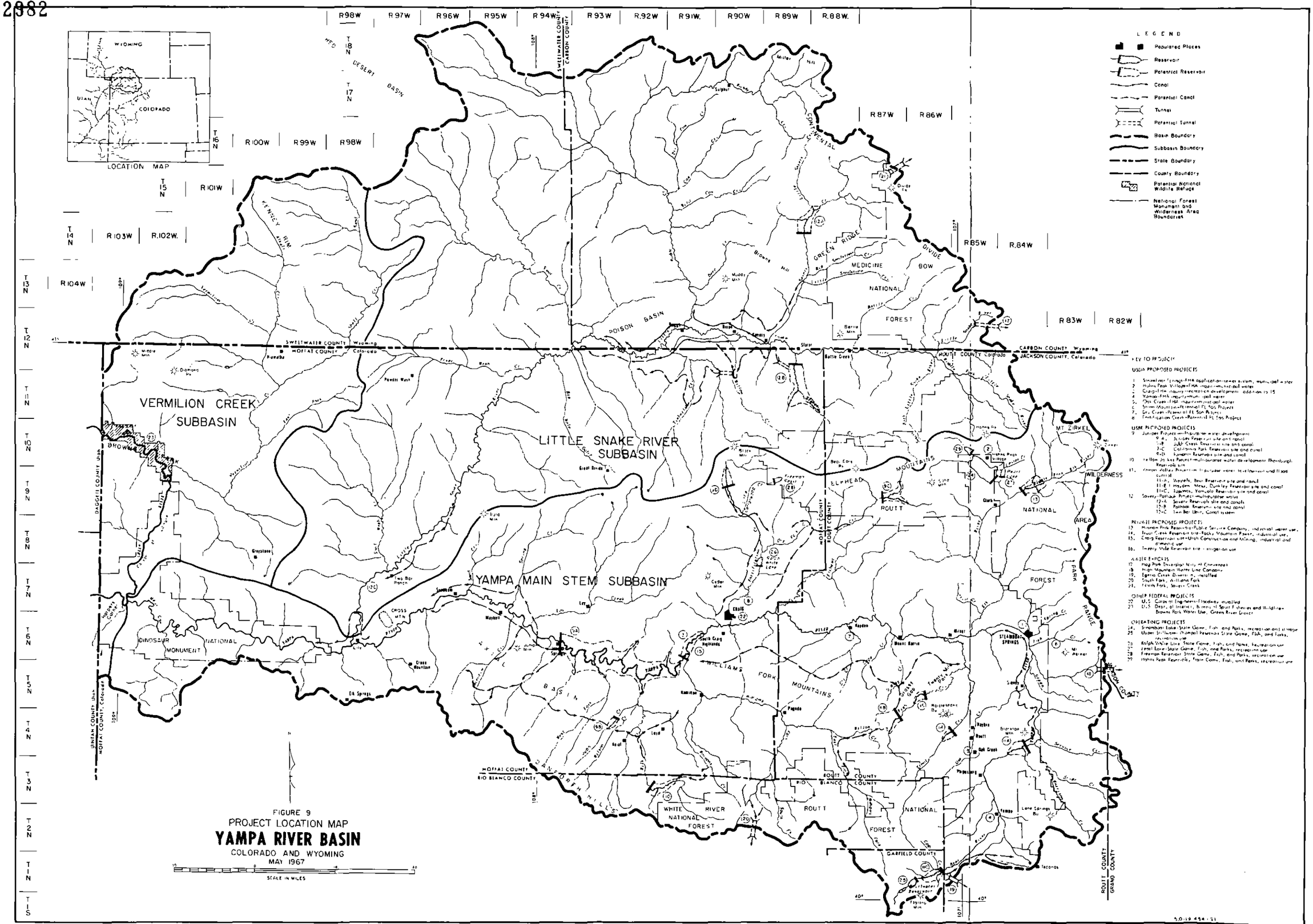


FIGURE 9
PROJECT LOCATION MAP
YAMPA RIVER BASIN
COLORADO AND WYOMING
MAY 1967

M7-S-18989B-N

area as the U. S. Bureau of Reclamation's proposed Bear Reservoir but the dam site is further downstream. Agreements may be worked out to utilize the same reservoir for both irrigation and power generation uses.

There are five communities that have potential for some type of water development and preliminary project initiation has been made by Steamboat Springs, Craig, Yampa, Hahns Peak Village, and Oak Creek. Steamboat Springs obtains their water from two Yampa River tributaries and though the supply is adequate, the distribution system is not large enough to meet peak demands. In addition to potential enlargement of the water system, enlarged sewage collection and treatment facilities will be needed to meet the demands of this area of future population expansion. These potential developments should be given high priority to prevent contamination of the Yampa River and satisfy the water needs of the community.

Craig will need to enlarge their water treatment facilities or move them to a more satisfactory site in the near future. Heavy sediment loads are presently overtaxing the plant filter capacity during the spring and a new site for municipal water development is a potential remedy. Craig also has indicated interest in constructing a reservoir on the Yampa River southwest of town to primarily furnish recreation opportunities for tourists and local residents.

Yampa has a potential for larger municipal water storage facilities or development of additional water sources. The community is without water during periods of prior rights diversion above their intake on the Yampa River and larger storage facilities could alleviate the situation. A sewage treatment plant is also a possibility for future development.

Hahns Peak Village has a potential for a recreation water development project and Oak Creek has a possible project to extend their present water system by enlarging their storage reservoir.

Channel Improvements and Levees

Channel improvements and/or levees could be used to alleviate occasional flooding problems along Fortification Creek near Craig and in Hayden, along Dry Creek. Channel realignment and improvement of Fortification Creek from Craig to the Yampa River would reduce the threat of ice breakup flooding in the urbanized area of Craig and would also protect agricultural developments nearby.

Realignment, improvement and maintenance of the Dry Creek channel would minimize the possibilities of damaging flood flows through Hayden. Developments have encroached upon natural drainage ways and low areas creating potential flood hazards that could be significantly reduced by channel improvements.

Several areas of irrigated land in the basin, especially those along the main tributaries, are being eroded away during high stream flows. Channel revetments or streambank stabilization as well as maintenance of existing improvements could be carried out to reduce these losses in agricultural land.

Farm Drainage

There is a potential for improvement of existing drainage systems and installation of new ones. The present rate of accomplishment is about forty acres per year and accelerated installation of drains is a prime potential. Open ditch drains in the 6-8 foot depth range are adaptable to the topographic, climatic, soil, subsoil, and ground water conditions found in most areas in the basin. Individual systems, or small group action projects where conditions such as access and property lines are factors, are generally satisfactory.

Future development of irrigated lands will require installation of drainage systems. From available information it is estimated that new reclamation projects will have a potential for at least 11 miles of open drains.

Irrigation Systems

Updating and renovation of many existing irrigation systems in the basin is an important development potential. Inefficient systems can be improved for more effective diversion, control, and delivery of water for on-farm use. Reorganization, consolidation and/or construction of new facilities are related development opportunities. New or improved systems can provide better yields and greater farm income with the same water supply.

Potential water supply projects throughout the basin will also provide opportunities for development of new farm irrigation systems along with the project distribution canals (Project Location Map, Figure 9). New farm units, resulting from reclamation type projects, will need head ditches, laterals, turnouts, permanent-type control structures, land leveling and other facilities.

Developments for Recreation - Fish and Wildlife

Presently there are about 22 guest ranches and resorts, largely rancher operated, which can be considered as year-round operations, although their income is principally during the summer and fall and is related to the fishing, hunting, and packtrip seasons. In addition about 53 other ranchers supply accommodations during the fall big game hunting season

when existing facilities are in extreme short supply. This seasonal use is a "boom and bust" type of base to the private service industry. There is a need to expand recreational opportunities into other seasons. The hunting and fishing demand is a substantial base for need to expand the service industry, provided use if found for the expanded facilities during other seasons of the year.

The county Technical Action Panel "Appraisals of Outdoor Recreation Potentials" indicate several possibilities for expansion of the recreation base. US Highway 40 is a major tourist highway across the basin. In addition it parallels the Yampa River for long distances. This should be an ideal combination to attract more vacationers to extend their stay in the basin if accommodations were made available in the more attractive sites which would make use of the highway, the river, the mountains, and the scenery. US Highway 40 is the access route to Dinosaur National Monument and other major national parks in adjoining areas, as well as major recreation areas of the national forests and state park system both in and adjoining the basin.

The Moffat County Appraisal of Outdoor Recreation Potentials lists twenty known potential impoundment sites ranging from 4 to 23,000 acres in surface area. The Routt County Appraisal lists 53 potential sites ranging from 4 to 900 acres in surface area. While it is recognized that all of these will never go in due to social, political, legal, and regional compact limitations, the inventory does furnish data useful in projecting recreation potentials. Table 24 represents one such projection.

Land Treatment and Adjustments

The land treatment needed to maintain or improve soil and water resources is governed by the way the land is used. Continued maintenance of the existing conservation measures is a need on land that will stay in its present use. Development of potential changes of land use in the basin will require a change in treatment needs. Regardless of ownership, State, private, or Federal, there is a potential of improving management practices and applying conservation measures on land not yet adequately treated and on land that will be changed to new uses.

Potential treatment and adjustments include:

(1) Improving cover on crop, forest, pasture, range, and wildlife lands

(2) Retaining water for beneficial use

(3) Protecting land against soil erosion

(4) Reducing water and sediment damage

(5) Improvement of systems and water management on irrigated lands

VIII. EXISTING WATER AND RELATED LAND RESOURCE PROGRAMS AND PROJECTED DEVELOPMENT

USDA-Projects and Programs

PL 566 Projects

Watershed protection and flood prevention work is one of the programs carried on by the USDA through the administrative leadership of the Soil Conservation Service. This work combines soil and water conservation treatment on the land with control and use of runoff by means of upstream structural measures. Projects are planned for multiple use and conservation of all water and related land resources in a watershed. The SCS assists sponsoring agencies, such as soil conservation districts, and state or local governments in planning and executing the upstream watershed protection measures. The U. S. Forest Service, Farmers Home Administration, and other Federal, State, and local agencies also give assistance in developing these projects. Cooperative USDA agency contributions to these projects are of three kinds: (1) Technical assistance in planning, designing, and installing works of improvement and land treatment measures, (2) Sharing costs of flood prevention and agricultural water management, public recreation or fish and wildlife developments, and (3) Extending long-term credit to help local interests with their share of costs, including costs of developing industrial or municipal water supplies.

There are no completed PL 566 projects in the basin but applications have been received and field examinations have been made on three proposed Public Law 566 watersheds. These are Fortification Creek near the town of Craig, Dry Creek near Hayden, and Storm Mountain in the vicinity of Steamboat Springs. Though planning action has been tabled or suspended on these projects, problems in these areas will require some type of project action in the future probably in the 1980-2000 period. Infrequent flooding causes damages in all three areas. Sediment deposition, erosion, and other property damage are some of the problems. The municipal water supply system at Craig receives high concentrations of sediment during flood flows in Fortification Creek, and the Hayden sewage system has backup from high flows from Dry Creek. These are detrimental to public health, and in view of expected increases in population and related urban expansion these situations will become more critical. Flood prevention has not been economically justifiable in the past but as developments become more extensive these projects can be expected to become necessary and economically feasible.

The application for the Storm Mountain Watershed project primarily requested agricultural water management developments. Supplemental benefits for the 53,900 acre watershed would include flood and erosion damage reduction and recreational uses. The project was feasible as

originally proposed but local sponsors rejected the plan due to the high cost of water development. Since then other interests have filed on the available water and any future reservoir development will require another site. Preliminary investigation was suspended in July 1959.

Dry Creek Watershed (44,500 acres) south of Hayden had as its principal objective the installation of flood prevention structural measures on Dry Creek and its tributaries for the protection of public and private property. Anticpated benefits would include: (1) Elimination of flood damage to Hayden, (2) Improvement of public health through protection of the municipal sewage disposal system, (3) Reduction of sedimentation damages, (4) Provide additional water for irrigation, and (5) Accelerated installation of land treatment measures on agricultural lands of the watershed. The Dry Creek project is tabled at the present time primarily due to a presently unfavorable benefit-cost ratio. The costs of necessary structural measures would exceed the benefits to be derived by the community and agricultural interests at todays level of development. Also, a high percentage of land treatment measures should be applied to certain areas before structural installations are considered. Land treatment measures required would include contour farming, buffer stripping, stubble mulching, grass seeding on steep erosive areas and proper range management.

