ITED STATES DEPARTMENT OF THE INTERIOR

THE GREEN RIVER AND ITS UTILIZATION

EOLOGICAL SURVEY WATER-SUPPLY PAPER 618

UNITED STATES DEPARTMENT OF THE INTERIOR
Ray Lyman Wilbur, Secretary

GEOLOGICAL SURVEY
George Otis Smith, Director

Water-Supply Paper 618

THE GREEN RIVER AND ITS UTILIZATION

BY

RALF R. WOOLLEY

UNITED STATES
GOVERNMENT PRINTING OFFICE
WASHINGTON : 1930

For sale by the Superintendent of Documents, Washington, D. C. - - - Price, $1.25

CONTENTS

ILLUSTRATIONS

PREFACE

By Nathan C. Grover [1]

The Green River and its drainage basin are interesting economically, historically, and scenically. The river constitutes one of the great natural resources of Wyoming, Colorado, and Utah. It has had an influence on the exploration, settlement, and development of the West and is woven into the history of the white man's progress throughout a broad region. Its canyons are grand and beautiful but unfortunately are so difficult to traverse that they have been seen by relatively few people.

The Green River is the largest tributary of the Colorado and brings to that river nearly one-half of the water flowing in the stretch just below the junction. The mean annual run-off of the Green from a drainage area of nearly 45,000 square miles is about 5,700,000 acre-feet; the mean annual run-off from a drainage area of 26,500 square miles of the Colorado above the Green is about 6,800,000 acre-feet. Although its drainage basin is more than 70 per cent greater than that of the Colorado above the junction, the run-off of the Green is somewhat smaller because of the relatively low precipitation on much of the basin. It is far larger than any other tributary of the Colorado, the next in size being the San Juan, which has a mean annual run-off of somewhat more than 2,500,000 acre-feet.

The drainage basin of the Green, situated in Wyoming, Colorado, and Utah, ranges in altitude from more than 15,000 feet in the summits of the mountains to about 3,900 feet in the valley at its mouth. The average annual precipitation on the basin ranges from perhaps 50 inches or more near the summits of the high mountains to 6 inches or less in the southern valleys. The run-off from tributaries ranges from perhaps 30 inches or more in depth in the high mountain areas to a small fraction of an inch in the driest valleys.

Within the basin of the Green are mountain valleys that have excellent stands of timber, broad fertile valleys that are irrigated in part, excellent range lands for stock, and vast areas of mountains and valleys that are essentially of desert character. Within it also are large deposits of phosphate rock, extensive coal fields which yield valuable bituminous coals, and vast areas of oil shales. Oil fields that may have considerable future importance may yet be discovered

[1] Chief hydraulic engineer, U. S. Geological Survey.

here. The population in 1920 was largely engaged in agriculture and devoted principally to producing forage crops and raising stock.

The basin is traversed by two transcontinental railroads—the Union Pacific-Oregon Short Line system and the Denver & Rio Grande Western Railroad. It is penetrated also from the east by the Denver & Salt Lake Railroad (Moffat line). Two transcontinental highway routes also cross the basin, one by way of Green River, Wyo., and the other by way of Green River, Utah. Many highways of lesser importance make a large part of the basin reasonably accessible.

Because of resources in agricultural lands, in water for their irrigation and for the development of power, and in the possibilities of producing electric power from coal and oil, the future growth of the region will doubtless be largely rural but in part urban, based on agriculture and industry. Water will be needed in large quantities as an important if not a controlling factor in such growth; in agriculture for irrigation; in the production of electric energy, for use through the turbines of water-power plants and through the condensers of steam-power plants; in manufacturing, for many industrial processes; and in the present and future towns and cities for domestic and municipal uses.

The ultimate area of land that may be irrigated in the basin of the Green River is estimated at 1,782,800 acres. There are four principal irrigable sections. The basin of the upper Green River, in Wyoming, in which there is an estimated irrigable area of 755,000 acres, is all above 5,800 feet in altitude. Its agricultural possibilities are therefore limited to the forage crops needed for winter feeding to the great herds of stock that graze within the mountain valleys of the upper basin. The Yampa and White River Basins, in Colorado, have irrigable areas estimated at 467,400 acres, ranging in altitude from 5,000 to 8,000 feet and therefore utilized largely for producing forage crops. The Uinta Basin in Utah, having an estimated irrigable area of 295,000 acres, lies at 5,000 to 6,000 feet above sea level, and forage crops predominate there. The lower Green River Basin, including the valleys of the Price and San Rafael Rivers, contains an estimated irrigable area of 265,400 acres. These lands, which are situated farther south and at lower altitudes, have a greater range in agricultural products than the other three irrigable sections.

Only 1,850 horsepower of water power is now developed in the basin of the Green River. The total of undeveloped water power, 760,000 horsepower, is more impressive. In general the undeveloped power sites are situated wholly or in part on public lands, and permits or licenses for their use may be obtained from the Federal Power Commission under the terms of the Federal water power act, approved June 10, 1920 (41 Stat. 1063).

The probable future uses of water within the basin of the Green River will not exhaust the supply. With the irrigable areas of the basin fully developed a large quantity of water will still be discharged by the Green into the Colorado and will be available for producing power in the long stretch of canyons below the mouth of the Green and for irrigating agricultural lands in the great valleys situated in Arizona, California, and Mexico below the Grand Canyon.

Many excellent sites for constructing storage reservoirs are situated on the Green River and its tributaries. These sites will have great value both for local utilization and for equalizing the flow of the Colorado River below the mouth of the Green. Thereby the importance of the Green River is greatly increased, and its future large utilization for agriculture and industry is made probable.

The broad aspects of the Green River have been known by white men for nearly a century. Hunters and trappers penetrated into its basin in the early part of the last century, but until the migration and settlement in Utah of Mormons in 1847 and subsequent years, and the discovery of gold in California in 1848, followed by the overland rush of gold hunters to that State in 1849–50, relatively few white men had seen the river in any part of its course. Two great overland trails used in the migrations to California and Utah crossed the Green River—one in Wyoming near the site of the present town of Green River, Wyo., and one near the site of the present town of Green River, Utah. As would be expected, a few adventurers who came to the river at these crossings attempted navigation, but the canyons and rapids in the Green River between these two places and in the Colorado River below the mouth of the Green were so dangerous that transportation by boats was found to be impracticable.

A few men have succeeded in putting boats through or around all the rapids of the Green River. Powell started his bold trip through the canyons of the Colorado at Green River, Wyo., in 1869 and so traversed all the canyons of the Green as well as those of the Colorado. A few other adventurers, explorers, or scientists have followed him, as outlined in this report. The canyons were accurately mapped in 1922, when a party of topographers, geologists, and hydraulic engineers of the United States Geological Survey carried instrumental surveys from Green River, Wyo., to Green River, Utah. Mr. Woolley, the author of this report, was attached to that party as hydraulic engineer.

Mr. Woolley is a resident of Utah who has spent his engineering life on problems related to the development of the resources of the region. In studying projects for developing water power and irrigation within the Green River Basin, he has visited all the principal power sites and agricultural valleys. He has traversed the river by boat from Green River, Wyo., to Green River, Utah, through the beautiful and dangerous canyons that are rarely seen by man. He has, of course, made use of all available pertinent information collected by the personnel of the Geological Survey and others over a period of many years. His basis of information is therefore the best that could be obtained at this time. He speaks with authority and from first-hand knowledge, and his report has a value that could be obtained only by thorough familiarity with the river and its possibilities of utilization.

In this report Mr. Woolley has presented the available physical facts that are related to the present and future utilization of the Green River and his estimates of the probable ultimate development of water-power sites and irrigable lands. His conclusions are given without bias for particular schemes or projects. The facts will serve to guide stable growth in industry and agriculture; the estimates represent a probable measure of ultimate regional development. Similar facts and estimates for the Colorado above the mouth of the Green are contained in Water-Supply Paper 617, Upper Colorado River and its Utilization, by Robert Follansbee, and for the Colorado below the mouth of the Green in Water-Supply Paper 556, Water Power and Flood Control of Colorado River below Green River, Utah, by E. C. LaRue. These three reports are supplementary to Water-Supply Paper 395, Colorado River and its Utilization, by E. C. LaRue, which contained the facts related to the whole basin that were available at the time of its publication, in 1916. In the intervening years much of the river has been accurately surveyed, and additional records of discharge have been made. Because of the more complete information on which they are based, the three recent reports, Water-Supply Papers 556, 617, and 618, are more satisfactory in presentation and conclusions than the earlier report. The fundamental data presented in them are essential to stable regional development, and their compilation and publication in usable form will serve to promote proper utilization of the rivers and other natural resources contained within the drainage basin.

Mr. Woolley has not attempted to carry his study to such a degree of detail as to show to what extent a comprehensive plan of development of the Colorado River as a whole may involve correlation of development on the Green River, but he has presented basic information whereby this question may be considered by others.

SYNOPSIS OF REPORT

LOCATION AND GEOGRAPHY OF GREEN RIVER BASIN

The Green River Basin comprises a little less than 45,000 square miles of high plateaus and mountains in southwestern Wyoming, northwestern Colorado, and northeastern Utah. The Green River, which flows southward through the basin, has a total length of about 730 miles, of which about 291 miles is in Wyoming, 397 in Utah, and 42 in Colorado. The Wyoming part of the drainage basin covers about 17,600 square miles, the part in Utah 16,700 square miles, and the part in Colorado 10,600 square miles. This area is a part of the great arid region of the West, and in many respects its topographic features are unique. In addition to mountains, hills, plateaus, plains, and valleys, there are buttes, lines of cliffs, canyons, and narrow gorges scores of miles in length and hundreds of feet in depth, with precipitous rock walls.

Owing to the highly differentiated physiographic features of the Green River Basin it is naturally divided into several minor basins, which are designated in this report as follows: Upper Green River Basin, Yampa and White River Basins, Uinta Basin in Utah, and lower Green River Basin. The Green River canyons are also described, with a brief history of their exploration.

GENERAL FEATURES AND AGRICULTURE

Upper Green River Basin.—The Green River rises in the glaciers and numerous small lakes on the western slope of the Wind River Range near the Continental Divide, in southwestern Wyoming, where Trail and Wells Creeks unite to form the main stream. For the first 25 miles it flows northwestward through the Green River Lakes, and then it turns south and continues in that direction to the Utah line.

In the extreme northern part of the basin frost is not uncommon in every month in the year, and the maximum growing season rarely exceeds 75 days. Accordingly, hay is practically the only crop produced. In that part of the basin below an altitude of 7,000 feet the normal growing season is from 60 to 115 days, and alfalfa, wheat, oats, field peas, potatoes, and hardy garden vegetables are grown with moderate success. Dry farming has made no progress in the basin because of insufficient precipitation at the lower altitudes where the growing season is long enough to permit the maturing of grains.

In 1922 about 235,000 acres was under irrigation in the Wyoming portion of the Green River Basin, and 520,000 acres more was estimated to be irrigable, or an estimated ultimate irrigated area of 755,000 acres.

Yampa and White River Basins.—The Yampa and White Rivers are tributary to the Green River. The combined area of the two basins is about 12,830 square miles, 7,950 square miles for the Yampa and 4,880 square miles for the White. Of the total, about 10,600 square miles is in Colorado, and the rest is in southern Wyoming and eastern Utah. Some parts of the surface of these basins consist of open or comparatively level country, but much of it is made up of rolling hills flanking the higher portions which may properly be called mountains. In general, these basins contain but a small amount of tillable land. The valleys in the upper parts of the basins are comparatively small and along the main streams are very narrow. The irrigated and easily irrigable areas are limited to narrow strips of bottom lands along the principal streams. The widest areas of such lands range from 3 to 5 miles in width.

The entire region is exceptionally well adapted for the raising of livestock, as there is so much noncultivable pasture and range land that supports a good growth of native forage. This fact, together with the additional fact that general farming is not profitable because of adverse climatic conditions and lack of cheap transportation facilities, limits the raising of crops to those which can be profitably marketed locally and principally to those incident to the livestock industry.

The altitude of the irrigable lands ranges from 5,000 to 8,000 feet above sea level. The length .of the growing season ranges accordingly from about four months at 5,000 feet to only two months or less at 6,500 to 8,000 feet. In 1926 there was 124,500 acres in these basins under irrigation, and the estimated additional irrigable areas amounted to 342,900 acres, or an estimated ultimate irrigated area of 467,400 acres.

Dry farming has been tried extensively. In the western portion the results have been disappointing, but in the eastern portion there is more rainfall, and grain cereals are produced up to altitudes of about 7,500 feet.

Uinta Basin in Utah.—The Uinta Basin geologically includes all the territory extending east from the Wasatch Mountains to the White River Plateau and bordered on the north by the Uinta Mountains, Yampa Plateau, and Danforth Hills and on the south by the summit of the Roan or Book Plateau. The term "Uinta Basin in Utah" as used here includes some 6,600 square miles, drained principally into the Green River by the Duchesne River and Ashley Creek. The general altitude of the basin floor is 5,000 to 6,000 feet. The interior of the basin is comparatively shallow and is traversed longitudinally by the Duchesne River. The Green River flows southward across the basin and has cut for itself, except for the 80 miles of its meandering course across the interior depression, canyons from 1,000 to nearly 3,000 feet deep.

Irrigation is necessary to produce successful crops in this basin. In a few places there is sufficient rainfall for the production of small grains, but in these places the growing season is short, and accordingly attempts at dry farming have met with but moderate success. The average growing season ranges from 122 days at Vernal to about 104 days at Duchesne. The principal crops are alfalfa, clover seed, and cereals. Forage crops predominate, forming 80 per cent of the whole in the area outside of Ashley Valley. All fruits and vegetables grown are consumed locally, and considerable fruit is imported.

The fact that the basin has no railroad transportation adds materially to freight costs and restricts the agricultural development to those products which might be consumed locally and those which have a relatively high market value such as alfalfa seed, dairy products, honey, and poultry products.

About 175,000 acres was irrigated in this basin in 1921, and it is estimated that a total of 295,000 acres may eventually be irrigated by utilizing all feasible reservoir sites.

Lower Green River Basin.—The lower Green River Basin is all in eastern and southeastern Utah. It is sparsely settled and, being lower than the adjacent territory, is somewhat warmer, especially in summer. The growing season averages from 115 days near Price and Castle Dale to 150 days along the Green River, but the annual precipitation over the agricultural areas is much too low to produce crops without irrigation. Where the precipitation is greatest, because of increased altitude, attempts have been made at dry farming, but the success of these ventures has been very disappointing. Moreover, the cultivable areas are small, so that dry farming will not be much of a factor in the agricultural development of this basin.

The principal irrigated areas lie along the east base of the Wasatch Plateau, in the valleys of the Price and San Rafael Rivers and their tributaries. Along the lower courses of these two streams and the Green River itself the irrigable areas are restricted to small irregular tracts adjacent to the streams because of the bad lands, which constitute a large part of the basin.

The crops raised in the lower Green River Basin are principally alfalfa, wheat, oats, and corn, with some of the hardy fruits and garden vegetables. All the crops produced are consumed locally or find a ready market at one of the near-by coal-mining camps.