Fortification Creek Watershed in Moffat County north of Craig contains 169,000 acres. The project objectives are: (1) Installation of structural measures to provide flood protection for urban and agricultural lands in and around Craig, and (2) Complete land treatment on public and private lands in the watershed. Other benefits would include storage of supplemental irrigation water supplies for use during the later part of the irrigation season. This project was tabled due to questionable feasibility. The benefits presently fall considerably short of the costs even if the value of stored water was included.

Data from the 1966-67 Conservation Needs Inventory shows four potentially feasible watersheds in addition to those that have watershed applications. These are the Elkhead Creek, Trout Creek, Morrison Creek, and Bear River Watersheds. All four are potential agricultural water management projects with related flood damage problems on irrigated hay meadows. Since these watersheds have limited possibilities for flood prevention, they are considered to have a low priority as PL 566 projects.

There are several other watersheds in the basin which may eventually become feasible projects and warrant further consideration. Should proposed U. S. Bureau of Reclamation projects fail to materialize many smaller, PL 566 type projects might be reevaluated. The amount of flood control benefits to be derived from any of these projects is presently very minor and primary objectives would be agricultural water management.

PL 46 Program

The Soil Conservation Service (SCS) is the technical soil and water conservation agency of the United States Department of Agriculture (USDA). The SCS under the Soil Conservation Act (Public Law 46, 74 Cong., 1935) carries on a broad program of direct assistance to farmers and ranchers through soil conservation districts, as well as aiding other agencies. Related activities include farm and ranch planning and assistance in the installation of conservation practices, soil surveys and investigations, plant material improvements for conservation work, snow surveys and water supply forecasts, technical assistance to other USDA activities, and aid to other agencies responsible for administering conservation work on private lands. Four soil conservation service districts cover about 97 percent of the area in the Colorado portion of the basin and one district about 82 percent in the Wyoming portion.

Stubble mulch farming practice in Moffat County

Conservation practices installed throughout the basin with SCS technical assistance include farm ponds, irrigation field ditches, land leveling and smoothing, stubble mulching, chiseling and subsoiling, conservation cropping systems (use of crop residues), range deferred grazing, fish pond stocking, wildlife habitat development and preservation, crop to grassland conversion, windbreak establishment, pasture and hayland management, renovation, irrigation system rehabilitation, planting, and other conservation practices.

Cooperative Snow Surveys

Snow surveys conducted by the Soil Conservation Service provide a means of water supply forecasting in Colorado. More effective utilization of water is possible by having advance knowledge of seasonal and annual water supplies. Snow surveys have been conducted within the basin since 1936 with nine snow courses (two in Wyoming, and seven in Colorado) currently contributing data to the Cooperative Snow Surveys. Regular forecasts are made monthly during the winter and the spring. They are distributed to all water users, water resource agencies, and others who utilize these data. Appreciable assistance is provided by other public agencies, especially the U. S. Forest Service and the Bureau of Reclamation.

The Yampa Basin is characterized by relatively high snowfall and low summer precipitation, so forecasts based on snow survey data are dependable.

Weather modification studies are also being carried on in the Park Range east of Steamboat Springs. The Bureau of Reclamation in cooperation with several agencies including the Soil Conservation Service is experimenting with cloud seeding and precipitation augmentation methods under the Atmospheric Water Resources Project. If weather modification methods can be perfected many dividends such as increased water yield for irrigation, power production, municipal and industrial use, wildlife enhancement, and recreation will be realized. Since a large portion of the water in the Yampa River flows into the Green River, benefits of the program will reach into other states in the Colorado River Region.

The Atmospheric Water Resources Project, initiated in 1965, has done much to increase technology in the field of weather modification. Twenty additional snow courses and two precipitation gages are integrated with the older established network in a coordinated data collection and analysis program. Six of the high elevation courses have been automated and transmit data to Steamboat Springs continuously throughout the winter. This program is being used to evaluate the effects of the project. No new snow course installations are planned for forecasting purposes, but there may be some additions or deletions in the weather modification monitoring network.

Installation of automated snow measuring gage

Agricultural Stabilization and Conservation Service

The SCS also provides technical assistance to the Agricultural Stabilization and Conservation Service (ASCS). Farmers and ranchers participating in the Agricultural Conservation Program (ACP) receive cost-sharing assistance averaging about one-half the cost of carrying out approved conservation practices of public benefit. For those practices on which the Soil Conservation Service has technical responsibility, ACP assistance requests are referred to SCS technicians who determine need and feasibility, provide designs, layouts and specifications, supervise installation, and certify compliance to technical standards. ACP cost-shared practices include irrigation canal laterals, farm ponds, pipelines, land leveling, spring development, water control structures, debris basins, streambank protection, channel improvement, and water tanks or troughs. County Agricultural Stabilization and Conservation committees help coordinate the ACP program with the objectives and activities of the local districts.

In addition to the ACP program, the ASCS administers: (1) The Feed Grains, and Wheat Program, which provides diversion and price support payments to farmers who shift land out of feed grains, and wheat production to conservation uses, (2) The Cropland Adjustment Program whereby landowners sign contracts for 5 to 10 year periods to convert cropland to grass, trees, and other nonagricultural uses for conservation purposes, and (3) The Price Support Program which provides price support loans, purchases, and payments to maintain prices of and income from dairy products, grain, and wool, among others.

Farmers Home Administration

The Farmers Home Administration (FHA) was established to aid in the solution of rural and small community problems. The FHA offers a variety of loans which include:

(1) Farm Ownership Loans to enlarge, improve, develop, refinance, or buy farms,

(2) Economic Loans to Cooperatives to establish or expand cooperatives,

(3) Economic Loans to Individuals for a maximum of $3,500 to help improve incomes of disadvantaged and low-income families in either agricultural or nonagricultural pursuits,

(4) Grazing Association Loans to help groups of ranchers buy or lease tracts of land for joint grazing purposes,

(5) Operating Loans for equipment, livestock, feed, fertilizer, seed, or refinancing farm debts other than real estate or buildings,

(6) Rural Housing Loans to construct, repair, purchase, refinance, or modernize homes and farm buildings or to provide water for rural use,

(7) Water Development and Soil Conservation Loans to develop, conserve, and make better use of soil and water resources on farms,

(8) Watershed Loans to local organizations to carry out plans to protect, develop, and utilize the land and water resources in small watersheds,

(9) Financial Assistance Loans to public or quasi-public bodies and nonprofit corporations that will serve residents of open country and rural towns (up to 5,500 population) for developing and improving domestic water and waste disposal systems, and

(10) Recreational Enterprise Loans to rural community groups or associations to finance recreational facilities and to family

farmers to establish income-producing recreational enterprises. Recreational facilities financed include: (1) Ponds, lakes, parks and picnic areas, (2) Sports areas including golf courses and ski slopes, (3) Camping facilities such as cabins, dining halls, sanitation facilities and roadways, (4) Forest trails and natural scenic attractions, (5) Fishing waters, (6) Hunting areas and preserves, and (7) Domestic water, irrigation, drainage, or waste disposal systems in connection with recreational facilities. Loans for recreational enterprises to individuals are made only to farmers and ranchers who personally manage and operate family farms. The loan must also be used to develop an income-producing enterprise that will supplement their farm income.

The SCS cooperates with FHA by reviewing the technical phases of loan application that concern soils information, engineering design and layout, and other soil and water problems.

The Colorado State Planning Office is preparing comprehensive county plans concerning domestic water and waste disposal problems for all counties in the Colorado portion of the Yampa Basin. Direction, guidance, and financial assistance for this work is being provided by the FHA. Future developments will be based on the recommendations of these county plans.

The Farmers Home Administration is also charged with the chairmanship of Technical Action Panels (TAP). There are state, county, special district, and area TAP's that are composed of Forest Service, Soil Conservation Service, and Farmers Home Administration representatives. The TAP's assist rural people and rural communities identify the services they need for economic, social, and cultural growth as well as locate and secure needed services. They also assist individuals and groups with economic development plans, community development projects, inventories, and surveys.

Outreach functions are also implemented through state and county TAP's. This program, established by Executive Order No. 11307, requires that the facilities of the USDA field agencies be made available when necessary, to other agencies of the Federal Government, in extending their programs to solve rural area problems. The FHA has leadership responsibility for implementing the Outreach function in the field.

The FHA loan program has assisted three grazing associations and two recreational facilities in the basin. The Elk Creek Grazing Association borrowed about $320,000 to acquire 3,700 acres of rangeland north of Steamboat Springs which is used to graze 1,500-1,700 yearlings. Members are allowed to graze up to a maximum of 100 animals depending on the number of use rights purchased.

The Bear River Grazing Association recently borrowed $177,000 from the FHA to buy a ranch near Maybell. The loan will enable the 10 member association to acquire 1,325 acres of deeded land and 1,850 acres of leased land. The Association plans to cross-fence pastures for better utilization and convert irrigated cropland to irrigated pasture. The SCS provides the Associations technical assistance through the local soil conservation districts.

The Eureka Pool, Inc. Grazing Association is composed of 22 families and is located near Baggs, Wyoming. The Association borrowed $872,500 to purchase 58,800 acres of deeded land, 9,840 acres of State leased land, 10,240 acres of leases on Union Pacific Railroad land, and grazing rights on 219,680 acres of BLM land (public domain). This provides grazing for about 3,200 animal units for 8 months.

The Steamboat Springs golf course was established through a $40,000 recreational loan from the FHA. A nonprofit recreation association used the money to buy 80 acres west of Steamboat Springs on which a nine-hole golf course was developed. The course is operated by the association on a membership basis (90 members).

Recreation development at Steamboat Springs

There is also a new recreation development at Steamboat Springs that has recently received FHA approval. The Steamboat Health and Recreation Association, composed of 250 members, has obtained a Recreational Enterprise Loan of $246,000 for construction of a swimming pool and bath house. Construction is now under way and the facility should be completed in 1969.

Rural Electrification Projects

The Yampa Valley Electric Association provides service to most of the Yampa River Basin area, including the Baggs, Dixon, and Savery areas of Wyoming. The Association was organized in July 1940 and obtained its first Rural Electrification Administration loan on November 25, 1940. Since that time the Association has received loans from the REA totaling about 7.9 million dollars. They presently have 1,620 miles of line to serve a total of 5,808 consumers, classified as follows:

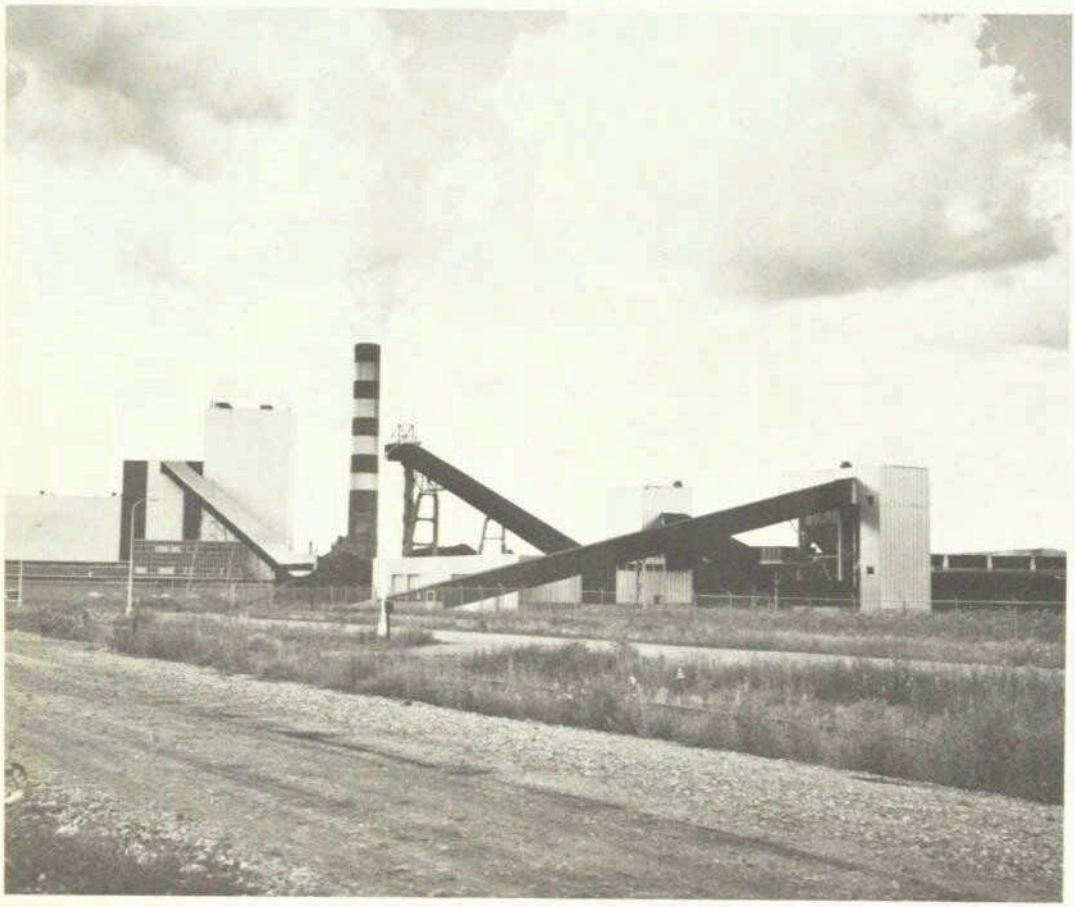
Rural	1,193
Seasonal	102
Town-residential	3,070
Irrigated	65
Commercial	990
Large power	43
Street lighting	8
Public buildings	37

The Association has been a major factor in recent pump irrigation developments, and by providing low-cost power to the farms and ranches of the basin it has helped make agriculture an easier and better life. With present facilities the Association provides an abundant supply of power for the present stage of development, and these facilities can be expanded to meet future demands.

The Colorado-Ute Electric Association, an association of Rural Electric Association Cooperatives, built a 25.5 million dollar coal-fired electric generating plant near Hayden, Colorado. A Rural Electrification Administration loan was used in financing the project. Construction started on April 20, 1963, and plant operation began on July 1, 1965. The plant is jointly owned by Colorado-Ute Electric Association, headquartered at Montrose, Colorado. The Salt River Agricultural Improvement and Power District presently has a 50-megawatt reservation that is recallable by Colorado-Ute upon proper notice and compensation.

The Hayden plant uses approximately 640,000 tons of coal annually and presently is producing 165 megawatts. Water for the plant is taken from the Yampa River. A 5,000 acre-foot water reserve is held in Steamboat Lake through joint agreement. About 45 people are presently employed. The Hayden plant and Colorado-Ute Electric Association's Transmission

System are interconnected with the transmission system of Yampa Valley Electric Association and the extensive United States power grid system. The power produced is principally used to serve Colorado-Ute Electric Association's 11-member REA cooperatives in western and southwestern Colorado. It is used partly as exchange power with the Bureau of Reclamation for power released at Hoover Dam for the Salt River Agricultural Improvement and Power District, thus improving transmission efficiencies and reducing line losses.



Hayden coal-fired electric generating plant

National Forest Development and Multiple Use Programs

Water Resources

The national forest watersheds will continue to be managed in accord with the two principal long-range objectives: (1) Protection of the watershed by stabilizing the soil and thereby preserving and improving water quality, and (2) Management of the area to increase the quantity of water.

Quality of water yielded will receive major consideration in the multiple use management of the national forest lands. To accomplish these objectives, a program of watershed management will be carried out, including the application of new methods and practices as they are developed and proved.

National forest lands are the most important water producing lands in the basin. More than half of the streamflow comes from these lands. This water is valuable for domestic supplies, irrigation, power, industrial, fishery, and recreation use. It is basic to the economy of the basin in many areas.

National forest watersheds may be likened to reservoirs, the volume and quality of water fluctuate in response to changing relationships between soil, precipitation and plant cover. These relationships are influenced by land use and management. The benefits or damages resulting from good or bad land management extend far downstream.

The program of watershed management, rehabilitation, and protection to assure full protection of the hydrologic condition of the watersheds in the management of uses and other resources include:

(1) Prepare and maintain watershed management plans and manage watersheds which are a direct source of domestic water supply in such a manner that will yield raw water at the quality standard established.

(2) Protection to, and minimizing damage from, the greatly increasing number of water development projects in and adjacent to the national forests.

(3) Obtain and provide soil and hydrologic information needed for protection, development, and management of national forest lands and resources in a manner which will preserve or improve the soil and water resources.

(4) Watershed rehabilitation measures to stabilize gullies and channels, control sheet erosion, control erosion of abandoned roads and trails, streambanks and lakeshores.

(5) Installation of snow fences to increase snowpack depth and prolong the runoff period.

(6) Range revegetation, plant control, and type conversion on rangelands to increase water yield.

(7) Design and apply management practices on national forest watersheds to improve the quality, quantity and timing of water yield for onsite national forest purposes and to meet the needs of downstream water uses.

(8) Harmonize water resource management projects with the development and management of related national forest lands to achieve compatible multipurpose development.

(9) Cooperate with appropriate Federal, State, and local agencies.

Timber Resources

The quantity and quality of timber to be produced in the basin will depend largely on the timber management practices applied. Maximum timber benefits will accrue only if intensive management of this resource is carried out.

Timber cut from national forest

Management of existing commercial timber stands will determine benefits that can be derived from use of other resources. Removal of timber cover may increase water yield and change timing of flow. Good management practices will prevent water quality deterioration that could be caused by erosion and sediment production. Some cutting practices affect wildlife distribution and population and also influence the grazing patterns of domestic livestock. An intensive timber management program is prerequisite to the fulfillment of the many potentials in the basin.

Aspen logging, Routt National Forest

The big job of putting the timber stands in good growing condition will be done through commercial timber sales and related sale area betterment work. Measures, such as harvest cutting, thinning, pruning, and tree planting regulate the use of growing space and are directed toward quality and quantity wood production. The key to realizing this potential is the development of a marketing capacity which will utilize the products cut.

In cooperation with adjacent national forests, a program is being initiated to establish a forest industry in northern Colorado that will utilize small, round material from trees not suited for sawlogs and poles. Groundwood and other wood-using plants could utilize this size material. The raw material would come from cutover areas, small trees from current sawtimber sale areas, from sawmill residue and from commercial thinnings. Only a very small percent of the estimated allowable cut for roundwood is being utilized. Natural expansion of the post and pole industry will demand an increasing share of the available resource.

Direct improvement of tree quality by pruning is expensive, hand-labor work. Increased labor costs have almost precluded pruning except in the very best of stands. More pruning activities would be justified if labor costs become less significant or if plywood or utility pole markets expand. Forest Service research has shown opportunities in timber harvest techniques for water yield improvement. Such research is continuing. Well-managed, properly-spaced timber stand is not only healthier and more vigorous but it lets a greater volume of precipitation reach the ground than an overstocked stand. A smaller number of trees per acre may use less water for transpiration. The net result may be increased streamflow. Because water yield in the basin is becoming increasingly important, its relationship to timberlands and their management cannot be overemphasized.

Thinning timber stands increases the grass and browse understory benefiting the range and wildlife resources. Cutting patterns, cutting intensities and tree species can be varied to enhance both resources.

The attainment of an annual harvest of timber on a sustained-yield basis is the goal of the national forests. This goal is being accomplished by:

(1) Reducing timber losses from disease, insects, and fire,

(2) Intensifying management of existing stands,

(3) Improving utilization,

(4) Reforestation and afforestation on 6,290 acres of nonstocked and partly stocked timberland,

(5) Timber stand improvement of commercial timberland,

(6) Fire control measures to reduce fire hazard on commercial timberland,

(7) Inventories will be obtained on all commercial forest lands and timber management plans will be completed for all working circles,

(8) Improve accessibility by development of needed roads.

Clear-cut timber operations

Range Resources

The development and management of 553,600 acres of national forest range land involves the proper stocking and improvement of the resource to achieve desirable watershed conditions and sustained high level production of forage. This is being done by building up forage production through reseeding, other range improvement measures, and better management of the range resource with due regard to other resources and uses.

While a small percent of the national forest grazing land will be put to other uses, the remaining rangeland has the potential whereby the carrying capacity of most allotments can be increased by 40 to 50 percent with increased use of fences, control of brush and noxious or poisonous range plants, seeding and water developments. This will help meet present unfilled demand for grazing in the national forest lands.

Forest Service program proposals include the following:

(1) Revegetate and control poisonous and noxious plants on 29,000 acres of rangelands.

(2) Complete and keep current range inventories and management plans on all range allotments.

(3) Properly coordinate all range use with other resource use.

(4) Separate cattle and sheep grazing on common use areas.

(5) Construct fences and water developments to initiate programs of intensive management for control of livestock and more efficient use of forage.

(6) Complete the reconstruction or rehabilitation of presently deteriorated range improvements.

The forage resources on the national forest lands is of major importance in maintaining one of the basin's key industries.

Recreation Resources

The national forest recreation resources will be so developed and managed that the kind, quality, and quantity of their development and maintenance will be sufficient to keep abreast of this tremendously increased demand.

The recreation resource management program includes:

(1) Provides adequate sanitation, cleanup, safe water, fire prevention, and public safety at all developed and proposed recreation sites and heavily used unimproved areas.

(2) Prepare and execute development places for proposed campgrounds, picnic sites and other recreation sites including boating, winter sports and sightseeing according to future demand.

(3) Dispersement of use through the construction of recreation improvements at unimproved areas.

(4) Increased effort in visitor information, interpretive activities, with emphasis on wildlife, history and geology on the national forest lands.

(5) Repair and reconstruct recreation dams and spillways as necessary in order to place them in a safe condition for recreation use.

(6) Intensifying management and care of wilderness areas to protect and preserve them for the growing public use.

(7) Development of recreation areas that can be used during off-season and slack periods.

(8) To meet the predicted demands, develop new campgrounds and picnic sites.

With wise planning and development, the national forest areas have the capacity to meet the needs to the year 2020 and still not be near the visitor saturation point.

Wildlife Habitat Resources

The long-range objective of habitat management is to make it fully productive to support fish and game populations to contribute to the need of public use and enjoyment.

The Wildlife Habitat Management Program includes the following:

(1) Follow wildlife habitat management plans, assuring proper coordination between wildlife habitat management and other resources.

(2) Inventory and evaluate wildlife habitat resources in cooperation with other Federal agencies and States in which national forests are located, as a basis for orderly development of wildlife habitat improvements and coordination programs. This will include big game, gamebirds, small game and fishing habitat surveys and investigations.

(3) Improve fishing streams and lakeshores by stabilizing banks, planting streamside cover, and constructing channel improvements.

(4) Improve food and cover on key wildlife areas.

(5) Develop wildlife areas, permanent openings, and food patches.

(6) Construct new water storage reservoirs and shallow water impoundments.

(7) Identify on the ground all public lands and water areas with the provision of access.

Cooperative State-Federal Forestry Programs

The Federal Government cooperates with the States and private landowners to improve protection and management of all forest and nonforest watershed lands.

This forestry assistance covers tree planting, forest management, fire and watershed protection, and marketing and utilization of forest products. In the programs the Forest Service works directly with the Colorado and Wyoming State Foresters under a partnership agreement. Actual work is carried out through various cooperative programs. The State does the actual work and administers the program on State and private lands. The Forest Service allots Federal funds and provides counsel on all phases of the programs. The cost of the projects is shared by each.

Cooperative Fire Control

The purpose of the Cooperative Fire Control Program is to protect all State and private forest and nonforest watershed lands from fire. In Colorado and Wyoming the State Forester assists each county in making wildland fire plans, purchasing equipment, organizing firefighters, and training manpower. For actual suppression of fires they depend primarily on the counties for manpower and equipment. Technical assistance is furnished by the State Forester's office.

An increase in the number of man-caused fires can be expected with expanding public use unless an aggressive fire prevention program is carried out.

The objective is to hold fire damage below the level which will seriously interfere with optimum yield of water, timber, forage, and recreation values. The major problem in control of fires on the forested area is the existence of sizable areas of unburned logging slash. Additional effort is needed to reduce the slash hazard, either through elimination of the slash or through increased utilization of the left-over materials.

Cooperative Forest Management

The Farm Forestry Program assists private landowners to improve the management and development of their woodlands. Assistance is also available to private woodland owners, loggers, and processors in marketing and utilization of timber and forest products. The program provides technical guidance in multiple use management of woodland resources. Owners are encouraged and assisted not only to make the best use of their opportunities to grow timber and other forest crops, but also to make the best use of their woodlands for other compatible and complimentary purposes. Loggers and others harvesting forest products are assisted in improving their methods and equipment.

Benefits are expressed in terms of increased volume of quality timber grown and harvested; recreation for profit and for personal pleasure; water for farmers, communities, and industries; forage for livestock and wildlife; and a reservoir of resources for future needs.

The State Foresters and their staffs offer on-the-ground technical assistance to the individual private landowners. The Forest Service, generally in cooperation with the State Forester, may work directly with universities, large landowners, wood-using industries, and other States, Federal, and private agencies on major forestry problems.

Cooperative Tree Planting

Under this program, private landowners may obtain planting stock from the Colorado State Forest Service at low cost for windbreaks, shelterbelts, or forest plantations. The Colorado State Forest Service has been active in tree planting for many years. It operates a nursery at Fort Collins where over three million trees can be produced annually.