In 1921 there was in this basin 118,000 acres under cultivation, and the estimated additional irrigable area was 147,000 acres, or an estimated ultimate irrigated area of 265,400 acres.

CLIMATE

The general climate is of the arid or semiarid type. The maximum of precipitation occurs in the winter and spring. The precipitation increases rapidly with altitude. The several minor basins drained by the Green River and its tributaries form as a whole a region which is somewhat isolated and sheltered from average storm tracts and whose subdivisions have similar climatic characteristics. Most of the area is comparatively free from sudden meteorologic changes due to storm movement, though owing to the general high altitude temperature changes are large, the frost-free season is short, and much of the annual precipitation is in the form of snow.

In the upper Green River Basin the mean annual temperature is about 37°. The average midsummer maximum is about 86° and the average minimum 49°. The average midwinter maximum is about 28°, and the average minimum ranges from −6° at Eden to −2° at Daniel. The extreme temperatures range from −51° at Daniel to 100° at Green River. The average annual precipitation is about 10.4 inches. The average snowfall is about 60 inches, equivalent to about 60 per cent of the precipitation.

In the Yampa and White River Basins the mean annual temperature is about 42.5°. The average midsummer maximum is 85° and the minimum 45°; the average midwinter maximum about 33° and the minimum about 3°. The extreme temperatures range from −54° at Steamboat Springs, the coldest of record in the entire Green River Basin, to 106° at Rangely. The average annual precipitation is 17.32 inches, and the snowfall ranges from 43 inches at Watson to 215 inches at Pyramid. The average snowfall is equivalent to about 62 per cent of the precipitation.

In the Uinta Basin the mean average temperature is about 44.7°. The average midsummer maximum is 88° and the minimum 53°; the average midwinter maximum 29.5° and the minimum about 3°. The extreme temperatures range from 106° at Vernal to −50° at East Portal. The average annual precipitation is about 11.71 inches, and the snowfall ranges from 15.2 inches at Myton to 136.8 inches at East Portal.

In the lower Green River Basin the mean average temperature is about 48°. The average midsummer maximum is 90° and the minimum 52°; the average midwinter maximum 34° or 35° and the minimum 7° or 8°. The lowest on record is −40° at Winterquarters, and the highest 112° at Green River. The annual precipitation is about 9.9 inches, and the annual snowfall about 20 inches, ranging from 122.2 inches at Winterquarters to only 10 inches at Green River.

WATER SUPPLY

In all studies of the utilization of streams it is essential that records of discharge be available in order to determine with some degree of accuracy the possibilities of development. Such records have been kept on most of the principal streams of the Green River Basin and on many of the smaller ones. A summary of these records forms an appendix to this report. Many valuable data have been obtained from these records, but for many of the smaller streams no data are available.

Apparently about 37 per cent of the mean annual run-off of the Green River at Little Valley originates in the upper Green River Basin above Bridgeport. About 25 per cent is contributed by the Yampa above Maybell, about 12 per cent by the Duchesne above Myton, about 9 per cent by the White above Meeker, and about 2 per cent by the Price above Helper, a total of about 85 per cent. The rest may be classified as unmeasured flow, although a small part of it is measured at the gaging station on Ashley Creek.

STREAM REGULATION

Without regulation of stream flow it is impossible to utilize the streams of the arid regions, because the annual fluctuations in demands for irrigation, power, and other uses do not coincide with the annual fluctuations of the streams.

As there are no densely populated sections in the Green River Basin, irrigation and power are the principal uses to which the benefit of stream regulation would accrue. In the upper Green River Basin the principal storage sites are glacial lakes, so situated that water from them might be used for power and then for irrigation. The greater benefit would arise from the use for irrigation, as the power possibilities are small. This report mentions 6 constructed reservoirs within this basin and 23 of the principal proposed reservoir sites, 10 of which are described in some detail.

In the Yampa and White River Basins the sites for the largest potential power projects are on the main streams below nearly all proposed irrigation projects. Numerous irrigation enterprises proposed in these basins involve reservoirs in the upper reaches of the streams. In some of these projects the water might be used for power before reaching the irrigation diversion dams, but their principal value would lie in the use for irrigation. Twenty constructed reservoirs within these basins are mentioned in this report, and 14 of the proposed sites are described in detail.

In the Uinta Basin in Utah most of the power sites are in the upper canyons of the tributaries of the Duchesne River that drain the south slopes of the Uinta Mountains. They are above irrigation diversions and accordingly can use all water that might be stored in the glacial lakes which form the principal reservoir sites on these streams. Developed storage would therefore be available to both irrigation and power enterprises. Three of the larger constructed reservoirs are mentioned in this report, with 80 of the proposed reservoir sites, 22 of the larger of which are described in detail.

In the lower Green River Basin conditions are similar to those in the Uinta Basin, but the greater benefit would accrue to irrigation. This report mentions 16 of the constructed reservoirs within this basin and 15 proposed sites, 8 of which are described in detail.

On the main stem of the Green River the benefits derived from storage would be decidedly favorable to power developments, as power is the principal resource of the stream, the irrigation possibilities being practically negligible.

The available silt and evaporation data pertaining to these different basins and sites are also set forth in considerable detail.

WATER POWER

The amount of hydroelectric power developed in the Green River Basin at this time is insignificant compared to the potential power. The basin is sparsely settled, and many of the towns are in or adjacent to producing coal fields. In the upper Green River Basin and the Yampa and White River Basins electricity is supplied almost exclusively by steam-generating plants. In the Uinta Basin electric power is supplied from three small hydroelectric plants. In the lower Green River Basin only a very small proportion of the power used is generated within the basin, most of it being imported over the transmission lines of the Utah Power & Light Co. There are seven developed hydroelectric power sites within the entire basin, with a total installed water-wheel capacity of 1,850 horsepower. Each of these sites is described in detail.

The determinations of undeveloped power for this report are based somewhat arbitrarily on two time elements—(1) the capacity available 90 per cent of the time, or that available during ordinary low stages and for so great a part of the time that comparatively little pondage will render it thoroughly reliable; (2) the capacity available 50 per cent of the time, or that available when conditions of flow are such that, although development is ordinarily warranted, substantial storage regulation or auxiliary steam power must be provided to render the capacity thoroughly reliable. The power sites included in this report are treated only as physical possibilities, without strict regard to economic feasibility. Some of the sites that are physically possible are obviously unattractive in the economic sense, but those that are included in the report are believed to be the most attractive ones in the different basins. Accordingly they form a basis of comparison which shows the relative value of the power resources.

The 50 sites that were investigated are estimated to be capable of furnishing with the existing stream flow about 51,780 horsepower for 90 per cent of the time or 88,565 horsepower for 50 per cent of the time. With regulated flow the total would be about 759,600 horsepower. The Green River and Yampa River sites are considered only with regulated flow.

RELATIVE VALUE OF STREAMS FOR POWER AND IRRIGATION

The accepted principle in the States in which the Green River Basin lies is that the different uses to which the water of the streams may be put are classified in order of their importance as (1) domestic, (2) irrigation, and (3) power and other industrial uses. Economic conditions play an important part in the development of the water resources of the West, and it is recognized by many that more flexible rules should be applied to the use of the streams. It is conceded, of course, that domestic use should always come first, but power and irrigation uses are likely to be of coordinate importance, and both should be encouraged wherever possible. If conditions are such that the power value of a stream is greater economically than its irrigation value, development of its power should be encouraged by removal of all restrictions that would tend to preclude such development.

MARKET

The present market for power in the Green River Basin is small. Steam-generating plants are used in the upper Green River Basin and in the Yampa River Basin, because of the availability of cheap coal. Power is imported over the transmission lines of the Utah Power & Light Co. to the lower Green River Basin, and the market in the Uinta Basin is supplied from hydroelectric plants.

The territory east and west of the Green River Basin—the Denver district and the Salt Lake Basin—and the railroads that cross the north and south ends of the basin offer possible markets for power generated in this basin. The demand for power outside of the Green River Basin but within reach is continually growing at the rate of about 10,000 horsepower a year, and it is not improbable that this demand will be supplied by a superpower system into which some of the Green River Basin power sites will be connected.

THE GREEN RIVER AND ITS UTILIZATION

By Ralf R. Woolley

INTRODUCTION

Purpose and scope of report.—The purpose of this report is to present the facts regarding the available water supply of the Green River Basin and other data that will be helpful in planning to put this water to beneficial use. For some parts of the basin a mass of information is available; for other parts the data are less complete. An attempt is made in this report to present an analysis of all this information, supplemented by personal field studies, in such a way as to indicate the economic factors involved in utilizing the waters of the basin, and also to give facts from which the relative value of the irrigation and power projects may be readily deduced.

It is obvious that a report of this kind for so complex an area must be restricted to some extent in the amount of detail, and for this reason no attempt is made to cover all the small individual irrigation enterprises or the small power possibilities, but it is believed that the material in this volume at least indicates the nature of the water-utilization problems in this basin and should be of value to anyone who may be contemplating the development and use of the natural resources of the basin.

Index system.—For the purpose of indexing data pertaining to the water resources of the United States the Geological Survey has divided the country into 12 major divisions conforming to the principal drainage basins. Each of these is subdivided according to minor drainage basins. In this system the Colorado River Basin is known as division 9, and the Green River Basin comprises subdivisions A, B, and C of division 9, designated 9A, 9B, and 9C. Each of these three principal subdivisions is again subdivided into smaller ones, as shown in Figure 1.

The designation "9AC 1" is explained as follows: The figure 9 is the number of a major division of the United States—the Colorado River Basin; the letter A, the first letter following the number, refers to that part of the Green River drainage basin above the mouth of the Yampa River, or one of the principal subdivisions of division 9; the next letter, C, represents the area drained by the New Fork River and its tributaries; the figure 1 is the item number given to the Pinedale power plant. Other power plants in this same subdivision would be indicated by the symbols 9AC 2, 9AC 3, etc. This same system is applied to reservoirs, reservoir sites, and

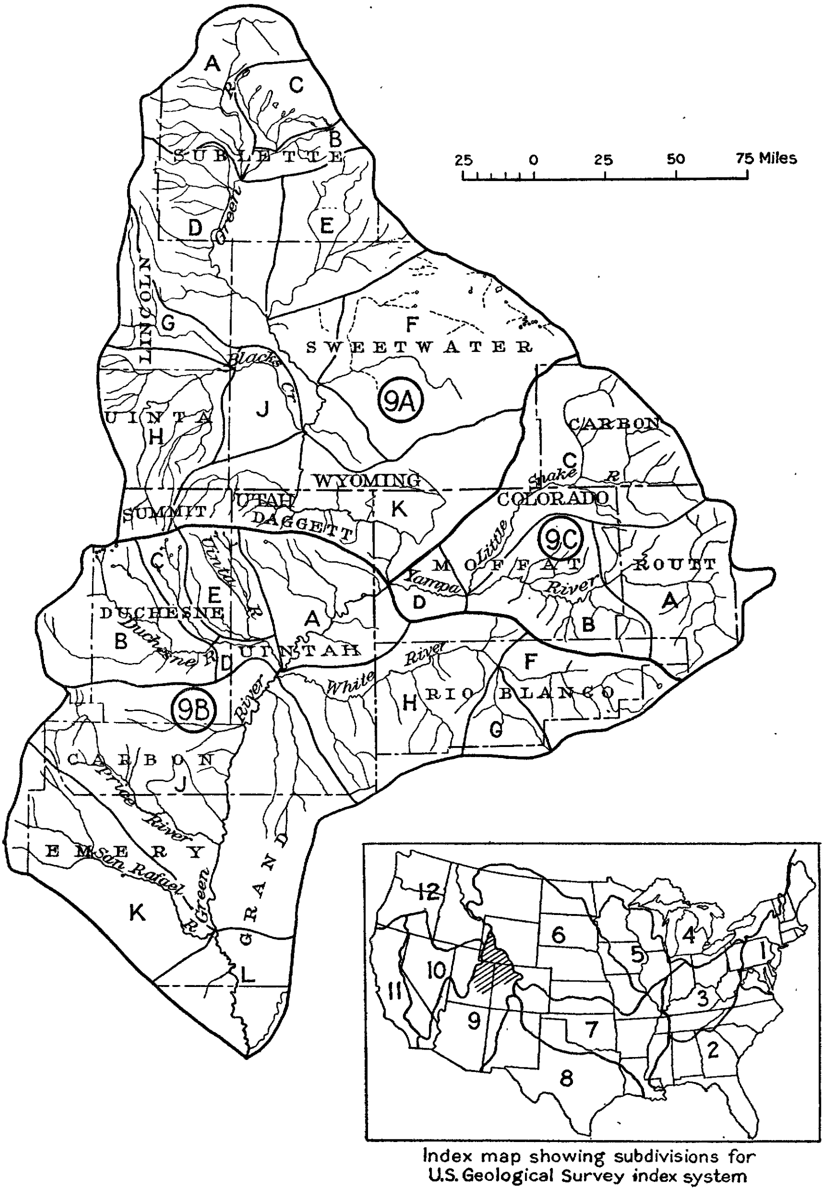


FIGURE 1.—Map of Green River Basin showing index divisions

power sites, the items being numbered consecutively beginning with 1 in each class.

Cooperation and base data.—The writer wishes to express appreciation to all who have cooperated with him in the preparation of this report.

The generous contributions of information by those who may be considered experts in their field of work adds value to a work of this kind and is a source of confidence to its readers. Special acknowledgments are made to the late Mr. C. C. Jacob, who as Federal court water commissioner for the Uinta Basin collaborated with the writer in preparing a report covering the use of the streams of that basin, much of the information being used in this report; to Mr. J. Cecil Alter, meteorologist, United States Weather Bureau, Salt Lake City, for the section on the climate of the Green River Basin; to Messrs. B. T. Chase and R. I. Meeker, for data on irrigation in the Yampa and White River Basins; to Mr. Depue Falck, for agricultural data covering the upper and lower Green River Basins and the Uinta Basin; to Mr. O. D. Stanton, for agricultural data covering the Yampa and White River Basins; and to the United States Forest Service, for data on forestation and the recreational uses of the forests.

The base data for this report are taken from all available sources. An effort has been made by the writer during his 15 years of intimate contact with the development of the basin to accumulate all information regarding its natural resources and especially that pertaining to the utilization of the streams.

The records of the State engineers' offices have furnished an index to the proposed irrigation and water-power developments, and practically all these projects have at one time or another been personally inspected.

County surveyors have gladly furnished data with which they are familiar, and private engineers have been equally willing to cooperate. As examples of aid of this kind, special mention is here made of Mr. L. J. Dolan, who furnished data on irrigation for part of the Little Snake River Valley, and Mr. W. I. Hoklas, who furnished data on steam-generating plants in northwestern Colorado.

Reports of private engineers have been made available to the writer—for instance, a special report by Mr. E. H. Burdick on one of the proposed reservoir sites in the Uinta Basin—and also unpublished reports of the United States Bureau of Reclamation on the proposed reclamation projects within the Green River Basin.