The program attempts to distribute trees at the lowest possible price. The ultimate objective, of course, is to stimulate tree planting by providing stock at prices so low that any landowner can afford planting stock.

Approximately 47 percent of the land within the Colorado portion of the basin is in State and private ownership. Part of it is forested land. It is in the public interest to protect, restock, and maintain the productivity of these lands. Several Federal programs authorize the Forest Service to cooperate with State forestry departments and private landowners in reforesting their lands. The three major programs are:

(1) Cooperative Distribution of Planting Stock

(2) Soil Bank

(3) Forestation Assistance to States

Cooperative Watershed Program

Under this program, private landowners, States, and Federal agencies work together on a project basis to improve the protection and management of the water resource. The State Forester provides technical assistance to private landowners in project areas suited to forestry. This includes fire protection, timber stand improvement, tree planting, watershed rehabilitation improvements, and pest control.

The Forest Service has coordinated responsibilities which include: (1) Planning forestry phases of watershed work plans on non-Federal lands and furnishing technical assistance to landowners for installing and maintaining forestry measures, (the state foresters carry out a part or all of these activities), and (2) Other Forest Service cooperative programs with PL 566 projects.

Cooperative Pest Control

Cooperative Forest Pest Control Programs are carried out within the State Forest Service organizations. The authority to enter into cooperative agreement with the States is provided under the Federal Pest Control Act of 1947. The Forest Service, through Federal Pest Control funds, may pay up to 33 1/3 percent of pest control costs on non-Federal lands.

Disease and insect attacks have been serious in the timber stands of the basin. Barkbeetles have been the major source of trouble. Heavy infestations of dwarf mistletoe are found in the lodgepole pine type.

The program is administered by the U. S. Forest Service. The objective is to detect, evaluate, and suppress insect and disease outbreaks on State and private lands before they become a serious widespread infestation.

The Forest Service cooperates with other Federal agencies and State, county, and municipal agencies and private landowners. It provides leadership and financial aid in survey programs and suppression or control projects on all classes of forest land.

The State Forester is generally responsible for developing cooperative forest insect and disease control projects on non-Federal lands.

Projects and Programs of Other Agencies

Bureau of Land Management

The Bureau of Land Management is responsible for the administration and management of 2,541,800 acres in the basin. The basic objective of this management is to administer these lands under the multiple use concept of the greatest good for the greatest number of people. It is concerned with the identification, classification, use, and disposal of public lands and the development, conservation, protection, and use of all the natural resources. It is also attempting to rebuild and restore the productivity of areas damaged by floods, winds, fires, and overuse.

To facilitate the management of the Bureau of Land Management lands in the Colorado portion of the basin the Craig District has been divided into two resource management areas. The Little Snake River Resource Management Area has six planning units, and the Yampa River Resource Management Area has four planning units. In the 10 planning units, which are classified under the Classification and Multiple Use Act of 1964 for retention in Federal ownership to be managed for multiple uses, a resource analysis will be completed. This unit resource analysis will quantify the present situation or capacity in end product terminology (visitor days of a particular type of recreation, MBF of timber, dollars of flood damage occurring) for each resource category. Opportunities for development or improvement will be identified and located for each resource category. These will be quantified in units of output expected.

The unit resource analysis is not a plan, but merely an inventory from which the planning base will be established.

The Bureau of Land Management has an active program of range and watershed improvement including brush control, contours, fencing, seeding, water spreading, detention dams, diversions, stock water ponds, and spring development. It also has an active program of recreation site selection and withdrawal. In 1964 approximately 7,600 acres had been designated as recreation sites. As funds are made available they will develop these sites. Timber management and sales have not been important in the basin, but forest management plans include stand improvement and insect or disease control. As markets develop timber will be marketed on a sustained yield basis.

Stock pond development in Moffat County

Soil and water conservation is a prime concern on the Bureau administered lands in the basin. Projects to control erosion and to improve ground cover are being completed each year. Areas showing the greatest need are given highest priority in this work.

Parts of this basin have been designated as frail lands. The drainage areas included in the frail lands are (1) The upper one-third of the Sand Wash, (2) Powder Wash and those portions of, (3) Vermilion, and (4) Shell Creeks in Colorado.

Intensive erosion control projects are planned for these lands and are being carried out as funds allow. Work will include check dams, contour furrows, seeding, gully checks, drop structures and large water control dams. The size or acres covered by each practice will vary with needs of a particular area, but the end result will be a marked decrease in sediment yield and an improved quality of water.

Grazing systems are being implemented wherever possible to increase plant density and vigor. The primary purpose of these systems is to reduce sediment yields and increase water quality, and secondly to produce more forage for livestock and wildlife.

Demands for forest resources are increasing in the basin not only for timber production, but as a multiple use tool. This in turn is causing an increased demand on previously unused timber resources, including those on BLM lands. The timber industry is being forced to use small portable "woods" mills for rough production and to finish their products at the larger sawmills. Longer haul distances and somewhat smaller, poorer quality sawtimber are bringing about this type of operation in the basin.

The recreation developments on the public domain will include: campgrounds, picnic sites, hiking and riding trails, boating facilities, and scenic roads with turnouts and overlooks. Special attention will be given to historical and archaeological points of interest.

Bureau of Reclamation

The Bureau of Reclamation has a vigorous program of project evaluation throughout the basin. Four major projects being considered are in various stages of analysis. The Savery-Pot Hook project is authorized and awaiting funding. The Juniper, Yampa Valley, and Yellow Jacket projects are being evaluated. Many of the irrigated areas along tributaries to the Yampa River are short of late season irrigation water supplies. Reservoir storage is needed to supplement the existing water supply of these areas and to provide water for the development of additional irrigated cropland. Development of these four proposed projects would provide reservoir storage and distribution systems for a large portion of the irrigated and irrigable lands in the basin. These projects are all multiple purpose in nature and will include recreation pools and provide for some flood damage reduction.

The proposed Juniper Project, also known as the Lower Yampa, has four units which would develop the water resources of the Yampa River for irrigation, recreation, fish and wildlife conservation, and power generation. The units are (1) Juniper Reservoir and canals, (2) Jubb Creek Reservoir and canals, (3) California Park Reservoir and canals, and (4) Rampart Reservoir and canal.

The Juniper Dam would store and regulate Yampa River water for release to lands in the Maybell-Sunbeam areas. Canals would be built to distribute irrigation water along both sides of the Yampa River below the dam. Releases from the Juniper Reservoir into the Yampa River would produce large amounts of power and also operate pumping facilities to lift water to lands in the Axial Basin and Deception Creek areas. The pumped water would be delivered by a canal system running both east and west above the southern edge of Juniper Reservoir. The eastern canal would terminate at the proposed Jubb Creek Reservoir, a holdover storage facility, and the western canal would end near Deception Creek.

California Park Reservoir would store the surplus flows of Elkhead Creek for conveyance to irrigable land north and east of Craig. The distribution system would utilize Elkhead Creek for a distance below the reservoir. The water would then be diverted into a canal along the west side of Elkhead Creek. A branch of this canal would cross the divide and irrigate lands along Dry Fork Creek, a tributary to Fortification Creek. Surplus flows in Fortification Creek would be collected by the Rampart Reservoir and released into a canal that would run in a southwesterly direction. This canal would distribute water to irrigable lands along the west side of Fortification Creek between the dam and Craig.

The Yellow Jacket Project would provide benefits to the Yampa and White river basins through three reservoirs and related distribution systems. Yampa Basin benefits would be derived from the proposed Thornburgh Reservoir, formed by a dam on Milk Creek, a tributary to the Yampa River. The Morapos Creek diversion shown on the Project Location Map has been deleted from the plan. Water from Thornburgh Reservoir would be released into Milk Creek for downstream distribution to a portion of the lands in the Axial Basin area above the potential Juniper Reservoir.

The Yampa Valley Project, also referred to as the "Upper Yampa" would develop water from the upper reaches of the Yampa River and its tributaries for irrigation, recreation, fish and wildlife, and flood control. The project is composed of three units - the Wessels, Hayden Mesa, and Toponas. The Wessels unit includes Bear Reservoir on the Yampa River and a related distribution system. The main canal would distribute releases from the reservoir, along with unregulated streamflow surpluses, to downstream users along the south and west banks of the Yampa River to a point west of Steamboat Springs.

Water for the Hayden Mesa unit, regulated by Dunkley Reservoir, would be supplied primarily from collection of excess flows of the East Fork of Williams Fork and Fish Creek. Small amounts of additional water would be collected from Grassy, Sage and Dry creeks during early parts of the irrigation season. A diversion canal would transport water from Williams Fork to the Dunkley Reservoir site on Fish Creek. Water would be released into a distribution system for use south of the Yampa River between Mount Harris and Craig. The main canal would branch to the east near Grassy Gap to service land in Twenty Mile Park.

The Toponas unit, located on the divide between Yampa and Colorado rivers, would benefit both basins. The Yampa River Basin would benefit from the Yamcolo Reservoir on Bear River (Yampa River) and an enlarged canal, which would distribute reservoir releases to new and supplemental service lands near Toponas. An alternate proposal known as the "Yamcolo Project" is being considered. This would involve a smaller reservoir in the same location along with a feeder canal from Coal Creek. Water would be distributed to supplemental service land through existing facilities. No new lands would be developed by the project but consideration might be given to the rehabilitation of existing canal systems.

Pot Hook Dam site, Slater Creek

The Savery-Pot Hook Project would provide water for new and existing irrigated lands along the Little Snake River. The project would also provide recreation and fish and wildlife benefits. Savery Reservoir would be built on Savery Creek in Wyoming and would store presently unused flows of that stream. Part of the water released from Savery Reservoir would be diverted into existing canals and ditches along Savery Creek and the Little Snake River. The major portion of water released from Savery Reservoir would be used to develop new irrigated lands north of the Little Snake River between Dixon and Savery, Wyoming. The Two-Bar and Lily area developments (12-C Project Location Map) utilizing Savery Reservoir releases have been deleted from the project. Releases would also be made to benefit the Savery Creek fishery below the dam. Pot Hook Reservoir would store surplus flows of Slater Creek. Water required for prior rights downstream would either be bypassed or stored in the reservoir and be replaced from Savery Reservoir. Direct releases would be made into a new canal through a tunnel on the west side of the dam. This canal would convey water westward to lands along the south side of the Little Snake River. The canal and its major lateral would service presently nonirrigated land and provide supplemental water to some areas without a full supply.

Bureau of Sports Fisheries and Wildlife

The Browns Park National Wildlife Refuge is being purchased and developed by the Bureau of Sports Fisheries and Wildlife. This wildlife area is along the Green River from above Dinosaur National Monument to the Colorado State line (Figure 8 - Transportation and Recreation Area Map following page 66). This Bureau has purchased 3,262 acres of private land and leased 636 acres of State land. The refuge has 2,524 acres of wet or irrigated land out of the 3,899 acres. The irrigated land is used to provide food and cover for local nesting waterfowl. In the winter it is flooded to provide resting areas for migratory waterfowl.

It is anticipated that an additional 2,146 acres of private land will be purchased, leasing arrangements will be made on 660 acres of State land, and 6,119 acres of public domain will be transferred to the refuge area.

A limited amount of hunting will be allowed. The management plans for the area will specify the amount of hunting and locations where it will be allowed.

Another area of 12,000 acres is being planned on the Yampa and Little Snake rivers.

These wildlife refuge areas are needed to improve flyways and to attract more waterfowl. Hunting of local waterfowl is excellent, before open water freezes, but additional food and resting areas must be provided if

migratory waterfowl are to be attracted. Small game hunting is in demand but rabbit hunting seems to be about the only type with adequate game. Additional waterfowl such as ducks and Canada geese, could be attracted to the area with increased food, nesting, and resting areas.

Colorado Agricultural Experiment Station

The Great Divide Experimental Range is located about 30 miles northwest of Craig. This experimental range was established in 1941 as a cooperative study by the Soil Conservation Service and Colorado A&M College (now Colorado State University) to determine the most effective methods of improving depleted sagebrush range.

The experimental area is predominantly in the rolling loam range site with sandy loam soils. Experimental results on this rangeland give some excellent guidelines as to range improvement possibilities on this and similar range sites. The results were obtained using yearling beef cattle while the surrounding range is used as summer range for cattle and spring-fall range for sheep.

The studies have shown that three times as much beef per acre can be produced on this range by burning and then seeding to adapted grasses. This burned and seeded range has maintained its productivity for over 8 years with proper use. Carrying capacity has been improved from 6.3 acres per steer-month on untreated sagebrush range to 2.3 acres per yearling steer-month on the burned and seeded pastures. This range can also be brought back to almost full production in four growing seasons by mowing the sagebrush and practicing deferred grazing.

U. S. Army Corps of Engineers

The U. S. Army Corps of Engineers has not had an active flood control program in the basin due to the limited flood damages and project opportunities. There is one emergency local protection project at Craig constructed on a temporary basis shortly after the March 1947 flood. This work consisted of emergency channel improvement and realignment on a short reach of Fortification Creek from Craig to the Yampa River. It has functioned satisfactorily since completion. There was also some channel clearing and improvement on Dry Creek for the protection of Hayden.

National Park Service

The National Park Service has an active development program for Dinosaur National Monument under the Mission 66 Program. The "Monument" also has a cooperative agreement with the Moffat Soil Conservation District to receive technical assistance on soil and water conservation problems.

In recent years the National Park Service has completed a new Monument headquarters and visitor center at Dinosaur, Colorado. They have also completed a hard surface road to Harpers Corner and a number of new campgrounds and a picnic area in the Colorado portion of the Monument. There are 20 campground units and 20 picnic units accessible by automobile. There are also 32 campground units in the Lodore and Yampa canyons, which are only accessible by boat.

Grazing is permitted on approximately 82,200 acres of the Monument in Colorado. The Bureau of Land Management licensed livestock grazing within the Monument from 1934 until 1961. Since then the National Park Service has administered the grazing and has cooperated with the Moffat Soil Conservation District in improving the grazing resource. This grazing by domestic livestock will be permitted until 1985.

The National Park Service, through the services of the Bureau of Land Management, has been able to exchange State lands within the Colorado portion of the "Monument" for other lands. In January 1965 there were still 6,285 acres of private lands within the Colorado portion of the monument. The National Park Service has a program to acquire these lands. When this is accomplished the National Park Service will be in a better position to manage the monument.

Developments for Recreation, Fish and Wildlife

The Colorado Game, Fish and Parks Department has an extensive recreational area development program in progress in the Yampa River Basin. Developments include five operational reservoirs and related recreational facilities with a sixth reservoir nearing completion, (Figure 9 - Project Location Map). Three of the reservoirs, Hahns Peak, Freeman, and Upper Stillwater (Yampa Reservoir), are on national forest land while Pearl Lake, Ralph White, and the new Steamboat Lake are on State lands. The three lakes and related facilities on national forest land are administered by the Forest Service. The remaining areas are handled by the Colorado Game, Fish and Parks Department. The Department has built a 30 unit campground at Pearl Lake and a 20 unit development is under construction at Ralph White Lake. Similar facilities will be built at Steamboat Lake after its completion.

All reservoirs have good access roads for easy accessibility and maximum use. Fish are planted regularly in reservoirs and lakes for a maximum use based upon the available water surface area and anticipated fishing pressure. Use fees are collected by the Colorado Game, Fish and Parks Department or the Forest Service.

The Colorado Game, Fish and Parks Division manages two areas for big game range, the Browns Park Management Area and the Indian Run Management Area. There is no charge to hunt on these public areas.

Recreation developments will be extensive. Many natural features such as mountains, rivers, lakes, wilderness areas, and heavy snow catchment basins can be developed into recreation sites. Many of the developments will have multiple purposes which will enhance other uses as well as provide recreation. The proposed recreational developments are shown on the Transportation and Recreation Map (Figure 8) following page 66.

Nearly all of the water storage and irrigation projects will provide water based recreation. Accommodations will be built near these storage reservoirs for boaters, fishermen, water skiers, and others. There are about 18 large irrigation water storage reservoirs with about 36,500 surface acres planned before the year 2020.

In addition to these large irrigation reservoirs, other reservoirs will be built for recreation. Some may be built by State and local agencies but many will be built on farms and ranches by individuals. Included in the reservoirs that will have a recreational value are Steamboat Lake, Big Red Park Reservoir, First Creek Reservoir, Rabbit Ears Lake, South Fork Elk River Reservoir, and Adams Park Reservoir.

The Eureka Livestock Grazing Pool in Wyoming is planning a recreation development near the proposed Savery Reservoir on the Little Snake River. The development will include cabins, roads, and boat docks.

Multipurpose reservoirs are being built on Federal land for livestock water, fishing, irrigation water, and erosion control. The Forest Service and Bureau of Land Management are building other projects or issuing permits to State agencies or others to build them.

The Forest Service is now planning for recreation use to meet the public needs to the year 2000, and has inventoried 368 new camp and picnic sites, having 11,472 family units.

The State of Colorado is interested in developing State parks for recreation use and enjoyment. They have studied several areas, most of which have fishing streams or natural scenic areas surrounded by mountains. Rattlesnake Butte in Routt County is a potential State park (1,000 acres) that could be developed on private and Bureau of Land Management lands along Trout Creek. This area adjoins the Routt National Forest and would provide camping, hiking, picnicking, fishing, and other wilderness type recreation. Blacktail Mountain (1,000 acres of private and Bureau of Land Management lands) is another development study in Routt County about 8 miles east of Oak Creek. This is a natural scenic area along the main stream of the Yampa River, and includes the confluences of Morrison and Silver creeks. The East Fork State Park study area is on private lands adjoining the national forest. This area is approximately 7 miles up the East Fork of Williams Fork above its junction with the Williams Fork.

Another area under study for a State park is White Bear Ranch (2,500 acres) in Moffat County. This area is directly east of Dinosaur National Monument. The ranch was formerly a Wells-Fargo horse ranch and some of the old buildings in a cottonwood grove are still in existence. It is along the Yampa River and would be on a planned county road landing to the east entrance of Dinosaur National Monument. Senator Ed Johnson's homestead along U. S. Highway 40 in Moffat County is presently a tourist attraction and is proposed as a State park which will include 10 acres of land, buildings, and a picnic area.

Impact of Projected Development

This survey does not attempt to project all developments in the basin but rather to estimate probable changes in water and related land use after consideration of resource limitations and institutional restrictions. As in previous sections of the report material on the Wyoming portion of the basin is included only where and to the extent required for evaluation purposes.

The economy of the basin has been built upon agriculture, coal, oil, gas, recreation, and tourism. Future growth will stem from the development of all of these resources, but the greatest impact will come mainly from the abundant coal resources and recreation potential. Because of expected changes in management, the increased irrigated area will support about the same number of farm families as present.

Population Projections

Population projections are based on the assumption that the natural resources will be more fully utilized in the future and that the desirable climate, recreation potential, available water supplies, and mineral resources such as coal and nearby oil shale deposits, will lead to some population growth during the next 50 years. However, no large population increase is foreseen at this time.

Projected population by the year 2020 is 24,400 (table 25), which is a growth of approximately 11,000 people over the 1967 population estimated at 13,400. This increase in number of inhabitants by the year 2020 is primarily the estimated natural increases in population plus some immigration connected with the development of the coal and recreation potential.

Table 25.--Historical and projected population, Yampa River Basin in Colorado and Wyoming, 1930-2020

Year	Colorado	Wyoming	Total
1930	13,850	850	14,700
1940	15,120	960	16,080
1950	14,210	880	15,090
1960	12,330	830	13,160
1980	14,600	900	15,500
2000	18,300	1,000	19,300
2020	23,300	1,100	24,400

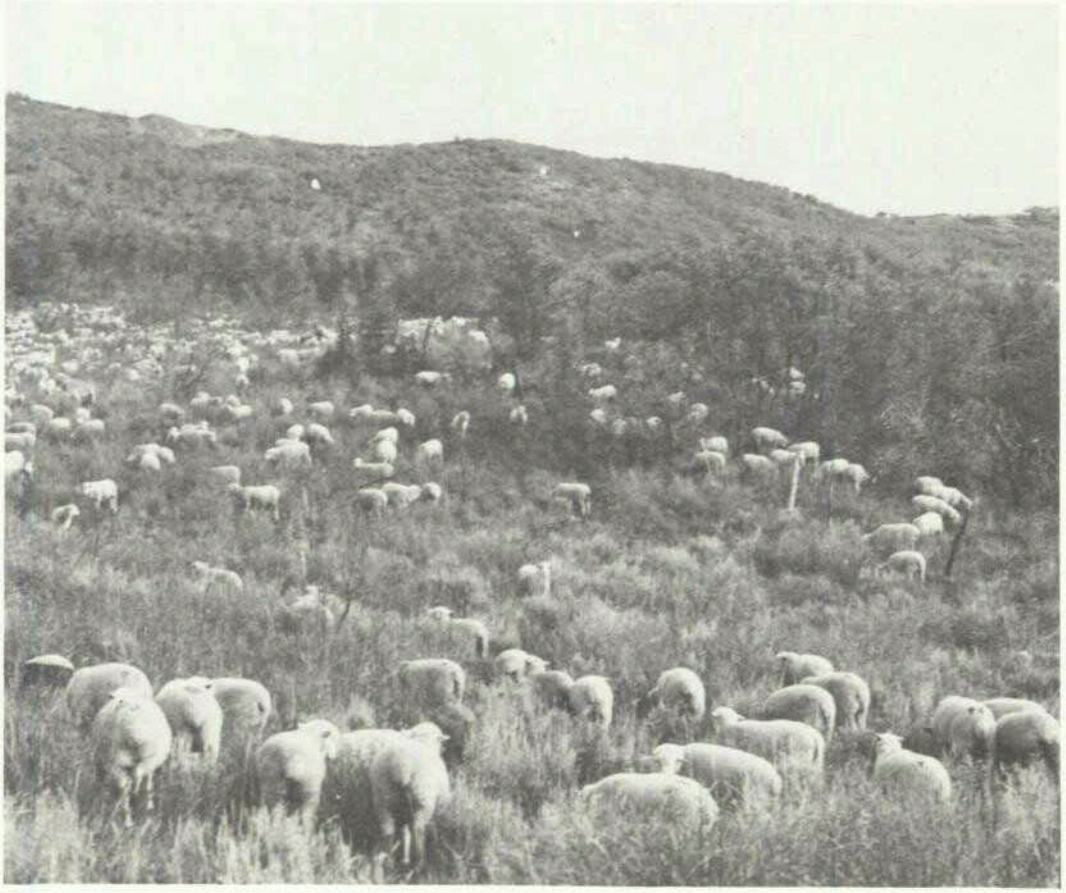
Source: USDA Field Party

Adjustments in Land Use

Agriculture in the United States is in a period of rapid adjustment. Because of its relative isolation this basin had not experienced the full impact of this change. The basin is 200 miles from large urban centers and U. S. Highway 40 is the only U. S. Highway traversing it. In the foreseeable future, this condition will probably continue since the basin is not included in the proposed interstate highway systems and no major industrial development is projected. It is possible that the projected oil shale development in the White River Basin may affect the economy of the Yampa River Basin to a major extent. Otherwise this basin will remain largely rural and sparsely populated.

The most significant characteristic of land use is that approximately 59 percent of the land in the basin is in Federal ownership and will likely remain so. This land is largely administered by the Forest Service and the Bureau of Land Management. Increased recreational use of the Federal lands in relation to other uses is the most significant trend for all Federal lands. It is possible that some of the 2.5 million acres administered by the Bureau of Land Management will move into private ownership within the next 50 years. This is particularly true for the 106,100 acres lying outside the boundaries of the grazing districts. This land is generally in isolated tracts and probably will be transferred to State or local government for public purposes or disposed of through exchange or public sale. Additional lands under the jurisdiction of the Bureau of Land Management may be sold or leased in connection with industrial, residential or power developments within the basin.

Agriculture is the principal user of land in the Colorado portion of the basin, with about 94 percent being used for cropland or grazing for domestic livestock. During the 1943-60 period, total acreage of harvested cropland increased from 127,100 acres in 1943-51 to 153,700 from 1952-60 (table 13). As previously noted irrigated and dry cropland pasture has shown a consistent increase during this same period and it is likely this trend will continue as a means of offsetting reduced grazing permits on Federal rangeland, and as a means of adding to the livestock enterprise.



Sheep grazing on summer range

Projections of changes in land use were made for the year 2020 and for the intervening 20-year periods following 1964 (table 26). These projections were made for the purpose of estimating potential consumptive water requirements and to indicate trends in land use and agricultural production. Irrigated cropland harvested averaged about 45,600 acres during the 1943-60 period (table 13). By 1960 this had increased to 49,200.

The projection for 2020 estimates irrigated acreage will total 142,000 acres. The acreage devoted to crops is projected to be 93,300, or about 66 percent of the irrigated cropland. About 86,300 acres of this would be devoted to hay production and the balance (7,000 acres) would be devoted to small grains or corn. The acreage of irrigated pasture in 2020 is estimated to be 48,700, or 34 percent of the irrigated cropland.