Many of the base data for the power studies are original, and to the river surveys that have been made by the United States Geological Survey within the basin is due the degree of certainty with which the power capacity of the surveyed streams could be determined. On the basis of such a survey of the Yampa River in 1922, Mr. Warren Oakey, who accompanied the survey party as a hydraulic engineer, made a report on the power possibilities of that stream from Craig to its mouth. This report is unpublished but is open for public inspection, and the information it contains is used as the basis for the discussion of the power on the Yampa River in this report.

Information regarding power consumed by the Union Pacific system between Cheyenne, Wyo., and Ogden, Utah, was furnished by Mr. Charles P. Kahler, the electrical engineer of the company, and like information for the Denver & Rio Grande Western Railroad was furnished by Mr. Arthur Ridgeway, chief engineer.

The following table of river surveys in the Colorado River Basin does not include every small stream that might have been surveyed for a few miles above its mouth as an incident to the survey of the main stream, and it does not include detail surveys of dam sites, but it includes all the principal streams, covering those stretches that may have power value. The published standard river-survey topographic sheets are available for purchase from the Director of the Geological Survey at 10 cents a sheet.

River surveys in Colorado River Basin

Stream	Stretch surveyed: Location	Stretch surveyed: Miles	Date of survey	Topography	Scale	Contour interval: Land	Contour interval: Water	Publication
GREEN RIVER BASIN								
Green River	Sec. 13, T. 24 N., R. 112 W., to sec. 20, T. 35 N., R. 111 W.	98	1909	None	1:31,680			Water-Supply Paper 396 (plan and profile).
Do	Green River, Wyo., to Green River, Utah.	387	1904; 1913–14; 1918; 1922	20 to 400 feet above river	1:31,680	20	5	Plan and profile of Green River, Green River, Utah, to Green River, Wyo. (16 sheets).
Do	Mouth to Gunnison Butte, about sec. 10, T. 20 S., R. 16 E., Utah.	128	[a] 1914	Some	1:31,680	25		Water-Supply Paper 396 (plan and profile).
Yampa River	Craig to Sidney	50		None	1:126,720			Unpublished (plan and profile). Fire map of Routt National Forest.
Do	Sec. 32, T. 6 N., R. 93 W., to Craig, T. 6 N., R. 90 W.	28		do	1:126,720			Unpublished (plan and profile). An old compilation.
Do	Mouth to sec. 32, T. 6 N., R. 93 W.	111	1922	100 to 200 feet above river	1:31,680	20	5	Plan and profile of Yampa River, Colo., from Green River to Morgan Gulch (5 sheets).
Little Snake River	Mouth to sec. 9, T. 7 N., R. 98 W.	12	1922	20 to 100 feet above river	1:31,680	20	5	Do.
Duchesne River	NE. ¼ sec. 30, T. 1 N., R. 8 W., to sec. 14, T. 3 N., R. 9 W.	15	1923–24	200 to 1,100 feet above river	1:31,680	20	20	Plan and profile of Duchesne River and tributaries (6 sheets).
Hades Creek	Mouth, in sec. 26, T. 2 N., R. 9 W., upstream.	4½	1923–24	100 to 1,100 feet above river	1:31,680	20	20	Do.
West Fork of Duchesne River	Mouth, in sec. 19, T. 1 N., R. 8 W., to sec. 30, T. 1 N., R. 9 W.	6½	1923–24	200 to 500 feet above river	1:31,680	20	20	Do.
Wolf Creek	Mouth, in sec. 26, T. 1 N., R. 9 W., upstream.	2	1923–24	200 to 300 feet above river	1:31,680	20	20	Do.
Rock Creek	South line of sec. 9, T. 1 N., R. 6 W., to sec. 8, T. 3 N., R. 7 W.	16½	1923–24	do	1:31,680	20	20	Do.
West Fork of Rock Creek	Mouth, in sec. 5, T. 2 N., R. 7 W., upstream.	2½	1923–24	100 to 600 feet above river	1:31,680	20, 100	20	Do.
West Fork of Lake Fork	Forks, in sec. 32, T. 1 N., R. 4 W., to sec. 9, T. 3 N., R. 6 W.	20½	1923–24	C0 to 700 feet above river.	1:31,680	20	20	Do.
Spring Branch	Mouth, in sec. 13, T. 2 N., R. 6 W., to sec. 11, T. 2 N., R. 6 W.	2	1923–24	20 to 700 feet above river.	1:31,680	20	20	Do.
East Fork of Lake Fork	Forks, in sec. 32, T. 1 N., R. 4 W., to sec. 10, T. 3 N., R. 5 W.	20	1923–24	100 to 300 feet above river	1:31,680	20	20	Do.
Swift Creek	Mouth, in sec. 4, T. 2 N., R. 4 W., to sec. 33, T. 3 N., R. 4 W.	1½	1923–24	20 to 600 feet above river	1:31,680	20, 100	20	Do.
Uinta River	East line of sec. 5, T. 1 N., R. 1 W., to north line of sec. 26, T. 4 N., R. 3 W.	20	1923–24	20 to 400 feet above river	1:31,680	20, 100	20	Do.

[a] Survey by Bureau of Reclamation.

River surveys in Colorado River Basin—Continued

Stream	Stretch surveyed		Date of survey	Topography	Scale	Contour interval		Publication
	Location	Miles				Land	Water	
GREEN RIVER BASIN—contd.								
Pole Creek	Mouth to north line of sec. 23, T. 2 N., R. 2 W.	2½	1923–24	20 to 100 feet above river	1:31,680	20	20	Plan and profile of Duchesne River and tributaries.
Whiterocks Creek	South line of sec. 19, T. 2 N., R. 1 E., to sec. 13, T. 4 N., R. 1 W.	13	1923–24	200 to 600 feet above river	1:31,680	20, 100	20	Do.
Mosby Creek	Sec. 6, T. 3 S., R. 19 E., upstream	2	1923–24	On west side of canyon	1:31,680	20	20	Do.
Dry Fork	East line of sec. 16, T. 3 S., R. 20 E., upstream.	15	1923–24	80 to 800 feet above stream	1:31,680	20, 100	20	Do.
Ashley Creek	South line of sec. 12, T. 3 S., R. 20 E., upstream.	11½	1923–24	200 to 1,300 feet above stream	1:31,680	20, 50	20	Do.
Duchesne River	Mouth, in sec. 32, T. 4 S., R. 3 E., to sec. 28, T. 3 S., R. 1 W.	41	1913–14	Very little	1:48,000	25	5	Water-Supply Paper 396 (plan and profile).
Uinta River	Mouth, in sec. 17, T. 3 S., R. 2 E., to sec. 20, T. 1 S., R. 1 E.	22	1913–14	do	1:48,000	25	5	Do.
White River	Mouth, in sec. 4, T. 9 S., R. 20 E., to sec. 1, T. 9 S., R. 21 E.	17	1913–14	do	1:48,000	25	5	Do.
San Rafael River	T. 24 S., R. 16 E., to south line of T. 19 S., R. 9 E.		1925	Some	1:31,680	25	5	Plan and profile of San Rafael River below Castle Dale, Buckhorn, Wash., to mile 3 (4 sheets).
Do	Mouth, in sec. 25, T. 23 S., R. 16 E., to sec. 4, T. 24 S., R. 16 E.	4	1914	150 feet above river	1:31,680	25		Water-Supply Paper 396 (plan).
COLORADO RIVER ABOVE MOUTH OF GREEN RIVER								
Colorado River	Mouth of Green River to Grand Junction, Colo.	133	1912	200 to 1,200 feet above river	1:31,680	25	5	Water-Supply Paper 396 (plan and profile).
Do	Kremmling, in sec. 18, T. 1 N., R. 80 W., to Glenwood Springs.	90	1911	200 to 400 feet above river	1:31,680	25	5	Do.
Blue River	Mouth to Breckenridge	58	1924	300 feet above river	1:31,680	50		Unpublished (plan).
Eagle River	Mouth to sec. 30, T. 6 S., R. 80 W.	52	1924	200 to 600 feet above river	1:31,680	50		Do.
Roaring Fork River	Mouth to Snowmass, sec. 27, T. 8 S., R. 86 W.	29	1924	200 to 300 feet above river	1:31,680	50		Do.
Gunnison River	Cimarron Creek to Gunnison, sec. 2, T. 49 N., R. 1 W.	39	1909	None	1:31,680			Water-Supply Paper 396 (plan and profile).
Dolores River	Mouth to Paradox Valley, sec. 31, T. 47 N., R. 18 W.	73	1924	200 to 800 feet above river	1:31,680	50		Unpublished (plan, 2 sheets).
San Miguel River	Mouth to Sawpit	66	1924	250 to 500 feet above river	1:31,680	50		Unpublished (plan).

COLORADO RIVER BASIN BELOW MOUTH OF GREEN RIVER								
Colorado River and San Juan River.	Lees Ferry, Ariz., to mouth of Green River.	216	1921	400 to 800 feet above river	1:31, 680	20	5	Plan and profile of Colorado River, Lees Ferry, Ariz., to mouth of Green River, Utah; San Juan River, mouth to Chinle Creek, Utah (22 sheets).
Colorado River	Black Canyon to Lees Ferry	356	1923	Some	1:31, 680	50	5	Plan and profile of Colorado River from Lees Ferry, Ariz. to Black Canyon, Ariz.-Nev. (21 sheets).
Do	Mexican boundary to Black Canyon.	254	1902–3; 1920	Detailed	1:31, 680	10, 50	5	Plan and profile of Colorado River from Black Canyon, Ariz-Nev., to Arizona-Sonora boundary (20 sheets).
Williams River	Mouth to 500-foot contour	9	1902–3	10 to 100 feet above river		10	5	Do.
Gila River	Mouth of Salt River to Eastern line of T. 4 S., R. 11 E.	80		In places		10		63d Cong., 2d sess., H. Doc. 791; compiled by Corps of Engineers, U. S. Army.
Do	Mouth of Agua Fria River to T. 3 S., R. 5 E.	50	1903–4	Detailed	1:31, 680	5, 10, 50		On topographic map of Salt River project, U. S. Bureau of Reclamation.
Salt River	Mouth to mouth of Verde River	44	1902–3	do	1:31, 680	5		Do.
Do	Sec. 4, T. 3 N., R. 14 E., to San Carlos Indian Reservation.	38	1916	do	1:31, 680	25	5	Unpublished.
Verde River	Tangle Creek to sec. 35, T. 13 N., R. 5 E.	47	1916	150 to 250 feet above river	1:31, 680	25	5	Unpublished (plan and profile, 3 sheets).
Virgin River	Mouth upstream	37	1903–1923	50 to 500 feet above river	1:31, 680	50		Plan and profile by Bureau of Reclamation (3 sheets). Published by U. S. Geological Survey on sheets covering Colorado River from Lees Ferry to Black Canyon.
Gila River	Sec. 20, T. 19 S., R. 20 W., to sec. 4, T. 16 S., R. 17 W.	44	1915	100 to 500 feet above river	1:31, 680	25	5	Water-Supply Paper 396 (plan and profile).
Do	Sec. 19, T. 19 S., R. 19 W., to sec. 29, T. 18 S., R. 18 W.	10	1920	Detailed	1:24, 000	10		In preparation.
San Francisco River	Sec. 9, T. 11 S., R. 20 W., to sec. 4, T. 10 S., R. 20 W.	10			1:24, 000	10		Unpublished.

NOTE.—Maps are available for 39 dam sites on Colorado River below the mouth of Green River; 37 of these are described in some detail in Water-Supply Paper 556. Surveys of Colorado River below mouth of Green River extend from 2 to 30 miles up the canyons of tributary streams.

GENERAL FEATURES OF GREEN RIVER BASIN

LOCATION AND EXTENT

The Green River Basin comprises a little less than 45,000 square miles of high plateaus and mountains in southwestern Wyoming northwestern Colorado, and northeastern Utah. Its extreme length from north to south is about 366 miles, in latitude 38° to 43° 30 north. Its extreme width from east to west is about 246 miles in longitude 106° 30′ to 111° 30′ west. The Green River flows southward through the basin, and its total length from the junction of Trail and Wells Creeks, two small streams that unite to form the main stem, to its mouth is about 730 miles. About 291 miles of the stream is in Wyoming, 397 miles in Utah, and 42 miles in Colorado. The part of the drainage basin in Wyoming covers about 17,600 square miles, in Utah 16,700 square miles, and in Colorado 10,600 square miles.

GEOGRAPHIC AND TOPOGRAPHIC FEATURES

This basin is a rudely triangular area embraced between the Rocky Mountains on the east and the Wasatch Range on the west and extending from the sources of the Green River in the Wind River Mountains on the north to the base of the Uinta Range on the south.[1] It is a part of the great arid region of the continent, and in many respects its topographic features are unique. Powell[2] describes some of these features very graphically, as follows:

> Mountains, hills, plateaus, plains, and valleys are here found, as elsewhere throughout the earth; but in addition to these topographic elements in the scenic features of the region we find buttes, outlying masses of stratified rocks, often of great altitude, not as dome-shaped or conical mounds but usually having angular outlines; their sides are vertical walls, terraced or buttressed, and broken by deep, reentering angles, and often naked of soil and vegetation. Then we find lines of cliffs, abrupt escarpments of rock, of great length and great height, revealing the cut edges of strata swept away from the lower side. Thirdly, we find canyons, narrow gorges, scores or hundreds of miles in length and hundreds or thousands of feet in depth, with walls of precipitous rocks.

The north rim of the basin extends from the Gros Ventre Range on the west to the Wind River Range on the east and forms the boundary between the Green River and Snake River drainage basins. The Wind River Range, one of the ranges in the Continental Divide, trends north-northwestward through the west-central part of Wyoming and forms the east boundary of the basin as far south as South Pass. For about 100 miles southeast from this point the basin merges gradually into the Great Divide Basin on the east with no well-defined line of demarcation. The Park Range,

[1] U. S. Geol. Expl. 40th Par. Rept., vol. 2, p. 191, 1877.
[2] Powell, J. W., Exploration of the Colorado River of the West and its tributaries, 1869-1872, p. 149, 1875.

which is a western portion of the great Rocky Mountain system, forms the eastern boundary of the basin in Colorado, and from its south end a series of ridges bearing southwestward mark the divide between the White River and the upper Colorado River; these ridges finally merge into the terraced plateaus that constitute the southern part of the Green River Basin, in Utah.

The western boundary of the basin, beginning at the north end, consists of long, narrow ridges, known as the Absaroka Ridges, which form the southern flank of the Gros Ventre Range and merge into the rolling plateau region on the south to the vicinity of Evanston, where the divide between the Green River and Bear River drainage basins is quite as ill defined as the eastern limit adjoining the Great Divide Basin. Beyond this point the Wasatch Mountains extend southward to the high plateau region that forms the southern part of the Green River Basin.

Just south of the Utah-Wyoming line the transverse range of the Uinta Mountains marks the boundary between the broad valley of the Green River to the north and the broken plateau region to the south. The Uinta Mountains stretch eastward from the middle of the Wasatch Range for about 150 miles. The eastern third is somewhat irregular in form, but the main body of the range is a broad, single ridge with an average crest altitude of 10,000 to 11,000 feet, comprising a forest-covered region of rounded glacier basins studded by hundreds of small lakes and scored by deep, straight glacier canyons. East of the Green River the central ridge is called the Escalante Hills, and these finally merge into the broad valley of the Little Snake River on the north and the rolling foothills flanking the Park Range on the east. This eastern part of the Green River Basin consists of open or comparatively plain country on the north, rolling hills and mountains on the south, and badly eroded plateaus on the southwest. It is drained by the Yampa and White Rivers, the principal tributaries of the Green River from the east.

Just south of Uinta Mountains, lying parallel and adjacent to them, is the Uinta Basin, a low synclinal valley drained by the Duchesne River and its tributaries on the west and the lower part of the White River on the east. The south rim of this basin is the Tavaputs Plateau, which is cut in twain by gorges of the Green River, the Canyon of Desolation and Gray Canyon. The eastern part is known as East Tavaputs Plateau; the western as West Tavaputs Plateau.

The district lying south of the Tavaputs table-land and east and south of the High Plateaus, extending far beyond the south limit of the Green River Basin, is designated by Powell [3] the Canyon Land of Utah. In its midst the Green empties into the Colorado, and the Price and San Rafael flow into the Green.

[3] Powell, J. W., Report on the lands of the arid region of the United States, 2d ed., p. 105, 1879.

As a result of these highly varied physiographic features, the Green River Basin is naturally divided into several minor basins which will be described in greater detail in the following pages, and for the purpose of this report will be designated the upper Green River Basin, the Yampa and White River Basins, the Uinta Basin in Utah, the lower Green River Basin, and the Green River canyons.

UPPER GREEN RIVER BASIN

GENERAL FEATURES

The country in the upper part of the basin below the Green River Lakes consists of smoothly sloping hills with broad bottom lands along the river. It is well grassed and partly timbered. The soil is gravelly, and the area is too high and cold for extensive agriculture; but it is good cattle range during the summer, and the bottom lands, which range in altitude from about 7,600 to 7,900 feet above sea level, serve as good natural pasture.

Just north of Horse Creek the country is mainly flat but is diversified to some extent by the remains of benches of a higher level; to the south it becomes more undulating and hilly, with buttes and bluffs that give it a more forbidding aspect. Patches of snow-white alkali occur here and there, and the sage becomes stunted. In the vicinity of the Piney Creeks there is a decided decrease in the amount of alkali, the country is more uniform, and the natural vegetation is better.

Below the mouth of Horse Creek the Green River flows through a bottom land from 1 to 2 miles wide, but narrowed in places by the advance of the bluffs. On the west side the bluffs average about 50 feet in height to a point opposite the mouth of the East Fork, where they rival in height those on the east side of the river, but they almost immediately break away and disappear, and at the bend where the Piney Creeks enter they are completely gone.

Toward the southwest the country becomes more broken. Great masses of plateau with clean, sharp-cut edges appear, and back of them is a prominent long mountain ridge, known as Labarge Mountain.

Between Labarge and Fontenelle Creeks the land rises into a plateau which is cut into shreds by erosion. This plateau extends down to the Green River, where it breaks off in a bluff. Near the mouth of Slate Creek the Green River emerges from between these bluff walls, 200 to 300 feet high, in which it has been confined below the mouth of Labarge Creek.

West of the river between Slate Creek and Hams Fork the country is scarcely broken except by dry watercourses and one or two lines of long bluffs.

On the east side of the Green River between the East Fork and Sandy Creek is a vast plateau about 30 miles wide and 60 miles long, entirely without water. It is not perfectly level but slightly rolling, rising and sinking in long swells and breaking off in bluffs to the Green River on the west edge. Sagebrush is abundant over this area, but grass is very scarce.

That part of the basin in Wyoming lying south of the town of Green River is strikingly different from the country to the north and has been graphically described by Powell: [4]

> On the cliffs about Green River City towers and buttes are seen, which are regarded by the passing traveler as strange freaks of nature. Limestones are interstratified with shales, giving terraced and buttressed characteristics to the escarpments of the canyons and narrow valleys.

South of Bitter Creek on the east side of the Green River is a district which is known as the Alcove Land.[5] On the east side it is drained by Little Bitter Creek, a tributary to Bitter Creek but a dry gulch much of the year. The watershed is an irregular line, only 2 to 4 miles back from the stream but usually more than 1,000 feet above it, so that the waters have a rapid descent, and every shower-born rill has excavated a deep, narrow channel.

> These narrow canyons are so close to each other as to be separated by walls of rock so steep, in most places, that they can not be scaled, and many of these little canyons are so broken by falls as to be impassable in either direction. The whole country is cut in this way into irregular, angular blocks, standing as buttressed benches, and towers about deep waterways and gloomy alcoves.

West of the Green River between Blacks Fork and Henrys Fork is a region of buff, chocolate-brown, and lead-colored badlands. Its outlines are everywhere rounded, as the rocks of which it is composed crumble quickly under atmospheric agencies. However, there is the same abrupt descent of the streams and the same elaborate system of water channels as in the Alcove Land. The loose, incoherent sandstone, shale, and clay are carved by a network of intermittent streamlets into domes and cones, with flowing outlines. "But still there is no vegetation, and the loose earth is naked." Here and there a thin stratum of harder rock is evident by the shelves or steps upon the sides of the hills.

> Traces of iron and rarer minerals are found in these beds, and on exposure to the air the chemical agencies give a greater variety of colors, so that the mountains and cones and the strange forms of the badlands are elaborately and beautifully painted; not with delicate tints of verdure, but with brilliant colors, that are gorgeous when first seen but soon pall on the senses.

PRINCIPAL STREAM [6]

The Green River is one of the largest streams in Wyoming. It rises in the glaciers and numerous small lakes on the western slope of the Wind River Range, near the Continental Divide. The source

[4] Powell, J. W., Exploration of the Colorado River of the West and its tributaries, 1869–1872, pp. 151–152, 1875.

[5] Idem, p. 151.

[6] Hayden, F. V., U. S. Geol. and Geog. Survey Terr. Eleventh Ann. Rept., pp. 525–532, 1877.

is in an extremely rugged area, with snow-capped peaks rising to altitudes of more than 13,000 feet and deep, precipitous intervening gorges. Trail and Wells Creeks unite to form the main stream, and for the first 25 miles of its course it flows northwestward through the beautiful Green River Lakes; then it turns south and continues in that direction to the Utah line. Above the Green River Lakes the canyon is a narrow rock-bound gorge, which gradually widens out to the vicinity of Kendall. From this place the stream runs through a rolling plateau as far as Daniel, passing through a short canyon about 4 miles long, cut in rolling hills southeast of Aspen Ridge, 15 miles north of Daniel. The larger tributaries entering the stream above Daniel are Roaring Fork and Wagon, Tepee, Rock, Gypsum, Twin, and Beaver Creeks, all of which rise in the high mountains.

At Daniel the run-off from a portion of the Absaroka Ridges is brought in by Horse Creek, which flows to the east and for 4 or 5 miles above its mouth parallels the Green River in the same broad bottom land. Both streams in their parallel courses are sluggish and winding, with many sloughs, channels, and islands.

About 3 miles below the mouth of Horse Creek the Green River turns from an easterly course to the south, with increased velocity. Thence down as far as the mouth of Slate Creek it is bordered on the east by a bench plateau 200 to 300 feet above the channel, in some places breaking off in a precipitous bluff and in others descending by easy slopes to the river, with its edge in most places 2 or 3 miles back from the stream.

About 30 miles downstream from Daniel the East Fork, the largest tributary of the upper Green, joins the main stream, carrying the run-off from the entire mountainous area that forms the northeastern rim of the basin from Green River Pass for 40 miles to the southeast.

At 2 miles below the mouth of the East Fork the Green River makes a right-angle turn to the west, and about 4 miles farther downstream it makes another turn to the south and receives the run-off from Muddy Creek and North, Middle, and South Piney Creeks, all entering from the west. From South Piney Creek to the town of Green River, Wyo., the stream takes a southerly course through broad bottoms covered with groves of cottonwood. Labarge, Fontenelle, and Slate Creeks, all relatively small streams, enter from the west. The waters of Slate Creek are alkaline. Sandy Creek also enters in this stretch; it comes in from the east and drains the mountainous and plateau area that forms the southern part of the east rim of the basin in Wyoming.

Below the mouth of Sandy Creek the slope of the river is rather flat, and its course is tortuous, until it enters the deep canyon gorges through the Uinta Range, 69 miles below the town of Green River.

About 2 miles below the town, Bitter Creek empties into the Green from the east, carrying the run-off from the Leucite Hills, northeast of the town, and from the Aspen Mountains and bad-land area to the southeast. About 30 miles farther downstream Blacks Fork enters from the west, draining the east slopes of the Bear River Range and a small portion of the north slopes of the Uinta range. Hams Fork, the principal tributary of Blacks Fork, joins that stream at Granger, and from this place the Oregon Short Line Railroad, leaving the main line of the Union Pacific, follows Hams Fork upstream as far as Kemmerer where it crosses the divide into the Bear River drainage basin. About 3 miles below the Utah-Wyoming State line Henrys Fork enters from the west, carrying the run-off from a portion of the north slopes of the Uinta Range.

GREEN RIVER TRIBUTARIES

The principal tributaries to the Green River in its upper basin in downstream order along the river are Horse and Cottonwood Creeks from the west; the East Fork from the east; North, Middle, and South Piney Creeks, Labarge Creek, and Fontenelle Creek from the west; Sandy Creek from the east; and Blacks Fork and Henrys Fork from the west.

Horse Creek rises on the eastern slope of the Wyoming Range at about 9,500 feet above sea level. It is a relatively small spring and snow fed stream with a flashy run-off during May, June, and July but a very low steady flow during the rest of the year. In the upper 16 miles of its course it flows through a deep canyon; for the remaining 20 miles it flows southeastward across the broad Green River Valley to its junction with the Green River near Daniel. Its drainage basin comprises about 195 square miles of rolling hills and mountains, well grassed and timbered. All the small affluents of the stream are collected into two main branches in the valley behind the basin rim. These two branches break through the rim and unite in the basin several miles above the mouth of the creek.

Cottonwood Creek, apparently the same as Marsh Creek of the Hayden Survey,[7] drains about 258 square miles of mountainous area on the eastern slopes of the Wyoming Range, rising at an altitude of 10,000 feet. It is formed by its North and South Forks, which unite about 10 miles southwest of Daniel, after emerging from their deep canyons to the west, beyond the edge of the valley. From this junction the creek flows southeastward in a shallow trough and joins the Green River about 15 miles south of Daniel. Beginning at a point 6 miles below the junction of the two forks, the creek divides into two parallel channels 1 mile apart and 9 miles long. These channels reunite 6 miles above the mouth of the creek. Both the North and South Forks in the upper parts of their courses flow through steep

[7] Hayden, F. V., op. cit., p. 528.

canyons until they reach the Green River Valley, and their flow is contributed by many small tributaries within the mountain area.

The East Fork is the largest tributary of the Green River above Green River, Wyo. It drains a part of the western slope of the Wind River Range extending from Fremont Peak on the north to Twin Buttes on the south, a distance of 45 miles. The run-off from the greater part of this drainage area is carried by the New Fork River, the main tributary of the East Fork. The source of the New Fork River is in the region of innumerable small glacial lakes immediately west and south of the headwaters of the Green River, at an altitude exceeding 11,000 feet. The New Fork River rises in a chain of these small lakes and flows southwestward 9 miles to the New Fork Lakes, which cover an area of about 2 square miles and are 7,700 feet above sea level. These lakes rest on a glacial plateau which flanks the Wind River Mountains and extends for a distance of about 30 miles southward, having a width of 3 to 5 miles, and from which there is an abrupt drop to the main valley floor of the New Fork River. Below the New Fork Lakes the stream has cut a channel through the outer edge of this plateau and descends rapidly until it reaches a point about 2 miles from the lakes; then it turns abruptly to the southeast and continues in that direction on a very much flatter grade to its confluence with the East Fork. From this point the course of the East Fork is southwestward to its junction with the Green River, near Big Piney. A number of tributaries enter the New Fork River along its course. In order of their position downstream the main ones are Willow, Pine, Pole, and Boulder Creeks. Like the New Fork River, all these streams rise in a number of small lakes on the western slope of the Wind River Range and flow through lakes on the plateau above mentioned. Each stream falls rapidly as it drops from the plateau lakes to the New Fork River bottoms.

North, Middle, and South Piney Creeks, with respective drainage areas of 129, 112, and 110 square miles, rise in the Absaroka Ridges, the southern extension of the Wyoming Range and flow eastward through short canyons to the undulating floor of the Green River Valley, thence in shallow depressions across the valley, finally joining the river near Big Piney. All the streams receive numerous small tributaries in the mountainous part of their courses but practically no perennial run-off after leaving the mountains. These streams are apparently the same as those designated White Clay, Bitterroot, and Piney Creeks, respectively, by the Hayden Survey [8] in 1877.

Labarge Creek has a drainage area of 198 square miles. It rises at an altitude of 9,000 feet on the east slopes of the Absaroka Ridges, flows southward until it reaches the valley floor and thence eastward 10 miles to its confluence with the Green River. After leaving the

[8] Hayden, F. V., op. cit., p. 527.

mountains, through which it flows in a narrow valley between the ridges, it is bordered on the north by low, flat country and on the south by a plateau area that separates it from Fontenelle Creek. This plateau surface is virtually shredded by erosion.

Fontenelle Creek drains a mountainous area of 239 square miles. It was named after one of the best known of the early fur traders of this region. Its course is southeasterly through a narrow valley bordered on each side by low bluffs, which rise to the level of a sage-covered plateau. Several small tributaries empty into the stream in the mountains, but no perennial tributaries enter below the mountains.

Sandy Creek is the only perennial tributary of the Green River from the east between the East Fork and the Utah line, a distance of nearly 200 miles. It rises in the Wind River Mountains and drains about 100 square miles of country between the basin of the East Fork on the west and the North Platte River on the east. The source of Sandy Creek consists of a number of small lakes between 9,000 and 10,000 feet above the sea, and from these the stream flows in a southerly direction, leaving the mountains and joining the Green River in the southern part of T. 22 N., R. 109 W. Below the mountains Sandy Creek receives but one tributary, Little Sandy Creek. Aside from the very small mountainous area, the basin is a generally level plateau. The stream leaves the mountains as a full-grown river and immediately turns to the south, flowing down the east side of the valley close to the base of the mountains.

Blacks Fork, one of the chief tributaries of the Green, is the only perennial stream that enters between the mouth of Sandy Creek and the Utah State line. It drains a large area in the southwest corner of Wyoming, extending from the south end of Meridian Ridge of the Wyoming Range, on the north, to the Uinta Mountains on the south, and from the basin of the Bear River, which includes a narrow strip adjacent to the Utah line on the west, to the Green River on the east. Blacks Fork rises on the northern slope of the Uinta Range at the base of Tokewanna Peak and Mount Lovenia, which stand 13,200 and 13,250 feet respectively above sea level. It flows northeastward as far as the Union Pacific Railroad 15 miles west of Granger where it is joined by Muddy Creek. From this point it flows east for 30 miles, then turns south and pursues a winding course to its mouth, about 16 miles south of the town of Green River. The only perennial tributaries besides Muddy Creek are Smith Fork, which enters from the south about 12 miles above Muddy Creek, and Hams Fork, which enters from the north at Granger.