Table 26.--Present and projected land use, Colorado portion of the Yampa River Basin, 1964-2020

Land use	Present	Projected		
	1964	1980	2000	2020
	Acres	Acres	Acres	Acres
Cropland				
Irrigated	82,600	98,000	142,000	142,000
Dry farm	187,300	185,000	165,000	165,000
Grazing	2,873,500	2,834,000	2,805,000	2,797,000
Timber and grazing	513,000	512,000	510,000	509,000
Timber	311,000	310,000	308,000	307,000
Wilderness 1/	29,300	29,300	29,300	29,300
Recreation, Fish and Wildlife 2/	160,000 3/	184,000 3/	190,000	196,100
Other 4/	143,300	147,700	150,700	154,600
Total	4,300,000	4,300,000	4,300,000	4,300,000

1/ Grazing is permitted on 18,000 acres of the Mount Zirkel Wilderness.

2/ Designated and developed lands only - does not include all of the multiple use lands of the national forests and public domain.

3/ Grazing is permitted on 82,200 acres of Dinosaur National Monument until about 1985.

4/ Includes water acres, town sites, rights-of-way, mineral lands and other miscellaneous uses.

Source: USDA Field Party

Irrigated land projections in Colorado include 67,620 acres of new or reclaimed lands, of which 65,870 would be developed by the Bureau of Reclamation projects and 1,750 by reclamation of seeped or phreatophyte

areas or other private developments. In the same projection period it is estimated the net increase would be 59,400 acres because 8,220 acres of irrigated lands would be lost through: (1) Inundation by new reservoirs (2,460 acres), (2) Urbanization (400 acres), (3) Conversion to recreation lands (2,660 acres), (4) Industrialization or other rights-of-ways (400 acres), and (5) Abandoned (2,300 acres).

A special study of the irrigated lands in Wyoming was made to provide water use data. The 1943-60 average acres irrigated was estimated to be 16,500 acres. In 1964 the irrigated acres were estimated to be 17,600 acres, of which 17,000 was irrigated from the Little Snake River and 600 acres in the Vermilion Creek Subbasin. The Savery-Pot Hook Reclamation project is projected to increase the total irrigated acreage to 23,000 acres by 1980. The irrigated acreage should be stabilized at about this acreage through 2020.

Dry cropland acreage averaged about 150,900 acres in the 1943-60 period. This acreage had increased to 187,300 by 1964. By the year 2020 the acreage of dry cropland will be reduced to about 165,000 acres. The major part of this will occur as a result of irrigation of presently dry croplands and the balance by urbanization or the conversion of dry croplands to permanent rangeland.

Projections indicate that by 2020 approximately 196,100 acres will be used primarily for recreation. Approximately 182,100 acres of Federal land will be used primarily for recreation or fish and wildlife developments, but almost the entire Federal acreage will have some recreation use under multiple use management plans.

Projections for guest ranch and resort use indicate an increase of approximately fivefold between 1960 and 2020. It is estimated that approximately 10,000 acres of private lands will be used almost exclusively for recreation by the year 2020. Most of these guest ranches and resorts will also make extensive use of the adjoining Federal and State land.

The Colorado Game, Fish and Parks Department has an active program for improving the recreation use in this basin and it is estimated that approximately 6,000 additional acres will be used exclusively for recreation by the year 2020. In addition to this acreage it is estimated that the Colorado Game, Fish and Parks Department will have at least 15,000 acres of land used primarily for game winter range and refuge areas.

Potential Agricultural Production

Projections of livestock product requirements for the United States indicates that by 2020 we will need about 3.3 times the present production of beef and veal and about 2 times the present production of lamb or mutton. Since resources available for agricultural production in the basin are primarily suited to livestock operations, production of livestock feed or forage was estimated for 2020 as a means of estimating potential livestock production within the Colorado portion of the basin (table 27).

Table 27.--Projected changes in livestock feed or forage production, Colorado portion of the Yampa River Basin, 1964 and 2020

Source	1964		2020	
	Acres	AUM's feed or forage produced	Acres	AUM's feed or forage produced
Rangeland grazing	3,486,700	511,000	3,324,000	654,000
Cropland grazing				
Irrigated pasture and cropland grazing	82,600	88,900	142,000	260,900
Dry cropland and planted pastures 1/	138,600	55,100	116,000	60,500
Total cropland grazing	---	144,000	---	321,400
Cropland hay and forage	68,600	273,300	86,800	525,300
Total	---	928,300	---	1,500,700

1/ Does not include summer fallow acreage.

Source: USDA Field Party

Rangeland grazing is projected to produce 654,000 animal unit months of grazing in 2020, which is an increase of 143,000 (28 percent) from the 1964 total of 511,000 animal unit months of grazing. This increase is possible because a large part of the rangeland in the Colorado portion of the basin is potentially productive and most of the 162,700 acres that is projected to move out of grazing use is not the most productive rangeland. Included is the 82,200 acres within Dinosaur National Monument on which grazing by domestic livestock is scheduled to terminate in 1985. However, even with the best management this increase in grazing capacity on the rangeland will take place slowly. Increased feed or forage supplies can be developed more effectively and rapidly by production on irrigated cropland.

By 2020 cropland grazing is estimated to furnish 321,400 animal unit months, or 33 percent of total grazing. This would be a 123 percent increase from present conditions. At present 68,600 acres of hay and forage crops (irrigated and dry farm) are producing an estimated 273,300 animal unit months of winter feed supplies. With improvement in water supply and management it is estimated that by 2020 almost all of the winter feed supplies will be produced on irrigated cropland. An estimated 86,300 acres will be required for hay land and approximately 500 acres for corn silage. Projections indicate that this hay and silage would provide about 525,300 animal unit months of winter feed supplies. About 48,700 acres of irrigated pasture and approximately 42,000 acres of dry cropland pasture will also be needed to balance the livestock forage requirements.

As previously mentioned, the Colorado portion of the basin presently provides year long feed and forage supplies for about 72,000 animal units of livestock plus an estimated 61,000 animal unit months of grazing for migratory livestock. The total of 1,500,700 animal unit months of feed and forage projected in 2020 would provide balanced feed and forage for 125,000 animal units of domestic livestock and some additional grazing for migratory livestock. Based on 1960 prices the gross returns for livestock and livestock products should be about 13.2 million dollars in 2020 as against 7.6 million dollars in 1959.

Forest Products Industries

The timber management objective is to develop the commercial timber area to its sustained yield capacity. At the present time there is, however, unsatisfactory growth on at least three-fourths of this area.

Timber management programs will be guided by the following:

(1) Harvest all overmature timber by 2000.

(2) Reduce infections of dwarf mistletoe and other diseases and maintain such infections at the lowest level practical.

(3) Develop a desirable distribution of age classes.

(4) Reduce overstocking of seedling-sapling lodgepole pine stands by commercial and noncommercial thinnings.

(5) Initiate a reforestation plan that will include old burns and potentially nonstocked areas by 1980.

(6) Assure adequate stocking of lodgepole pine and Engelmann spruce cut-over areas within five years after cutting.

(7) Keep insect infestations within the current endemic level.

(8) Keep fire damage within the established 5-year objective.

Future demands on the forest resources will intensify. Projections of demands on forest resources are unanimous in estimating that future use will be much heavier than it is presently. Use of timber products nationally is projected to increase about 81 percent by 2000.

Demand by the end of the century for lumber, pulpwood, plywood, and veneer should increase. The affect of the spruce barkbeetle attack will disappear as the new trees reach merchantable size. Increased demands for many timber products will result in the construction of plants to produce these products from timber resources. A program has been initiated to establish a forest industry in or adjacent to the basin that will utilize small, round material from trees not suited for sawlogs and poles. The raw material would come from old cut-over areas, small trees from current sawtimber sale areas and from commercial thinnings from lodgepole pine stands. Such an industry will clean up stands infected with dwarf mistletoe and maintain good stocking in lodgepole stands.

The reason for the higher cut objectives is twofold: (1) The current cutting rate is low; and (2) The 1950-1959 harvest was less than 50 percent of the established allowable cut. The two principal reasons for not reaching the allowable cut objectives were lack of an industry and of an adequate transportation system.

Future harvest rates depend to some extent on the program that evolves from the current study of means of increasing water yields from the forests. If increased cutting is deemed advisable, it is conceivable that many timber stands will be harvested on a greatly accelerated rate during the next twenty to forty years.

Recreation

The projected economic impact of the recreation industry is difficult to measure since it is primarily reflected through the service industries. The problem is compounded by the rather indefinite development picture in relation to recreation. This is particularly a problem in projecting water based recreation, which largely depends on the development of major multiple-purpose reservoirs by the Bureau of Reclamation. Another difficulty is created by the fact that it is difficult to project the degree to which entrepreneurs will be willing to invest in recreation developments. Since recreation visitors usually use more than one facility or type of recreation experience, no attempt has been made to measure the impact of specific recreation types. It is also recognized that projections of recreation use shown on table 23 (page 99) account for only a few of the outdoor recreation opportunities of the basin. However, it is significant that the recreation projections show an increase in recreation use of over 400 percent between 1960 and 2020. This also provides some measure of the magnitude of recreation developments that will be required in this time period. Based on the service industries sales of over 3

million dollars during 1963 (table 9 - Routt and Moffat counties, Colorado, are the major sales areas in the basin) there is a potential for equivalent sales of 15.8 million dollars by 2020. The associated employment of 410 people in 1963 would increase to approximately 2,000 in 2020.

Another example of the impact of recreation visitors is provided by a recent study of "Public Access to Public Domain Lands." 1/ This is a study of the hunter expenditures in the Piceance Creek area near Meeker in the White River Basin and it shows that every dollar spent locally generates approximately 74¢ in extra income locally. About 56¢ of this extra income is immediate or direct income for the local economy and the balance is generated before it finally leaks away to outside sources. The ratio of expenditures to income is high for deer hunters because much of it is for access fees, guide service, hotels and motels, and other services. This produces more local income than sales of items or goods imported from other areas. Perhaps this new money is the best explanation for the popularity of the tourist with the local businessman.

Social and Institutional

Perhaps the most important effect of the proposed development program outlined in this report is that it would improve the economy of the area. The addition of approximately 59,000 acres of irrigated cropland in the Colorado portion of the basin would help to stabilize the number of farms and ranches at about the present number of 650. This would also aid in improving the income so that the operators would have sufficient funds to install needed range improvements and other conservation practices. This is perhaps the most important factor if the land and water resources are to be preserved for the use of future generations. The additional water facilities developed in connection with the Bureau of Reclamation's multiple purpose reservoirs would also attract a number of tourists and this would aid in stabilizing the basin's economy.

This development program is important in the State of Colorado because it would both improve the local economy, and provide for a more complete utilization of the land and water resources. The projected steam power and hydroelectric plants would utilize the coal and water resources, provide for additional tax base, and increase local employment opportunities.

1/ MUNGER, J. A., PUBLIC ACCESS TO PUBLIC DOMAIN LANDS. U. S. Department of Agriculture, Economic Research Service, Miscellaneous publication No. 1122, December 1968.

Potential Water Use

Projections of potential developments and related water depletions were made for 1960-1980, 1980-2000, and 2000-2020. The total annual water depletions in the basin are estimated to average about 393,500 acre-feet in 2020 (table 28). This is more than a threefold increase over the estimated average annual depletion (102,100 acre-feet) 1943-60 period. Approximately 313,600 acre-feet (80 percent) of the projected annual depletions will be used within the basin and the remaining 79,900 acre-feet (20 percent) are projected out-of-basin exports (Figure 9 - Project Location Map following page 108).

There are three potential exports in addition to the Egeria Creek and Hog Park diversions presently in operation and previously mentioned. The High Mountain Water Line Company (Four Counties Water Users Association) will be the largest export in 2020, with a projected total of 40,000 acre-feet annually. The water will be used on the eastern slope in Boulder, Adams, Weld, and Larimer counties, Colorado. The South Fork Williams Fork Diversion is expected to divert 3,300 acre-feet annually to the Lost Park Reservoir in the White River Basin. The Rawlins Diversion will export 800 acre-feet annually throughout the projection period for use by Rawlins, Wyoming.

This report is limited in scope to a land and water resource assessment and does not presume to plan or design operational aspects of proposed developments. The within-basin depletions, as described here, are consumptive use estimates. They do not indicate diversion and storage requirements or include any conveyance losses. Consumptive use estimates were not made for water exported from the basin. The entire amount of water exported from the basin constitutes a stream depletion with respect to the Yampa River regardless of its ultimate use.

Precipitation and runoff are highly variable and are governed primarily by chance processes. Investigations have not been made in sufficient detail to analyze or make probability forecasts of future streamflow. Data presented are based on water supply assumptions relative to the 1943-60 period.