Henrys Fork drains 644 square miles of the north slope of the Uinta Range in Utah and Wyoming. It rises just east of Blacks Fork at the foot of Gilbert Peak, which stands at an altitude of 13,422 feet. The source consists of a number of small glacial lakes, and from these the stream flows a little east of north through a rugged canyon for at least 15 miles. At the lower end of the canyon a narrow gateway through the hogback ridges at the foot of the flanks of the mountains opens into a broader, more open canyon, which eventually merges into the rolling plain that forms the lower part of the basin. Near Lonetree, Wyo., Henrys Fork swings eastward for about 30 miles, then southeastward, crosses into Utah and empties into the Green River 3 miles south of the State line. Its principal tributaries are Beaver Creek and Burnt Fork.

YAMPA AND WHITE RIVER BASINS

GENERAL FEATURES

The basins of the Yampa and White Rivers comprise the entire northwest corner of Colorado, a small part of southern Wyoming, and a small part of eastern Utah. They are treated together because they have similar characteristics and because certain irrigation projects contemplate the use of the waters of the White for irrigating lands in the Yampa Basin.

The foothills of the Park Range lie along the east side of this area; the north side merges into the broad open country of the Green River Basin in Wyoming; the east end of the Uinta Mountains occupies the northwestern part; and the White River Valley lies along its southern border, extending westward into the Uinta Basin. The combined area of these two basins is about 12,830 square miles, 7,950 square miles in the Yampa River Basin and 4,880 square miles in the White River Basin. The altitude ranges from 4,640 feet at the mouth of White River to 14,000 feet at the crest of the Rocky Mountains, on the eastern boundary. Some portions of this area consist of open or comparatively level country, but much of it is made up of rolling hills flanking those higher portions which may properly be called mountains.[9]

Besides the east end of the Uinta Mountains, several other prominent topographic features lie within the area. The Danforth Hills rise between the Yampa and White Rivers in the eastern part; the Yampa Plateau and Midland Ridge are conspicuous features of the southwestern part; and Juniper and Cross Mountains, two isolated hills east of and in line with the Uinta Range, rise abruptly out of the basin or broad valley through a part of which the Yampa River flows and which has been designated Axial Basin.[10] Southwest of the Yampa Plateau and extending westward to a point beyond the Green River are the Yellow Hills, a group of low, rounded, naked hills carved from the yellow clay and shale that constitute the ground surface.

[9] White, C. A., On the geology and physiography of a portion of northwestern Colorado and adjacent parts of Utah and Wyoming: U. S. Geol. Survey Ninth Ann. Rept., p. 684, 1889.

[10] Idem, p. 684.

Some of the shale is slate colored, and some is pink, with soft and delicate tints. A network of wet-weather channels descends rapidly toward the Green River, and the intervening hills are entirely destitute of vegetation. South of the Yellow Hills and separated from them by a well-defined ridge is a broad stretch of red and buff bad lands which extend southward beyond the White River and constitute the lower part of the White River Basin. Beyond the river the alcove structure appears, somewhat like that in the Alcove Land, near Green River, Wyo., and this district was named "Goblin City" by a member of Powell's party.[11]

PRINCIPAL STREAMS

The Yampa River is a striking example of the seeming disregard of favoring conditions of location that is more or less characteristic of the Green River at several places along its course. The Yampa is fed by numerous small tributaries that drain the western slopes of the Park Range. Its upper course is turbulent for many miles through rocky defiles and narrow valleys. After emerging from the foothills it traverses the open country that lies toward the west, its general direction being toward the east end of the Uinta Range and along the greater part of the length of Axial Basin. Juniper and Cross Mountains lie directly in the way of the stream, and around these mountains are low-lying lands through which the stream might have gone with apparent ease. But upon reaching Juniper Mountain the river cut its way by a short canyon through the hard rocks that form the northern flank of the mountain, instead of swerving a little and passing around the mountain. This canyon is about 2½ miles long, and its walls are only a few hundred feet in maximum height above the stream bed. For 32 miles after leaving Juniper Canyon the river flows through the rolling sage-covered prairie lands of Axial Basin to Cross Mountain, through which it cuts another canyon in a similar manner. This canyon is about 3 miles long and is a narrow defile with almost vertical rock walls, which reach a maximum height of about a thousand feet or more above the low land at each end of the canyon. For 11 miles below Cross Mountain Canyon the river has a peaceful course through Lily Park, which is a broadening of the valley, and here it receives the waters of the Little Snake River, the last tributary of any importance. Then, instead of joining the Green River by way of the low land at either the north or the south side of the Uinta Range, it enters the east end of the range, and the remainder of its course is through the narrow Blue Mountain Canyon, which extends westward 45 miles through the upturned strata of the Uinta Range and joins the canyon of the Green River near the Colorado-Utah line.

[11] Powell, J. W., Exploration of the Colorado River of the West and its tributaries, 1869-1872, p. 167, 1875.

The Yampa River has three principal tributaries, the Elk River, Williams Fork, and the Little Snake River, and numerous smaller ones, many of which are only wet-weather streams.

The Elk River rises in the Hahns Peak region about 25 miles north of Steamboat Springs, Colo., flows southward through the once famous Hahns Peak placer-mining district [12] and a broad agricultural valley, and empties into the Yampa River near the settlement of Brookston.

Elkhead Creek joins the Yampa about 6 miles above Craig, and Fortification Creek enters at Craig. Both of these streams rise in the Elkhead Mountains, to the north, and flow southward through a rolling prairie region.

A few miles below Craig Williams Fork, the principal tributary from the south, empties into the Yampa. It rises on the White River Plateau just west of Pyramid Peak and flows northward and northwestward, skirting the south side of the Williams Fork Mountains, to its junction with the Yampa.

The Little Snake River rises in the Hahns Peak region just north of the headwaters of the Elk River. Its drainage basin covers about 3,700 square miles, or nearly half of the entire Yampa River Basin. It flows northwestward for about 20 miles, turns westward and follows roughly the Colorado-Wyoming line, crossing it several times in the next 45 miles, and finally swings to the southwest and maintains this course to its junction with the Yampa at Lily, a distance of about 50 miles. Along the upper course of the stream a number of small perennial tributaries enter, but in the lower 50 to 60 miles all the tributary drainage channels are dry except during wet weather, and much of the flow of the river itself is lost in the sandy stretches of its bed.

The White River has its principal headwaters in the wooded "flat tops" of the White River Plateau immediately south of the headwaters of Williams Fork of the Yampa. Its drainage basin covers about 4,880 square miles and lies just south of the Yampa River Basin. The divide between the two basins is formed by the Danforth Hills on the east and the Yampa Plateau on the west. In its upper course the White River is normally a clear mountain stream, but from Agency Park down the water rapidly becomes muddy. Agency Park contains the largest expanse of irrigable bottom and terrace lands along the White River and is the center for the main settlement of that region. The old Ute or White River Indian Agency was situated on the river bank at the extreme upper end of the park, about 8 miles above the present town of Meeker. Coal Creek, the only perennial tributary of the White River in the park, enters from the north, but its waters are usually all taken

[12] Gale, H. S., The Hahns Peak gold field, Colorado: U. S. Geol. Survey Bull. 285, pp. 28–34, 1906.

out for irrigation before it reaches the river. Sulphur Creek and Curtis Creek also enter the park from the north, but their channels are usually dry. Flag Creek, entering from the south, usually dries up or is diverted for irrigation as it enters the open valley. Not far west of Meeker the White River passes through the Grand Hogback in a short, rather broadly open canyon, and the valley again broadens into Powell Park, named for Maj. J. W. Powell. This park is smaller than Agency Park but, like it, has a number of channels entering from the north and the south, tributary to the river but dry during the summer. Below Powell Park the river flows in a moderately wide open valley bordered by almost continuous bluffs. Cottonwoods grow in clumps along the river banks, and the river flats are green. A scattering growth of piñon or cedar covers the higher slopes on the hillsides, and natural monuments and pinnacles, commonly eroded in fantastic shapes and positions, are picturesque features in the landscape. The territory drained by the northern tributaries of White River below Powell Park is composed of bad lands drained by Crooked Wash or Coyote Basin and the valleys of Wolf Creek and Red Wash with numerous other small washes. From the south the extensive drainage basins of Piceance and Yellow Creeks and other smaller streams from the Roan or Book Cliffs Plateau pour their alkaline waters into the main stream. During the spring and early summer and at frequent intervals in the summer the brief and violent storms that are characteristic of this region cause all of this lower tributary drainage to empty a great volume of thick muddy water into the main channel, so that the river seldom runs clear for long at a time in its lower course. After leaving Raven Park, a rather broad valley in which the settlement of Rangely is situated, the river passes through a stretch of barren, desolate land for about 55 miles and empties into the Green River in Utah a short distance below the mouth of the Duchesne River and about 35 miles west of the Colorado-Utah line.

UINTA BASIN IN UTAH

GENERAL FEATURES

The name "Uinta Basin"[13] geologically includes all the territory extending eastward from the Wasatch Mountains to the White River Plateau, 60 miles east of the Colorado-Utah line, and bordered on the north by the Uinta Mountains, the Yampa Plateau, and the Danforth Hills and on the south by the summit of the Roan or Book Plateau. Its entire length from east to west is about 170 miles, and the maximum width from north to south is a little over 100 miles, along a line that practically coincides with the one hundred and tenth meridian.

[13] Eldridge, G. H., The asphalt and bituminous rock deposits of the United States: U. S. Geol. Survey, Twenty-second Ann. Rept., pt. 1, pp. 331-340, 1901.

The Green River divides the basin into east and west halves and has cut for itself, except in the 80 miles of its meandering course across the interior depression, canyons from 1,000 to nearly 3,000 feet deep, which are wholly impassable except by boat at great risk. In the center of the basin the Green receives from the east and west, respectively, the White and Duchesne Rivers. The White enters the open valley about 12 miles above its confluence with the Green River, after a tortuous course through the bad lands along its lower reaches. The valley of the Duchesne River is open for 50 miles above its mouth, the bluffs being low and the channel bordered for most of the distance by rich bottom lands from 1 to 2 miles wide. North of this stream the uplands, particularly in the vicinity of the Uinta River and Lake Fork, afford extensive areas that are both arable and irrigable, and these under ditch have already given evidence of great productivity. The White and Duchesne Rivers have a comparatively large yearly run-off, but the water from the Uinta Range is of much greater purity than that carried by the White River. East of the Green River very little water enters the Uinta Basin from perennial sources, and the center of the basin becomes almost arid.

The south half of the basin, especially that portion east of the Green River and much of the White River Basin, presents a scene of great desolation. Canyons of labyrinthine intricacy have been cut to depths of hundreds of feet in the strata forming the Roan or Book Plateau, and the intervening ridges are sharp and crumbling, developing spires and buttes and castellated forms in greatest profusion, all seemingly ready to topple to pieces at the first heavy storm. Only a little water is carried in any of these gorges, and this, except at their heads, runs through the sands of their channels instead of as surface flows. It is, moreover, frequently impregnated with alkali, which abounds in all the formations of the locality. Because of this dissimilarity in the physiographic features of the two halves of the Uinta Basin and the industrial development of the western half resulting from its situation and topography, the name Uinta Basin is popularly applied only to this western half, all of which is in Utah, and for the purpose of this report it is designated the Uinta Basin in Utah.

UINTA RANGE

The Uinta Range is one of the few in the whole Cordilleran system of the United States that has an east-west trend. In both its physical features and its geologic structure it is characterized by a grand simplicity and regularity. Its extreme length is about 150 miles. The eastern third is somewhat irregular in form and not so picturesque as the western portion.

The greater part of the Uinta Range[14] lies in northeastern Utah and is the source of all the principal streams in the basin. The range has an average width of about 35 miles and extends eastward from the Wasatch Mountains to the Little Snake River. At its west end it is only about 25 miles wide; at its east end, in the vicinity of the Green River, it is nearly twice that width. Through the greater part of the range in Utah the width from the north to the south flank of the mountains is nearly 35 miles. Most of the range west of the Green River, which comprises all the more rugged portions, is included in the Ashley and Uinta national forests. The south side of this range, embracing the area drained by the Duchesne River and tributaries, from the headwaters of the Duchesne east to the tributaries of the Whiterocks River, was formerly included in the Uinta Indian Reservation.

In general form the range is an elongated broad, flat-topped arch in which the main east-west divide is nearer the north flank, so that a north-south profile shows an asymmetric outline. The culminating peaks and ridges lie for the most part along the north side of the broad summit of the arch, although some of them as Mount Emmons, Leidy Peak, and Marsh Peak, lie near the middle or on the south side. The plateaulike summit in many places has been deeply dissected and eroded into jagged peaks and ridges at whose bases lie immense amphitheaters that widen out and then close into deep canyons, carved through the upturned beds which form the slopes. The central part of the range along the anticlinal crest is formed of nearly horizontal strata, buried at many places beneath glacial material in which numerous lakelets and ponds still remain, held in their rocky basins by accumulations of débris. A great part of this region is occupied by grassy parks, open meadows, and forest-covered areas, above which the barren peaks rise in bold escarpments.

The northern flank of the range slopes off steeply from this central area to a great undulating basin, of which all except the west end forms a portion of the Green River Basin in Wyoming; the southern flank slopes much more gently to an extensive plateau region and thence into an undulating basin similar to the one on the north. These slopes have been deeply incised by the streams that drain the central area. In many places the streams have cut channels with increasing depth until they flow in canyons from 1,000 to 2,000 feet deep. The general surface features on the north and south sides of the range are rough and are made up of many minor irregularities. Many of the slopes of the highlands are dissected into a large number of small valleys; others are gentle plains on one side and have steep escarpments on the other. Generally the surface consists of ridges or

---

[14] Schultz, A. R., A geologic reconnaissance of the Uinta Mountains, northern Utah: U. S. Geol. Survey Bull. 690, p. 36, 1919.

hogbacks produced by the unequal erosion of upturned alternating beds of hard sandstone and soft shale.

On the south side of the range in the longitude of Vernal the altitude of the higher plateau ranges from about 8,000 feet at the front to about 9,000 feet where it merges with the old mountain topography of the central portion of the range. Farther west the altitude reaches 10,000 feet or more. This feature has been described for a part of the southwestern portion of the range by Lupton.[15]

The top of the plateau sloping gently from the mountains is an old erosion surface that has beveled all the formations regardless of their hardness or position. Near the mountain margin the more resistant strata form low ridges bounding longitudinal valleys that occupy the areas of softer rock. This surface has been covered by a mantle of coarse gravel composed largely of pebbles and boulders of red sandstone from the central portion of the range. Near its outer margin the plateau is cut by deep canyons, few of which reach completely across the plateau, so that east-west travel along the base of the range is comparatively easy, whereas along the front of the plateau it is practically impossible. At several lower levels there are broad gravel-covered bench lands, open valleys, and small inclosed basins along the principal streams, and these tracts are extensively used for agriculture. All that portion of the range west of a north-south line passing through the Green River at the mouth of Henrys Fork has been surveyed topographically by the United States Geological Survey, and for topographic details the reader should consult the Marsh Peak, Gilbert Peak, Hayden Peak, Coalville, Strawberry Valley, and Vernal topographic maps.

All the great canyons of the Uinta Mountains head near the crest of the range and descend to the north or to the south. The streams flowing to the south constitute the chief source of water supply for the Uinta Basin. As the axis of the range is nearer the north than the south margin, the canyons on the north slopes are shorter than those on the south slopes. All the larger canyons have the characteristic U shape due to glaciation. Their upper portions have been well cleaned out by the ice, but their middle and lower portions contain heavy morainic deposits. The streams in these canyons flow with the dip of the strata, and as they have lowered their beds, receiving considerable help from the glaciers, they have come to flow across the truncated edges of the layers in the great Uinta fold.

The higher central portion of this fold is now sculptured into a series of peaks, many of which rise 12,000 to 13,000 feet above sea level, and into narrow spurs which project into the basin region and divide it into a large number of cirques. In the western part of the

[15] Lupton, C. T., The Deep Creek district of the Vernal coal field, Uinta County, Utah: U. S. Geol. Survey Bull. 471, p. 582, 1912; The Blacktail Mountain coal field, Wasatch County, Utah: Idem, p. 601.

range, where the hard quartzite is common, occur sharp castellated forms similar to those in the Grand Canyon of the Colorado.

PRINCIPAL STREAMS

The Duchesne River and its tributaries drain most of the Uinta Basin in Utah. The main stream is formed by the junction of its North and West Forks at Stockmore, in the northwestern part of the basin. The North Fork rises in several small glacial lakes at the base of Bald Mountain and Mount Agassiz, two prominent peaks which are 11,947 feet and 12,433 feet respectively above sea level. The lakes are from 10,000 to 11,000 feet in altitude, and from them the stream descends rapidly in a southerly course through a glacial canyon to its junction with the West Fork. The West Fork rises at the base of Heber Mountain, in the Wasatch Range, and flows almost due east for about 20 miles. It rises at a lower altitude than the North Fork; its canyon is also much broader, and the topography is less rugged.

From Stockmore Duchesne River flows southeastward through a broad canyon bordered on both sides by high cedar-clad ridges. About 22 miles below Stockmore Rock Creek enters the main stream from the north, and the canyon broadens out as the river skirts along the west base of the Blue Bench and swings southward to the town of Duchesne. Here the Strawberry River enters from the west, and the main stream takes an easterly course for the next 35 miles through a broad valley following the general direction of the trough of the Uinta Basin syncline. In this stretch the stream receives Lake Fork, another important tributary from the north, entering near the town of Myton, and Cottonwood and Antelope Canyons on the south contribute uncertain and intermittent flows.

Near Randlett the Uinta River empties into the Duchesne from the north, and the main stream again turns to the southeast and finally reaches the Green River a short distance below Ouray. No important tributaries enter below the Uinta.

Rock Creek is the first important tributary to enter the Duchesne below Stockmore. It rises in a broad, flat-bottomed, amphitheatral basin, bounded by precipitous walls and containing 20 or more glacial lakes, among which is the famous Grandaddy Lake. The catchment basin is immediately east of that of the North Fork of the Duchesne River and has an average altitude of about 10,000 feet above sea level. It is heavily wooded where there is sufficient soil to permit timber growth, but it has been so well cleaned out by glaciation that there are now continuous areas, square miles in extent, where there is not sufficient loose material for trees or shrubs to gain a footing. For the first 14 miles of its course the stream flows nearly due south in a sharp inner gorge, such as is characteristic of the canyons of the south slope of the Uinta Range. In this stretch it is joined by the East and West Forks about halfway down and by the Southwest Fork near the mouth of this canyon. Here the course is changed from almost south to southeast and, about 10 miles farther down the stream, reaches the margin of the range, and the canyon gives way to a broad valley. Through this valley the grade of the stream flattens, and numerous beaver ponds are to be seen. Upon leaving this valley the course is southward through a broad canyon for 15 miles to the Duchesne. This canyon is bordered on its west side by Farm Creek Mountain and on its east side by a high, broken plateau, which slopes southeastward toward Lake Fork and is known as the Purple and Blue Bench country.

The Strawberry River with its tributaries drains the southwestern portion of the Uinta Basin. It rises along the east slopes of the Wasatch Range just south of the headwaters of the West Fork of the Duchesne. Its catchment basin is a rolling plateau that drains from the west, north, and east into Strawberry Valley, the lower part of which has been converted into a reservoir by the United States Bureau of Reclamation to store water for use in irrigating lands in the Utah Lake Valley west of the Wasatch Range. The capacity of this reservoir is 250,000 acre-feet, and the water is diverted from its original drainage basin to the Great Salt Lake drainage basin through a tunnel 19,900 feet long leading from the west side of the reservoir under the divide. With this development already taking much of the Strawberry River water out of the basin, it is obvious that any further development along the river must be limited to the surplus water of the stream, which is an uncertain quantity, although during some years more water flows into the Strawberry Reservoir than it will hold, and the surplus passes down the river. The Strawberry Dam is built in what is known as "The Narrows," where the river enters its canyon after leaving Strawberry Valley. For about 2 miles below the dam the course of the stream is south and then it makes a sharp turn to the east and flows in this direction for about 38 miles to its confluence with the Duchesne River at the town of Duchesne. The Strawberry River Canyon is broad, with flat bottom lands which are farmed wherever the soil conditions are favorable.

Nearly halfway between Strawberry Valley and Duchesne Currant Creek empties into the Strawberry River from the north. This stream, with its main tributary, Red Creek, drains much of the territory lying between the Strawberry and Duchesne Rivers and is the only large tributary entering on the north side of the river. The flow of Currant Creek is flashy, however; the channel may be overflowed because of a thunderstorm over its basin, and within a few hours it may be practically empty. From the south a number of tributaries enter the Strawberry River from canyons that lie nearly parallel to one another in a northeasterly course, but none of them carry much water. All of them are very muddy in the wet season or during local thunderstorms, but the natural low-water flow is negligible.

Lake Fork is formed by its two main branches, the West Fork and the East or Yellowstone Fork, which unite a few miles south of the margin of the Uinta Range. The West Fork rises just east of Rock Creek, in a number of small glacial lakes at the base of Mount Lovenia, which stands at an altitude of 13,250 feet. The catchment area is broad, open, and flat bottomed, with many marginal cirques, characteristic of all the basins on the south slope of the Uinta Range. For 7 or 8 miles below the catchment area the stream occupies a narrow rocky inner gorge, beyond which the canyon widens into a broad U-shaped valley. Moon Lake occupies the head of this valley, and about 10 miles below the lake the two forks unite. The East Fork also rises in glacial lakes, at the base of Wilson Peak and Kings Peaks immediately east of the catchment basin of the West Fork. Wilson Peak rises to an altitude of 13,095 feet, and the two Kings Peaks are the highest points in Utah, 13,496 and 13,498 feet above sea level. Most of the lakes that drain into the East Fork lie above 11,000 feet. The stream flows southeastward for about 20 miles through a very rugged canyon, and about midway down its canyon Swift Creek, a rather large tributary, comes in from the east. A smaller stream enters from the west a little farther down. After leaving the canyon, the East Fork flows a little west of south through a broad open valley to its confluence with the West Fork. From this point Lake Fork in its southeasterly course to the Duchesne flows through about 25 miles of broad flat-bottomed canyon, bordered on both sides by sloping, irrigated bench land.

The Uinta River rises on the east slope of the Kings Peaks and drains the south slope of the Uinta Mountains for about 15 miles east of these peaks. It has the largest catchment area of all the Duchesne River tributaries. The main basin is a broad open region, with comparatively slight relief. Several headwater streams wander from lake to lake or meadow to meadow, collecting the water from the melting snow and rains. At the lower margin of the main basin these headwater tributaries unite to form one stream which enters the rugged inner gorge of the Uinta Canyon. This inner gorge reaches a maximum depth of 100 feet in about 4 miles and dies out in another 2 miles. The entire length of the canyon is about 20 miles, and it finally gives way to the broad open country beyond the margin of the range. After leaving the mountains the Uinta receives Pole, Farm, and Whiterocks Creeks from the north and east. Below the mouth of Whiterocks Creek the river flows through a broad, gently sloping valley to its confluence with the Duchesne near Randlett. In this lower stretch of about 25 miles Deep Creek comes in from the east and Dry Gulch Creek from the west. Both of these streams, however, are virtually wet-weather streams, their catchment basins being the broken plateaus on each side of the Uinta River.

The Whiterocks River is the largest tributary of the Uinta River. It rises in a number of glacial lakes near the crest of the Uinta Range, just east of the catchment basin of the Uinta. Its course is south and southeasterly for about 15 miles through a deep, rugged canyon which opens through a narrow gateway out upon the terraced lowlands, where the stream joins the Uinta River near the Indian agency at Whiterocks.

Ashley Creek with its West Fork, locally known as Dry Creek, drains the south slopes of the Uinta Range for about 18 miles east of the Whiterocks catchment basin. The floor of its catchment area is more than 10,000 feet above sea level and is hemmed in by walls that rise in places over 2,000 feet higher. The main stream rises in a number of small branches that drain the small glacial lakes at the headwaters. It takes a southerly course through a deep, rocky canyon which has in places almost vertical rock walls, and finally leaves the mountains to enter the Ashley Valley about 8 miles north of the town of Vernal. Passing through this valley and continuing in its southerly course for about 22 miles farther, the stream finally empties into the Green River a few miles below Jensen. With the exception of Ashley Valley this area between the Uinta and Green Rivers is exceedingly broken; the bad lands and hogbacks are literally shredded by deep, precipitous canyons.

Dry Creek rises in an open amphitheatral area just south of the crest of the Uinta Range and about 4 miles west of Leidy Peak. The stream is about 28 miles long and for 23 miles of its course flows through a steep, narrow canyon from 500 feet to half a mile in width, cut through artistically tinted sandstone. Both Ashley Creek and Dry Creek at some points in their canyons sink into their channels during the low-water season, and the stream beds are dry for some distance below these points, the water coming to the surface lower down.

Brush Creek empties into the Green River a short distance above Jensen, but its flow is small, and during the irrigation season it is all diverted for use on lands around Jensen.

Bad Lands Creek and Cliff Creek are two small wet-weather streams that drain some of the bad land territory lying between Green River and the Colorado-Utah line north of the White River. They empty into the Green River from the east.

LOWER GREEN RIVER BASIN

GENERAL FEATURES

The lower Green River Basin is all in eastern and southeastern Utah. South of the Uinta Basin, as considered in this report, are the twin East and West Tavaputs Plateaus,[16] separated by the Green River. The East Tavaputs Plateau culminates at the Roan or Brown Cliffs, where bold southward-facing escarpments are presented. From the Brown Cliffs northward the plateau dips gently north to the Uinta Basin, and the crest of the cliffs is the south rim of that basin and east of Thompsons forms the divide between the Green River and Colorado River Basins in Utah. The bad land cliffs mark the divide between the Uinta Basin and the West Tavaputs Plateau, and toward the south this plateau drains into the Price River.

West of the Tavaputs Plateaus and southward beyond the limits of the Green River drainage basin the Wasatch Plateau forms the divide between the waters that flow into the Colorado River Basin on the east and those that flow into the Great Basin on the west. Away to the east is a district traversed by many deep canyons, which is generally spoken of as the bad lands but was designated by Powell the Canyon Land of Utah. Within this region the Green empties into the Colorado near the southeast corner of Wayne County, Utah, about 20 miles below the Orange Cliffs.

The Denver & Rio Grande Western Railroad crosses the lower Green River Basin in its route between Salt Lake City and Denver. An interesting description of the geographic and geologic features along the route, interspersed with items of interest in civic development and references to significant epochs in the record of discovery and settlement, is given in United States Geological Survey Bulletin 707.

PRINCIPAL STREAMS

No streams of importance enter the Green River from the east below the White River. Willow Creek, which geologically lies within the Uinta depression, drains a large part of the East Tavaputs Plateau, rising on the crest of the Roan or Brown Cliffs a few miles north of Thompsons station on the Denver & Rio Grande Western Railroad and flowing nearly due north for about 60 miles to its junction with the Green River a few miles below the mouth of the White River. This stream drains a barren region of light precipitation, and the flow is accordingly very uncertain. The principal streams entering the Green River in its lower basin are the Price and San Rafael Rivers, both of which rise on the east slopes of the Wasatch Plateau and drain the region west of the Green River.

---

[16] Powell, J. W., Report on the lands of the arid region of the United States, p. 93, 1878.

The Price River rises in the angle formed by the intersection of the Wasatch and West Tavaputs Plateaus and receives tributaries from both. The main stem of the stream is formed by the junction of Fish and White Creeks at Colton, a station on the Denver & Rio Grande Western Railroad. Its course is southeasterly through a deep rugged canyon to a point within a few miles of Price, where it crosses the north end of Castle Valley, and thence it flows through broken country near the foot of the Book Cliffs, along the southern boundary of the West Tavaputs Plateau, to a point within 20 miles of the Green River, cuts through these cliffs into the Beckwith Plateau, and joins the Green a few miles above the foot of Gray Canyon, 18 miles up the river from Green River, Utah. The principal source of the perennial flow of the Price River is Fish Creek, which with its tributaries drains the wooded slopes of the Wasatch Plateau in the northern part of the Manti National Forest. Many canyons cut the south slopes of the West Tavaputs Plateau and open into Price River Canyon from the north all along its course. Others drain the foothills to the east of the Wasatch Plateau and the broken region to the southeast and open into the main canyon from the west and south. In some of these canyons there are small perennial streams; others are dry most of the year. All of them, however, are subject to floods from occasional thunderstorms, which are not uncommon during the summer.

Fish Creek flows almost east for about 15 miles from its source, then swings northward and joins White Creek at Colton to form the Price River. Gooseberry and Pleasant Creeks flow into Fish Creek from the south about 3 miles and 8 miles respectively from its source. The Gooseberry Creek catchment basin is adjacent to that of Cottonwood Creek,[17] which flows down the west slopes of the Wasatch Plateau into the San Pitch River, and a portion of the water from it is diverted across the divide into Cottonwood Creek for irrigation near Fairview. The Mammoth Reservoir was built on Gooseberry Creek to store water for irrigation of lands near Price, but in 1917 the dam failed, and it has not been rebuilt.

The San Rafael River drains the region to the south of the Price River drainage basin. It has two principal branches—Huntington and Cottonwood Creeks, both of which rise in the Wasatch Plateau. These streams fall rapidly in their upper courses and leave the plateau through rugged canyons opening into Castle Valley, a long, narrow depression lying between the eastern escarpment of the Wasatch Plateau and the San Rafael Swell. Castle Valley is nearly 60 miles in length from north to south. The central portion is drained by the branches of the San Rafael, and the northern portion by the Price

[17] Not the Cottonwood Creek that joins Huntington Creek to form the San Rafael River. The name Cottonwood Creek is very common in the region where cottonwoods grow along so many of the streams.