Blaney-Criddle procedures were used in estimating the net consumptive use 1/ by crops for projected irrigated crop acreages and distribution. Adjustments were made for expected variations in the adequacy of water supply.

1/ Net consumptive use on irrigated land is the amount of water, excluding effective precipitation, used in evaporation and transpiration by a crop during its growing season.

Table 28.--Average annual water supply and river basin discharge, (acre-feet) Yampa River Basin in Colorado and Wyoming, 1943-60, and projected developments by 1980, 2000, and 2020

Item	1943-1960			1980			2000			2020		
	Colorado	Wyoming	Total	Colorado	Wyoming	Total	Colorado	Wyoming	Total	Colorado	Wyoming	Total
Irrigated crops 1/ (net consumptive use) 2/	58,100	13,300	71,400	81,200	23,200	104,400	134,300	23,800	158,100	134,300	23,800	158,100
Riparian vegetation, non-beneficial phreatophytes, seeped lands, and incidental areas 3/ (net consumptive use) 2/	16,700	1,900	18,600	18,900	2,100	21,000	20,100	2,200	22,300	21,700	2,300	24,000
Industrial, municipal, domestic and livestock use, and reservoir evaporation	8,300	1,000	9,300	45,700	1,700	47,400	94,500	1,900	96,400	129,400	2,100	131,500
Export, water transported out of Basin	2,800	0	2,800	26,100	18,900	45,000	36,100	33,800	69,900	46,100	33,800	79,900
Total depletion	85,900	16,200	102,100	171,900	45,900	217,800	285,000	61,700	346,700	331,500	62,000	393,500
Total water yield 4/	1,383,300	221,400	1,604,700	1,383,300	221,400	1,604,700	1,383,300	221,400	1,604,700	1,383,300	221,400	1,604,700
Import	300 5/	0	300	300	0	300	300	0	300	300	0	300
Total undepleted supply	1,383,600	221,400	1,605,000	1,383,600	221,400	1,605,000	1,383,600	221,400	1,605,000	1,383,600	221,400	1,605,000
River Basin discharge 6/ (supply minus depletion)	1,297,700	205,200	1,502,900	1,211,700	175,500	1,387,200	1,098,600	159,700	1,258,000	1,052,100	159,400	1,211,500

1/ Estimated irrigated acreage: 1943-1960 = 80,000 acres Colorado, 16,500 acres Wyoming; 1980 = 98,000 acres Colorado, 23,000 acres Wyoming; 2000 and 2020 = 142,000 acres Colorado, 23,000 acres Wyoming.

2/ Net consumptive use is the amount of water, excluding effective precipitation used in evaporation and transpiration.

3/ Estimates of water depletion resulting from riparian vegetation and nonbeneficial phreatophytes may in some instances include consumptive water use due to natural conditions that are impossible to separately identify and differentiate from man-related development.

4/ Water yield data is for the 1943-1960 period and does not represent a forecast of future annual yields.

5/ Pumped direct from Green River.

6/ Discharge data for the periods 1980, 2000, and 2020 are based on 1943-1960 yield data and are not a forecast of future annual discharges.

Source: USDA Field Party

Consumptive use of water by municipal, industrial, and domestic uses, evaporation from reservoirs, livestock use, noncrop water-using areas incidental to irrigation development, use by riparian and nonbeneficial phreatophytic vegetation, and other minor uses were estimated separately.

Major increases in potential water use for the projection periods are attributed to agricultural and industrial growth. Consumptive use by irrigated crops is expected to increase from the present 71,400 acre-feet annually to 104,400 acre-feet in 1980, and 158,100 acre-feet in 2000 and 2020. Industrial water users of greatest importance will be the proposed thermoelectric generators at Craig, Hayden, and Milner. Industrial water consumption for power generation is expected to increase from the present 3,300 acre-feet per year to 30,000 acre-feet in 1980 and level off at 70,000 acre-feet in 2000 and 2020.

IX. OPPORTUNITIES FOR DEVELOPMENT AND IMPACT OF USDA PROGRAMS

Development

Potential PL 566 Projects

Possibilities for project action under PL 566 are dependent on future developments in the basin. As previously described in Chapter VIII there have been applications and field examinations on three proposed watershed projects: Storm Mountain, Dry Creek, and Fortification Creek. The planning on these projects has been tabled or suspended due to high development costs and low economic feasibility. These projects are considered as a part of the long range program even though they are not justified under present conditions. Changes in land and water use could affect the feasibility and further studies will be warranted at a later date. Some of these changes will occur in the next 10 to 15 years, and projects will probably be developed in the 1980-2000 period.

In addition to these, there are opportunities for development in four other watersheds: Bear River, Morrison Creek, Trout Creek, and Elkhead Creek (table 29, page 153). These potential projects are also included in the long range program with development expected probably in the 1980-2000 period.

Bear River Watershed includes parts of Routt, Rio Blanco, and Garfield counties in Colorado and contains the communities of Phippsburg and Yampa. Floodwater damages occur to 1,600 acres of grass-hay meadow land but primary benefits would be obtained by agricultural water management. Phippsburg and Yampa could also receive municipal water from this project.

The watershed contains approximately 16,000 acres of irrigated land, and two ditch companies are considering development of additional water. This project has a potential under several different authorities, depending upon decisions by the sponsoring organizations.

Morrison Creek Watershed, located in Routt and Grand counties, Colorado, is a potential agricultural water management project. There are approximately 10,000 acres of irrigated land in the watershed and additional water could be developed to supplement the late season water demand. Reduction in floodwater damage on about 1,600 acres of grass-hay meadow land would be included in the benefits. There are several alternatives for development in this watershed and the interests of the local people will need to be more definite before further planning can proceed.

Trout Creek Watershed is composed of parts of Rio Blanco, Routt, and Garfield counties, Colorado, and contains the communities of Oak Creek and Routt. The watershed has about 3,000 acres of grass-hay meadow that

Table 29.--Proposed PL 566 project opportunities, Yampa River Basin in Colorado

Watershed name	CNI watershed number	Counties	Land ownership: Private	Federal	State & local	Total area	Number of farms	Dry cropland	Irrigated cropland	Primary purpose of project
			Acres	Acres	Acres	Acres		Acres	Acres	
Storm Mountain	5e-3	Routt and Grand	5,900	48,000	0	53,900	15	1,900	4,000	A.W.M. 1/
Fortification Creek	5e-9	Moffat	127,000	33,000	9,000	169,000	49	30,000	3,500	F.P. 2/
Dry Creek	5e-8	Routt	39,000	500	5,000	44,500	30	12,000	1,500	F.P.
Bear River	5e-4	Routt, Rio Blanco, and Garfield	68,000	61,000	2,000	131,000	40	3,000	16,000	A.W.M.
Morrison Creek	5e-5	Routt and Grand	59,000	88,000	1,500	148,500	50	4,000	10,000	A.W.M.
Trout Creek	5e-6	Routt, Rio Blanco, and Garfield	154,000	37,000	22,000	213,000	67	28,500	7,000	A.W.M.
Elkhead Creek	5e-7	Routt and Moffat	123,000	60,500	20,000	203,500	71	29,000	4,500	A.W.M.

1/ Agricultural water management

2/ Watershed protection and flood prevention

Source: 1966 Conservation Needs Inventory and USDA Field Party

receives some damage by floodwater. There are opportunities for developing additional irrigation water which would provide a supplemental supply needed for part of the present irrigated area of 7,000 acres and a full water supply for other areas presently in dry cropland. Water development will be expensive because the new lands are separated by several streams and mountainous terrain. A definitive course of action needs to be developed by a sponsoring group before project planning can be initiated.

Elkhead Creek Watershed in Routt and Moffat counties, Colorado, contains 4,500 acres of irrigated land. Part of the irrigated area is in need of an additional water supply to supplement the presently inadequate supply. There are several areas of dry cropland in this watershed which could be brought under irrigation. This would require installation of new canals and appurtenant irrigation structures. In addition, there are approximately 2,500 acres of grass-hay meadow that receive floodwater damage. Alternative courses of action proposed by interested groups need to be resolved before a reasonable planning approach can be pursued.

The opportunities for development in these watersheds include complex alternatives as to the course of action and authorities under which project action should be taken. There are varying degrees of local interest in the individual watersheds. The county Technical Action Panels are working with interested groups in coordinating the services of Federal, State, and private programs. Because of physical complexities and varying objectives in these watersheds, project definition and development will be slow.

Land Treatment Program Under PL 46 and Related Authorities

Land treatment is a continuing need. The Department, through the Soil Conservation Service, Agricultural Stabilization and Conservation Service, and the Farmers Home Administration, provides technical and financial assistance to land owners and operators for the planning and application of land treatment measures. Because of shifts in land use and accompanying changes in treatment needs, the Department periodically reviews and inventories the land treatment requirements on non-Federal rural lands. The most recent, the Conservation Needs Inventory, was made in 1966. Results of the inventory show that about 43 percent of 1,810,900 acres of State and private agricultural lands in the Colorado portion of the basin are in need of some type of land treatment. Based on the current rate of application, it is estimated that about 66 percent of the treatment needs will be completed by 1980. Further development of land resources will require additional conservation measures consistent with land use. In order to assure protection of the resource many of the measures may need to be applied at an accelerated rate. This will depend upon the location and rate of installation of potential developments.

Conservation on agricultural lands requires a combination of improvement measures and management practices. The following measures and practices are typical of the requirements of this area:

(1) Irrigated cropland

(a) Irrigation systems improvement - This includes such measures as the reorganization of existing systems, land leveling, ditch lining, erosion control measures, and drainage.

(b) Water management - Proper irrigation water management is needed to: (1) Control soil erosion, (2) Prevent excess water losses, and (3) Time water applications to meet crop needs. Adequate irrigation systems must be installed before proper water management can be accomplished.

(2) Dry farm cropland

(a) Residue and annual cover - Crop residue management, annual cover crops, or other annual recurring measures used locally when needed to meet the conservation problems.

(b) Stripping and diversions - This includes strip cropping and diversions that are needed to treat and protect the land. In addition, measures such as sod waterways and contour stripping may be used to supplement these practices.

(c) Permanent cover - This practice is for lands that are unsuited for row or grain crops and a land use change to a permanent cover of grass or trees is needed.

(3) Pasture and rangeland

(a) Protection only - Protection of plant cover from overgrazing. Livestock management and distribution is needed on overgrazed land to enable rangeland to recover and reseed naturally.

(b) Brush control and improvement - Chemical or mechanical measures are needed to eradicate or control the encroachment of undesirable woody, poisonous, and noxious plants that has destroyed or threatens the grass cover.

(c) Reestablishment of vegetative cover - This is a more intensive treatment. The pasture or range needs a complete reestablishment (without brush control) of vegetative cover. During the period of reestablishment these lands are protected from livestock grazing that might cause damage.

(d) Reestablishment with brush control - Brush control measures are necessary in the reestablishment of a desirable vegetative cover.

Table 30 shows the conservation treatment needs on State and private agricultural lands in the Yampa River Basin in Colorado and the amount of treatment that is expected to be completed by 1980.

Table 30.--Conservation treatment on State and private agricultural lands, Yampa River Basin in Colorado, 1980

Land use	Description of treatment needed	Treatment needed	Treatment completed by 1980	Treatment completed by 1980
		Acres	Acres	Percent
Irrigated cropland				
	System improvement	8,500	5,300	62.3
	Water management	25,600	12,800	50.0
Subtotal		34,100	18,100	53.1
Dry farm cropland				
	Residue and annual cover	28,400	14,200	50.0
	Stripping and diversions	42,900	4,300	10.0
	Permanent cover	28,900	19,400	67.1
Subtotal		100,200	37,900	37.8
Pasture and rangeland 1/				
	Protection only	430,400	344,300	80.0
	Brush control and improvement	184,200	102,200	55.5
	Reestablishment of vegetative cover	12,000	8,100	67.5
	Reestablishment with brush control	9,600	900	9.4
Subtotal		636,200	455,500	71.6
Total		770,500	511,500	66.4

1/ Totals include 19,100 acres of irrigated pasture and 30,700 acres of dry farm pasture.

Source: Conservation Needs Inventory (1966) - County data adjusted to the Yampa River Basin boundaries in Colorado

There are also opportunities for organization and development of additional livestock grazing associations. These associations could provide unified management and related improvement of substantial areas of the land resource. Associations could also sponsor more complete and adequate land treatment programs including range renovation, livestock management, and conservation with technical and financial assistance from the Farmers Home Administration, Agricultural Stabilization and Conservation Service, Forest Service, Bureau of Land Management, and the Soil Conservation Service.