River. The San Rafael tributaries cross the valley at intervals of a few miles apart and unite about 8 miles southeast of Castle Dale. From this point the main stream cuts a deep, narrow canyon through the San Rafael Swell, then flows across a low broken country to its junction with the Green.

Huntington Creek is about 40 miles long. It flows in a southeasterly course to the town of Huntington, bends southward, and joins Cottonwood Creek to form the San Rafael River a short distance southeast of Castle Dale. It rises on the south and east slopes of the Wasatch Plateau directly south of the catchment area of Gooseberry Creek, of the Price River system. The catchment basin consists of rugged mountains ranging from 8,000 to 10,000 feet in altitude. The canyon is narrow and is bordered by broken-down bluffs cut by numerous ravines. Many springs scattered over the drainage basin supply much of the normal low-water flow of the creek.

Cottonwood Creek, which is about 34 miles long, joins Huntington Creek near Castle Dale to form the San Rafael River. It rises in two main tributaries—Lowry and Seely Creeks, which come from the north and west respectively and unite about 15 miles northwest of Castle Dale. The general course of the stream is southeast. The catchment basin lies on the high slopes of the Wasatch Plateau, from which the main stream descends to Castle Valley through a narrow rocky canyon called Straight Canyon. At the head of this canyon Lower Joes Valley serves as a collecting basin which has its outlet through the canyon. No important tributaries enter the creek below this basin.

Ferron Creek is about 30 miles long and flows in a southeasterly direction to Ferron, where it makes a turn to the north and enters the San Rafael River. The catchment basin is just south of that of Cottonwood Creek and very similar to it. The creek leaves the higher plateau region through a canyon about 8 miles long and enters Castle Valley near Ferron.

Beside the two major tributaries, the Price and San Rafael Rivers, there are a number of smaller streams flowing into the Green River in its lower basin. With few exceptions, however, they are all wet-weather streams draining a portion of the bad lands that are characteristic of this region. Those streams which have a perennial flow have their sources in small springs that yield alkaline water, or the water soon becomes alkaline because of the abundance of soluble salts along their channels. The largest of these smaller streams are Minnie Maud or Ninemile, Jack, Florence, and Range Creeks.

GREEN RIVER CANYONS

GENERAL CHARACTER

The channel of the Green River through its upper basin is cut into the undulating surface of the basin floor—in some places only a few feet and in others more than 100 feet—with precipitous walls several hundred feet apart, and the stream meanders through the broad bottom lands, but in its course through the High Plateaus, to the south, the river has carved a series of remarkable canyons whose history is replete with interesting and romantic incidents, discoveries, starvation, and lonely, dangerous journeys.

On the headwaters of Green River lived the Crows, who called it the Seedskeedee Agie or Prairie Hen River. The Snakes and Utes, living farther down, called it the Bitterroot.[18]

Father Escalante in his memorable journey of 1776, in search for a route to Monterey from Santa Fe by way of the north, came upon the Green River in September. He camped on the bank of the river a short distance above and opposite the present settlement at Jensen, then crossed over and made his way westward through the Uinta Basin. To him the river was the San Buenaventura, a name attributed to Fray Alonzo de Posadas, who had preceded Escalante to this point of his journey in the early sixties of the eighteenth century.[19]

Just when the river began to be known as the Green and by whom the name was first applied are questions upon which historians are not agreed, but according to Chittenden [20] the name seems to have come into general use some time between 1824 and 1833. He says:

That part of the stream [Colorado River] now called the Green River was very commonly known, down to 1840, as the Seedskeedee, or Prairie Hen River. It generally so appears in the literature and correspondence of the times. The name Green River began to come into general use about 1833, although it dates back as far as 1824. Its origin is uncertain. Bancroft says it was given for one of Ashley's men, but it certainly was in use before Ashley was in the country, for William Becknell has left a narrative of a trip that he made from Santa Fe to Green River in 1824, and the name was evidently a fixture at that time among the Spanish. Fremont says that it was the "Rio Verde of the Spaniards" and adds that "the refreshing appearance of the broad river, with its timbered shores and green wooded islands, in contrast to its dry sandy plains, probably obtained for it the name of Green River." This does not seem unreasonable, although some who are well acquainted with the characteristics of the river are more inclined to attribute the name to the appearance of the water, which is a very pronounced green, than to the foliage of the valley, which is in no marked degree different from that along other streams in this locality.

At the time that Ashley and his men entered the valley of Green River, in1824, it was supposed to flow into the Gulf of Mexico. Various hints in the correspondence of the times show this to be the case, and it is averred even that General Ashley thought so when he started to descend the river in a canoe in 1825. It is certain,

[18] Dellenbaugh, F. S., The romance of the Colorado River, p. 67, 1909.
[19] Freeman, L. R., The Colorado River, yesterday, to-day, and to-morrow, p. 32, 1923.
[20] Chittenden, H. M., American fur trade of the West, vol. 2, p. 779, 1902.

however, that the Astorians understood the identity of the stream in 1811–12, for they called it the "Colorado or Spanish" River. (See Missouri Gazette May 15, 1813.)

Coutant [21] gives the credit for it to General Ashley:

Ashley was a cool, daring disposition, and under his leadership his men became bold and successful partisans. His company brought out in 1823 consisted of about 40 men, and with these he attempted to cover a large territory. * * * With his little band he pushed forward to Spanish River, the name of which he promptly changed to Green River, after one of his St. Louis partners. It has been claimed by several historians that the name of this river comes from the color of its waters; be that as it may, General Ashley named it.

But the following statement of Ashley is rather significant. After he had descended the river he described a meeting with some Indians from whom he bought horses and said: "I understood (by signs) from them that the river which I supposed to be the Rio Colorado of the West continued its course, as far as they had any knowledge of it, southwest through a mountainous country." [22]

Dale [23] also cites accounts of trapping parties coming up from Taos and Santa Cruz in 1824–25 to trap on the Green River as indicating that the lower reaches of the stream may have been known as the Green River before the advent of General Ashley.

EXPEDITIONS THROUGH THE CANYONS

The canyons of the Green that are cut through the great Uinta uplift are practicably impassable except by going downstream with boats, and even that is a difficult and hazardous venture. Several such trips have been made, and the following short descriptions taken from accounts of them give an idea of the physical characterisitics of the canyons.

ASHLEY

The first known trip by white men was made by Gen. William Henry Ashley in the spring of 1825.[24] At the head of a band of trappers he came upon the Green River in April, 1825, and made his first camp a few miles above the mouth of Sandy Creek. His expedition had become seriously crippled by the loss of "17 horses and mules, driven off by a marauding party of Crows," and the packs of the stolen animals were an added burden to the party. Ashley therefore determined to lighten the burden of his men and the remaining horses, and to do so he made four divisions of his party. Three of them were to go by land in different directions, and he was to descend the river with the principal part of the supplies.

[21] Coutant, C. B., History of Wyoming, p. 123, 1899.
[22] Dale, H. C., The Ashley-Smith explorations and the discovery of a central route to the Pacific, 1822-1829, p. 151, 1917.
[23] Idem, p. 156.
[24] Freeman, L. R., op. cit., p. 82, 1923.

Accordingly [he writes][25] some of the men commenced making a frame about the size and shape of a common mackinaw boat, while others were sent to procure buffalo skins for a covering. On the 21st of April, all things being ready for our departure, I despatched 6 men northwardly to the source of the river; 7 others set out for a mountain bearing south-southwest and north-northeast, distant about 30 miles; and 6 others were sent in a southern direction. * * * The partisans were also informed that I would descend the river to some eligible point about 100 miles below, there deposit my merchandise, and make such marks as would designate it as a place of general rendezvous for the men in my service in that country, and they were all directed to assemble there on or before the 10th of July following.

After the departure of the land parties, Ashley with six men on April 21 embarked on his "bull boat" and began the trip down the river. The starting point was apparently just a few miles below the site of Fontenelle, Wyo., for he says: "After making about 15 miles we passed the mouth of the creek which we had left on the morning of the 18th and to which we gave the name Sandy."

At the mouth of Henrys Fork a spot was selected as a place of general rendezvous, and it was designated by marks in accordance with the instruction given to his men. On May 3 the party was in Red Canyon, where

the navigation became difficult and dangerous, the river being remarkably crooked, with more or less rapids every mile, caused by rocks which had fallen from the sides of the mountain, many of which rise above the surface of the water and required our greatest exertions to avoid them. At 20 miles from our last camp the roaring and agitated state of the water a short distance before us indicated a fall or some other obstruction of considerable magnitude. Our boats were consequently towed to shore, along which we cautiously descended to the place from whence the danger was to be apprehended. It proved to be a perpendicular fall of 10 or 12 feet produced by large fragments of rocks which had fallen from the mountain and settled in the river extending across its channel and forming an impregnable barrier to the passage of loaded water craft. We were therefore obliged to unload our boats of their cargoes and pass them empty over the falls by means of long cords which we had provided for such purposes.

It was at this place that Ashley inscribed his name in paint on the cliffs above the river, and this inscription ("Ashley 1825") has given rise to much interesting speculation.

After camping in what is now Browns Hole, "on a spot of ground where several thousand Indians had wintered during the past season," the journey was resumed and a short run put the party into the Canyon of Lodore. The profound impression upon the men as they entered this great gorge is best expressed by Ashley himself under his entry of Friday, May 8.[26] He says:

We proceeded down the river about 2 miles, where it again enters between two mountains and affording a channel even more contracted than before. As we passed along between these massive walls, which in a great degree excluded from us the rays of heaven and presented a surface as impassable as their body was

[25] Dale, H. C., op. cit., p. 138.
[26] Idem, pp. 144–145.

impregnable, I was forcibly struck with the gloom which spread over the countenances of my men; they seemed to anticipate (and not far distant, too) a dreadful termination of our voyage, and I must confess that I partook in some degree of what I supposed to be their feelings, for things around us had truly an awful appearance.

At the mouth of the Duchesne River, then called the Tewinty by the Indians, Ashley made a cache and finally concluded his boat trip at some point in Desolation Canyon about 50 miles below the mouth of the Duchesne, then called the Uinta. He then purchased a few horses from the Eutaws and made his way back to the cache on the Duchesne, which he followed to its headwaters, and finally returned to the general rendezvous on Henrys Fork. In making his boat trip, Ashley says, "we performed 16 portages, the most of which were attended with the utmost difficulty and labor." Although this trip was incident to his fur-trading business, due credit should be given to Ashley for his success in so mysterious and hazardous an undertaking and for the facts which he determined relative to the river and its meanderings.

MANLY

In 1849 another trip was made down these canyons by W. L. Manly and six of his friends, and as a spectacular exhibition of foolhardiness it is apparently without peer. Manly was one of the ox-team drivers, commonly referred to as bullwhackers, of a company that was headed for California. It was announced by the head of the company before passing the Green River that on account of the lateness of the season he was going to winter in Salt Lake City.[27] Accordingly Manly and six of his fellow drivers, as he writes,[28]

put a great many "ifs" together, and they amounted to about this: If this stream were large enough; if we had a boat; if we knew the way; if there were no falls nor bad places; if we had plenty of provisions; if we were bold enough to set out on such a trip, etc., we might come out at some point or other on the Pacific. And now when we came to the first of the "ifs," a stream large enough to float a small boat, we began to think more strongly about the other "ifs." In the course of our rambles we actually did run across the second "if" in the shape of a small ferryboat filled up with sand upon a bar, and it did not take very long to dig it out and put it into shape to use, for it was just large enough to hold one wagon at a time.

The decision was finally made, and after the departure of the ox train Manly and his companions put their belongings into their crude craft and started down the river. The utter lack of conception of what was ahead of them is clearly shown in Manly's statement that "it looked as if we were taking the most sensible way to get to the Pacific, and almost wondered that everybody was so blind as not to see it as we did."

---

[27] Freeman, L. R., op. cit., p. 126, 1923.
[28] Manly, W. L., Death Valley in '49, p. 81, 1849.

Everything went well until the party reached the falls mentioned by General Ashley, which now bear his name. In their effort to line the empty boat past this obstruction it was caught by the swift current and pinned against a big rock in the stream, so tightly, as Manly says, "that we could no more move it than the rock itself." Undaunted by the loss of their boat the party made two canoes from two pine trees 2 feet in diameter, lashed them together, and proceeded on their way. It was soon concluded that this double canoe had insufficient carrying capacity, so a second pair was made about half a mile downstream. Finally after some further thrilling experiences with this crude equipment the party reached the Uinta Basin. Here the watercourse was abandoned after Walker, an Indian chief, had pictured to them the canyons ahead. Manly and his men with two pack horses given them by the Indians headed toward Salt Lake City, but they came upon a train of prairie schooners bound for California and gladly joined it.

POWELL

There is apparently no record of any other boat trips through the canyons until 1869, when Maj. John Wesley Powell made his memorable expedition in the interests of science. The funds were provided by the State institutions of Illinois and the Chicago Academy of Sciences, and Congress by a joint resolution permitted some rations to be taken from western Army posts. For two years before the exploration Powell made geologic studies among the heads of the canyons leading to the Colorado, and the desire to explore the main canyons grew upon him.[29] Accordingly a party was organized in the spring of 1869, boats were built in Chicago and shipped by rail to Green River, Wyo., and the trip was started on May 24, 1869. The party consisted of 10 men, with 4 boats and enough supplies to last 10 months.

Major Powell named the canyon gorges as he went down the river, and every name is remarkably appropriate and significant. The great mass of the mountain ridge through which the river has cut its entrance into the Uinta Mountains he named Flaming Gorge, because of the bright-vermilion rocks of which it is composed. The elongated U of the next few miles of the river's course between high rock walls he called Horseshoe Canyon. As he emerged from Horseshoe Canyon into a little park and then entered another canyon, the great number of kingfishers playing about suggested the name Kingfisher Canyon.

On June 2 the party reached the falls, where they found the inscription left by General Ashley. In writing of it Powell says: "The word 'Ashley' is a warning to us, and we resolve on great caution.

[29] Powell, J. W., Exploration of the Colorado River of the West, 1869-1872, p. ix, 1875.

Ashley Falls is the name we give to the cataract." The canyon in which Ashley Falls is situated was named Red Canyon and it opens into Browns Park. Within this park

> a spur of red mountain stretches across the river, which cuts a canyon through it. Here the walls are comparatively low but vertical. A vast number of swallows have built their adobe houses on the face of the cliffs on either side of the river. The waters are deep and quiet, but the swallows are swift and noisy enough, sweeping by in their curved paths through the air or chattering from the rocks. The young birds stretch their little heads on naked necks through the doorways of their mud houses, clamoring for food. They are a noisy people. We call this Swallow Canyon.