National Forest Development and Multiple Use Program

The U. S. Forest Service administers 931,000 acres of Federally owned lands within the basin. The Forest Service program is geared to meet the needs of the next 10-15 years. The basic renewable natural resources of the national forests upon which people will rely to an increasing extent in the years to come are water, timber, range, recreation, and wildlife habitat.

Outstanding recreation and wildlife resources, water for downstream use, and large expanses of undeveloped timberland are features of the basin. A substantial part of the forest land is grazed by domestic livestock.

Several critical areas in the basin include erosive lands and burns where the vegetation has been destroyed by fire. There are 29,000 acres of rangeland that are in need of revegetation. Intensive range management is necessary on each grazing allotment to provide cover that is effective in reducing storm runoff. Vegetal manipulation, to increase water yield, is a development program on the three national forests within the basin. Careful management is needed on areas subject to geologic erosion in the alpine or subalpine areas where vegetation is sparse due to adverse climate and shallow rocky soils. In these areas the natural geologic processes of erosion are taking place and the accelerated weathering of the parent rock is of limited duration. Other critical erosion factors are: (1) Combinations of soil and geologic factors that produce land movements (slipping and sluffing), and (2) Under certain soil moisture conditions and excessive steep slopes where the soils are shallow and underlaid by weatherable rock as shale, sandstone, or weathered granite rock that are easily fractured by weathering process. While these areas may be small, they can contribute sediment during the spring runoff and during high intensity summer rain showers.

Within the national forest area it is estimated there are 26 miles of streambank and lakeshore needing protection and stabilization to reduce sediment pollution. These estimates are based on the miles of stream and lakeshore needing structural measures to protect their banks from further soil loss. There are 33 miles of gullies, 70 miles of abandoned roads and trails, 5,020 acres of sheet erosion, and 370 acres of mining areas that need treatment. Table 31 is an estimate of land treatment and structural measures proposed for national forests - 1980.

Table 31.--Estimated units of land treatment and structural measures proposed for Medicine Bow, Routt and White River National Forests, Yampa River Basin in Colorado and Wyoming, 1980

Item	Unit	Amount
Range revegetation (plant control and type conversion)	Acres	29,000
Range - stock distribution trails	Miles	90
Range - fences	Miles	470
Range water developments	Each	680
Reforestation and afforestation (planting and seeding)	Acres	6,290
Timber stand improvement (release, thinning, and pruning)	Acres	27,650
Fish habitat improvement - streams	Miles	86
Fish habitat improvement - lakes	Acres	97
Develop wildlife shallow water impoundments	Acres	10
Develop wildlife areas - forage plants and permanent openings	Acres	3,350
Fire control - fuel treatment	Acres	410
Road construction and betterment	Miles	1,160
Trail construction and betterment	Miles	350
Erosion control - gully	Miles	33
sheet	Acres	5,020
streambank and lakeshore	Miles	26
abandoned roads and trails	Miles	70
Mine restoration	Acres	370
Snowpack management	Miles	15
Water storage structures	Each	14
Recreation sites - cleanup and disposal	Acres	410
Construction of campgrounds	Acres	186
Construction of picnic areas	Acres	11

Source: U. S. Forest Service

Other area treatment will consist of range forage improvement, fencing and water developments to control grazing, wildlife water developments, wildlife seeding and plantings, water storage structures, timber stand improvement, reforestation and afforestation, road and trail construction and betterment, snow fence construction, and recreation site development.

Research is being done by the Forest Service to determine the effects of various kinds of land treatment practices on water yield and other resource uses. Such practices as intensive thinning of lodgepole and ponderosa pine, clear cutting pine and spruce-fir timber in blocks or strips, and converting pinyon-juniper and oakbrush stands to grass show promise for increased water yield. Recreation, timber, and forage uses of the forest will be affected by vegetative manipulation. Land managers consider these values and carefully weigh the advantages and disadvantages to each use.

Research in snowpack management indicates that carefully designed and located snow fences can substantially increase snow accumulation and prolong snowmelt.

Alpine snow fields are an important source of summer streamflow in the basin. Indications are that many of the natural barriers in the alpine areas are inadequate to hold the snow which falls during the accumulation period. Snow fences erected on sites where drifting occurs induce additional drifting. These snow fences are being used to increase the size of the snow fields that usually last until late summer. They are also being used to increase the depth and the size of snow fields that normally disappear by early July. In this way, both the amount and the duration of water released to the streams during the summer would be increased. Timing of runoff in many areas can be as important as an increase in supply, or more so.

On the national forest lands the Forest Service will install the needed area treatment. The Forest Service anticipates receiving part of the installation cost through its regular funding.

Impacts

Because of the complex alternatives that exist under present conditions, development of potential PL 566 projects will probably occur in the 1980-2000 time frame. Therefore, impacts were not developed for these potential projects because changes in land and water use in the interim will affect future planning and detailed studies will be necessary as needs become more definite.

Land treatment is basic to the success of the overall watershed program. Conservation practices on range, forested lands, and irrigated cropland will assure improvement, protection, and maintenance of vegetation. The improved vegetative cover will provide additional forage values and will reduce floodwater and sediment damage.

The projected land treatment measures that will be applied by 1980 under the established PL 46 program were evaluated as increased income to the area. These measures are described in the development section of Chapter IX. The application of these measures by 1980 will increase annual income to the land resource area by $411,840. The measures and practices are applied to three land uses: (1) Irrigated cropland $52,650, (2) Dry farm cropland $92,430, and (3) Pasture and rangeland $266,760 (table 32).

Table 32.--Projected changes in livestock feed or forage production by land use and treatment practices, Colorado portion of the Yampa River Basin, 1980

Land use and treatment	Estimated land treatment needs	Forage increase if needed treatment is applied	
	Acres	AUM's 1/	Dollars
Irrigated cropland			
System improvement	5,300	5,300	23,850
Water management	12,800	6,400	28,800
Subtotal	18,100	11,700	52,650
Dry farm cropland			
Residue and annual cover	14,200	710	3,195
Stripping and diversions	4,300	430	1,935
Permanent cover	19,400	19,400	87,300
Subtotal	37,900	20,540	92,430
Pasture and rangeland			
Protection only	344,300	34,430	154,935
Brush control and improvement	102,200	20,440	91,980
Reestablishment of vegetative cover	8,100	4,050	18,225
Reestablishment of brush control	900	360	1,620
Subtotal	455,500	59,280	266,760
Total	511,500	91,520	411,840

1/ River Basin Staff estimated value of an AUM at $4.50.

Source: USDA Field Party

Grazing associations are a relatively new development in the basin and have not been in existence long enough to adequately estimate their long-term monetary benefits. Recent evaluations show that they present opportunities for small ranchers and farmers to: (1) Provide more stable operations, (2) Improve the quality of livestock, (3) Increase their share in land equity, (4) Make better use of land and water resources, (5) Create more bargaining power at the market place, and (6) Increase their income and strengthen the rural community.

The Forest Service land treatment program recommended for the early action program includes rangeland treatment practices that are estimated to increase the range carrying capacity by 20 to 50 percent. This will produce a substantial increase in beef and mutton production from the public range resource of the basin.

Timber stand improvement measures such as conversion, release cutting, thinning, pruning, and planting on the three national forests will increase the allowable annual cut four to five times. Vegetal manipulation to increase water yield is a going development program; studies have shown that water yield can be increased by strip and block cutting, clear cutting, thinning and pruning of commercial timber stands, and eradication of pinyon-juniper and oakbrush areas. These phases of forestry management enhance timber production and improve related soil, water and wildlife resources.

Recreation site development is needed to help meet the projected recreation demands. Many outdoor recreation activities are enhanced or are directly dependent upon water areas. An adequate supply of clean water is necessary before full development of recreational facilities can be realized. The construction of water impoundments will improve fish and game habitat and provide some of the additional water-based recreation. The development program for wildlife habitat and providing openings and food patches, will improve hunting as well as game habitat. Fish habitat will be greatly enhanced by stabilizing streambanks and lakeshores.

The road and trail construction and betterment program will enable timber operators to tap large areas of overmature timber, help disperse recreational use, and increase the visitor days use due to accessibility of areas not previously used. On the national forests, more road construction will mean multiple purpose roads to serve many uses.

Snow fences and tree and shrubs planted in rows will help accumulate snow in deeper drifts. The deeper snow fields will retard evaporation and will yield more late season water for downstream use.

Erosion control and other land treatment measures on the national forests will enhance watershed values by retarding erosion and stabilizing the soil. Suspended sediment will be reduced and water quality will be improved.

X. COORDINATION AND PROGRAMS FOR FURTHER DEVELOPMENT

Solving the land and water resource problems of the Yampa River Basin will take careful coordination between all of the concerned Federal, State, and local agencies or groups. The development program outlined in this report provides only guidelines as to needed development. Final development will depend primarily on the initiative of the people living in the basin.

Of major importance to the basin is the net increase of the projected 64,800 acres of new or reclaimed irrigated lands, plus the provision of a full irrigation water supply to approximately 28,600 acres which are presently in short supply. The development of these lands is the determining factor in solving the problem of underemployment of the land and water resources. Involved are all or portions of the Bureau of Reclamation's proposed Juniper Project, Yampa Valley Project, Yellow Jacket Project, and the authorized Savery-Pot Hook Project. Water conservancy districts have been organized to obtain water adjudications and promote each of these projects. Their work should be accelerated if possible to insure that these projects are developed in the near future.

In some cases projects proposed under regular Reclamation Law or provisions of Public Law 485 may be more easily developed or economically justified at a somewhat smaller scale of development with assistance of the Bureau of Reclamation under the provisions of Public Law 984. These and similar small water development projects involving irrigation facilities may also be developed as integral parts of watershed projects under Public Law 566, or other authorities which may be made available in the future.

The development of the new irrigated land will create an increased need for a coordinated program by the USDA agencies to assist the farm operators in developing and operating the land for irrigation. This development can best be coordinated through the USDA County Technical Action Panels (TAP) that consists of representatives of all USDA agencies in the county working through soil conservation districts and other units of local government. The Technical Action Panels are charged with coordinating all of the needed rural programs including land and water resource development programs of the USDA as well as cooperating with and assisting other Federal, State, and local agencies in making their programs effective in rural areas. The Technical Action Panels are also specifically charged with identifying problems and suggesting appropriate solutions in rural areas where existing programs are not meeting local needs.

If land and water resource problems are recognized and advance planning is completed in time, the USDA will have the necessary programs available when farm operators need assistance in developing the new irrigated

cropland projected for the basin. All of the existing programs (listed in a previous chapter of this report) will be needed in developing the resources. One of the largest needs will be for a loan program to finance needed conservation practices, land development, and irrigation facilities for new and old irrigated areas. The Farmers Home Administration loan programs can do a part of this, but the ever expanding capital needs of agriculture create a need for new capital sources. The Soil Conservation Service, working through local soil conservation districts, will provide technical assistance in farm and ranch planning, soil surveys, structural program investigations, and for installing conservation practices. The Agricultural Stabilization and Conservation Service will need to provide an expanded program of cost sharing (through ACP) for conservation practices that are deemed to be of public benefit. The Cooperative Agricultural Extension Service, through the local county agents, will need an expanded program of adult education and leadership training particularly for the new operators who move into the basin and are unfamiliar with local farming methods and climatic problems.

Much of the land to be irrigated by reclamation projects is presently under the administration of the Bureau of Land Management. The transfer of this land from public to private ownership will require considerable planning and coordination by the Bureau of Land Management. At the same time, the additional demand on the remaining public lands for all of the multiple purpose uses will require an active management program. Some adjustments in present use allocations and management may also be necessary.

Multiple use coordination of national forest resource management is important to the basin economy because of the wide variety of timber, grazing, wildlife, recreation, and watershed resources and the conflicts that develop between the various users. These many uses of the national forests are all tied together under a comprehensive, coordinated multiple use plan consisting of an inventory of natural resources, measurement of public demands, factors of sustained yield capacity, and timing and coordinated patterns of use.

The Forest Service and the Farmers Home Administration have a Memorandum of Understanding that provides for coordination of agency responsibilities and functions when a grazing association operates on national forest lands and also receives financial assistance from the FHA. The agreement permits rural groups to pool their resources for the efficient management of integrated public and private land areas. It also provides for technical assistance to these groups and for programs of sound range conservation and management.

The Forest Service cooperates with State agencies and private forest owners to (1) Protect State and privately owned forests and watersheds against fire, insects, and disease, (2) Encourage better forest practices for conservation, (3) Aid in distribution of planting stock for forests, and (4) Stimulate the development and management of State, county, and community forests.

Program coordination between all of the concerned Federal, State, and local agencies is necessary to assure that the proposed land and water resource development projects complement each other and provide for a coordinated development of the resources and economy of the basin.

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