Nine days was spent by the Powell party in getting through the Canyon of Lodore. The second day one of the party suggested that the canyon be called Lodore, and the name was adopted. Such names as Disaster Rapid and Hell's Half Mile are indeed suggestive of the thrilling experiences of the party in this canyon. One of these experiences nearly became a catastrophe when one of the boats was dashed to pieces, and two of the occupants narrowly escaped drowning at Disaster Rapid. Upon reaching the mouth of the canyon Powell [30] wrote:

> This has been a chapter of disasters and toils, notwithstanding which the Canyon of Lodore was not devoid of scenic interest, even beyond the power of pen to tell. The roar of its waters was heard unceasingly from the hour we entered it until we landed here. No quiet in all that time. But its walls and cliffs, its peaks and crags, its amphitheaters and alcoves tell a story of beauty and grandeur that I hear yet—and shall hear.

The little open area at the confluence of the Yampa and Green Rivers was named Echo Park, and the next canyon was called Whirlpool Canyon. Passing out of this canyon the party came into "a beautiful park" and went into camp on an island. "The broad, deep river meanders through the park, interrupted by many wooded islands," so the place was named Island Park.

On climbing the mountain to the east Powell saw that at the lower end of the park the river reenters the long spur of the mountains from which it has just come and after reaching the center of the ridge it turns to the southwest, splitting the mountain longitudinally; accordingly, this gorge was named Split Mountain Canyon. The trip through this canyon was marked by some additional experiences with rapids and one portage of the rations was made. The canyon opens into the Uinta Basin, and the broad valley through which the river flows was at one time the home of many antelope. It was known to the Indians as Won'sits Yu-av, Antelope Valley.

After spending about a week in the Uinta Basin the party resumed its voyage into what Powell calls the Terrace Canyons.[31] A few miles south of the mouth of the Uinta, the Green River enters the

---

[30] Idem, p. 30.

[31] Idem, pp. 52-56, 167.

Canyon of Desolation, so named because of its extremely barren and forbidding aspect. The walls of the canyon steadily increase in height to its foot, where it terminates abruptly at the Brown Cliffs; then Gray Canyon, named because of gray sandstone walls, begins with low walls, finally terminating abruptly at the Book Cliffs.

After leaving Gray Canyon, Major Powell states, "our way is through a valley, with cottonwood groves on either side. The river is deep, broad, and quiet." At the lower end of this valley a long rapid was run, and beyond this curious black bluffs were passed on the right, then two or three short canyons, and the mouth of the San Rafael River was reached. Beyond this, he says,

we pass some beautiful buttes on the left, many of which are very symmetrical. They are chiefly composed of gypsum of many hues, from light gray to slate color; then pink, purple, and brown beds. Now we enter another canyon. Gradually the walls rise higher and higher as we proceed, and the summit of the canyon is formed of the same beds of orange-colored sandstone. Back from the brink the hollows of the plateau are filled with sands disintegrated from these orange beds. They are of rich cream-color, shaded into maroon, everywhere destitute of vegetation, and drifted into long, wavelike ridges.

The course of the river is tortuous, and it nearly doubles upon itself many times. The water is quiet, and constant rowing is necessary to make much headway. Sometimes there is a narrow flood plain between the river and the wall, on one side or the other. Where these long, gentle curves are found, the river washes the very foot of the outer wall. A long peninsula of willow-bordered meadow projects within the curve, and the talus, at the foot of the cliff, is usually covered with dwarf oaks. The orange-colored sandstone is very homogenous in structure, and the walls are usually vertical, though not very high.

The country lying beyond the river is described as follows:

In every direction, as far as we are able to see, naked rocks appear. Buttes are scattered on the landscape, here rounded into cones, there buttressed, columned, and carved in quaint shapes, with deep alcoves and sunken recesses. All about us are basins, excavated in the soft sandstones; and these have been filled by the at e rains.

Over the rounded rocks and water pockets we look off on a fine stretch of river, and beyond are naked rocks and beautiful buttes to the Azure Cliffs, and beyond these, and above them, the Brown Cliffs, and still beyond, mountain peaks; and clouds piled over all.

On we go, after dinner, with quiet water, still compelled to row, in order to make fair progress. The canyon is yet very tortuous. About 6 miles below noon camp we go around a great bend to the right, 5 miles in length, and come back to a point within a quarter of a mile of where we started. Then we sweep around another great bend to the left, making a circuit of 9 miles, and come back to a point within 600 yards of the beginning of the bend. In the two circuits we describe almost the figure 8. The men call it a bowknot of river; so we name it Bowknot Bend. The line of the figure is 14 miles in length.

There is an exquisite charm in our ride to-day down this beautiful canyon. It gradually grows deeper with every mile of travel; the walls are symmetrically curved and grandly arched, of a beautiful color, and reflected in the quiet waters in many places, so as to almost deceive the eye and suggest the thought, to the beholder, that he is looking into profound depths. * * * At night we camp on the south side of the Bowknot, and as we eat our supper, which is spread on the beach, we name this Labyrinth Canyon.

Immediately upon leaving Labyrinth Canyon the party entered another canyon in which the water filled the entire channel, so that nowhere was there room to land.

The walls are low but vertical, and as we proceed they gradually increase in altitude. Running a couple of miles, the river changes its course many degrees, toward the east. Just here a little stream comes in on the right, and the wall is broken down; so we land and go out to take a view of the surrounding country. We are now down among the buttes and in a region the surface of which is naked, solid rock—a beautiful red sandstone, forming a smooth, undulating pavement. The Indians call this the "Toom'-pin Tuweap," or "Rock Land," and sometimes the "Toom'-pin wu-near' Tu-weap," or "Land of Standing Rock." * * * The stream is still quiet, and we glide along through a strange, weird, grand region. The landscape everywhere, away from the river, is of rock—cliffs of rock, tables of rock, plateaus of rock, terraces of rock, crags of rock—10,000 strangely carved forms. Rocks everywhere, and no vegetation, no soil, no sand. In long, gentle curves, the river winds about these rocks.

When speaking of these rocks, we must not conceive of piles of boulders, or heaps of fragments, but a whole land of naked rock, with giant forms carved on it; cathedral-shaped buttes, towering hundreds or thousands of feet; cliffs that can not be scaled, and canyon walls that shrink the river into insignificance, with vast, hollow domes, and tall pinnacles, and shafts set on the verge overhead, and all highly colored—buff, gray, red, brown, and chocolate; never lichened, never moss-covered, but bare and often polished.

We pass a place where two bends of the river come together, an intervening rock having been worn away and a new channel formed across. The old channel ran in a great circle around to the right, by what was once a circular peninsula; then an island; then the water left the old channel entirely and passed through the cut, and the old bed of the river is dry. So the great circular rock stands by itself, with precipitous walls all about it, and we find but one place where it can be scaled. Looking from its summit, a long stretch of river is seen, sweeping close to the overhanging cliffs on the right but having a little meadow between it and the wall on the left. The curve is very gentle and regular. We name this Bonita Bend.

A short distance beyond Bonita Bend swift water was encountered, and after an hour of rapid running, the party reached the junction of the Green and the Colorado, at the foot of Stillwater Canyon.

These streams unite in solemn depths, more than 1,200 feet below the general surface of the country. The walls of the lower end of Stillwater Canyon are very beautifully curved, as the river sweeps in its meandering course. The lower end of the canyon through which the Grand [Colorado] comes down is also regular but much more direct, and we look up this stream and out into the country beyond and obtain glimpses of snow-clad peaks, the summits of a group of mountains known as the Sierra La Sal. Down the Colorado the canyon walls are much broken.

The Labyrinth Canyon is about 62 miles long, and Stillwater Canyon is about 42 miles long. The walls of these canyons rise to a maximum height of about 1,300 feet.

In August, 1869, Powell reached his goal, the mouth of the Virgin River, but owing to the loss of many instruments and other unfortunate circumstances he was not satisfied with the results obtained and decided to make another descent if he could obtain financial aid from the Government. His second expedition left Green River, Wyo., May 22, 1871.

After Powell's second expedition it was apparently 20 years or more before other attempts were made to descend the canyons, but in 1891 the steam launch *Major Powell*,[32] 35 feet long, equipped with two 6-horsepower engines driving twin screws, was brought from Chicago by way of the Denver & Rio Grande Western Railroad to Green River, Utah, and launched on the stream to ply between that town and Moab, on the Colorado above the confluence of the two streams. A broken propeller screw resulted in the abandoment of this first attempt, and another unsuccessful attempt was made the following year. Finally in 1893 the boat was taken down to the mouth of the Green and back. Other steamboats were subsequently put on the river; the *Undine* was the most pretentious, and she was wrecked trying to run upstream on the Colorado River above Moab. Finally all thought of plying steamboats on the lower Green was abandoned.

GALLOWAY AND FLAVELL

The next navigator to become prominently identified with the Green River canyons was Nathan Galloway, a hunter and trapper, "one of the greatest the upper Colorado has ever known."[33] To him is given the credit for designing the forerunner of the type of boat which has since come into general use as best suited to the rough water in the canyons. "While Galloway doubtless did some boating through the upper canyons previous to that date, his first extended river trip was in 1895, when he left Green River, Wyo., and went through to Lees Ferry." He repeated this trip, starting in September, 1896, with a partner, William Richmond, but instead of stopping at Lees Ferry they went to Needles, reaching there February 10, 1897. About a month before this trip was started George F. Flavell, another trapper and prospector, and a single companion pushed off from Green River, Wyo., and they arrived at Yuma in the following December.

LOPER

In September, 1907, a prospecting expedition left Green River, Utah, in three steel boats each 16 feet long. The party comprised three men, one of whom was Albert Loper, who was with the Geological Survey expeditions on the San Juan and Green Rivers during the summers of 1921 and 1922 respectively.

STONE

Two years later Galloway again pushed off from Green River, Wyo., with a photographic expedition headed by Julius F. Stone, an eastern manufacturer, who was an outdoor man, with much boating experi-

[32] LaRue, E. C., U. S. Geol. Survey Water-Supply Paper 395, p. 21, 1916.
[33] Freeman, L. R., op. cit., p. 325, 1923.

ence to his credit and a desire to obtain "a complete collection of photographs covering the whole Colorado Canyon series." Of the voyage, Freeman [34] writes:

The voyage of the Stone party was a record-breaking performance in several respects. It was not only much the fastest trip ever made through the whole Colorado Canyon series, but it was far ahead of any other passage in the number of rapids run. The record for time still stands as the best ever made between Green River, Wyo., and Needles; the Kolb brothers, two years later, made a slightly better record for rapids run. The arrival at Needles also marked the completion of Galloway's second voyage through all of the canyons, and to date he is the only man to attain that distinction.

KOLB BROTHERS

The Kolb expedition which left Green River, Wyo., September 8, 1911, was another photographic trip. The party as it left Green River comprised Ellsworth and Emery Kolb and a moving-picture assistant whom they called Jimmy. The trip was a complete success. Interesting pictures were obtained, the most notable of which were the motion pictures showing the thrilling experiences with the boats in the rapids and other features of the trip.[35]

UNITED STATES GEOLOGICAL SURVEY

Notwithstanding the fact that each one of these canyon voyages added something of one kind or another to the general fund of information, the need for accurate survey data upon which to base a plan for the development of the power and irrigation resources along the stream was not satisfied.

Accordingly, a Geological Survey party was sent into the canyons during the summer of 1922 and made a complete topographic map and profile of the river from Green River, Wyo., to Green River, Utah, properly correlating the several isolated surveys of reservoir sites previously made by the Bureau of Reclamation and the survey of parts of Desolation and Gray Canyons made by the Utah Power & Light Co. The following condensed account of the trip gives some of the salient facts determined by this survey.

The boats.—Three boats for this expedition were built in Wilmington, Calif., and shipped by rail to Green River, Wyo. Two of them were of the Galloway type, 18 feet long and about 4½ feet beam. The other one was 16 feet long and was similar in plan to a common flat-bottomed rowboat. All of them were decked over at each end, with only an open cockpit in the center for the oarsman. The end compartments were equipped with hatch covers which were fastened with thumb nuts. These covers were made water-tight by lining the contact edges with rubber. The frames of the boats were oak, and the two large ones had ship-lapped sides. The bottoms were flat and

[34] Idem, p. 333.

[35] For a complete narrative of this trip see Kolb, E. L., Through the Grand Canyon from Wyoming to Mexico, 1920.

were protected by oak strips running lengthwise. Three men, including the boatman, rode on each of the large boats and two on the small one. The passengers sat on the hatches. After some deliberation on names for the boats the question was finally left to the boatmen, with the result that the names *Utah*, *Wyoming*, and *Colorado* were chosen and painted on the respective boats.

Personnel.—Most of the party assembled early in July, 1922, and made camp on Scotts Bottoms, a few miles below the town of Green River, Wyo. K. W. Trimble, the topographic engineer, was in charge; J. B. Reeside, jr., was geologist; Ralf R. Woolley was hydraulic engineer and recorder; H. L. Stoner represented the Utah Power & Light Co., which was cooperating in the work; Albert Loper, a man of many years' experience along the Colorado River, was head boatman; L. B. Lint and H. E. Blake were rodmen-boatmen; and John Clogston was cook. Preparations were finally completed to push off on the morning of July 13, and the evening before was spent at a dinner entertainment, given in honor of the party by the Community Club of Green River. The "bon voyage" of the club had a rather significant meaning to the members of the party after listening to the vivid tales of unsuccessful attempts to navigate the canyons by daring adventurers.

Green River to Flaming Gorge.—The barren waste land through which the stream lazily meanders grew somewhat monotonous by the time Flaming Gorge was reached. This monotony, however, was broken several times by small isolated ranches on one bank or the other of the stream. Some of these were abandoned, and at the others the occupants were fighting a desperate battle with the alkali and other obstacles in an effort to make a home At many places in the stream sand bars kept the party guessing as to where the deepest channel was, and sometimes poor guesses hung the boats up on bars, where it was necessary for the boatmen to get out and work them into deep water again.

At Smith Ferry, about a mile above the mouth of Henrys Fork, preparations were made to begin the survey work, because the survey of the Flaming Gorge reservoir site made by the United States Bureau of Reclamation in 1914 had covered the river from the dam site in Horseshoe Canyon up to the town of Green River, Wyo.

Flaming Gorge.—A definite elevation was taken from the permanent Geological Survey bench mark near Linwood, on Henrys Fork, and the mapping work was done as the party proceeded down the river. From Smith Ferry the river appears to drop into a hole, in the Uinta Range, and this is no doubt the "suck" spoken of by Beckworth.[36] Then suddenly the north wall of Flaming Gorge, with its vivid hues of red, brown, and ocher, rises like a huge flame of fire

[36] Bonner, T. D., Life and adventures of James P. Beckworth, p. 57, 1856.

ahead. The gorge is just a mile long and forms a very impressive entrance to the series of canyons below.

Horseshoe Canyon.—Horseshoe Canyon, which immediately follows Flaming Gorge, is a little less than 3 miles long. Through the Flaming Gorge and Horseshoe Canyon box elder trees are scattered along each bank where the walls offer any footing and pine trees dot the slopes, extending down to the water's edge. In places the solid rock walls are almost vertical and rise several hundred feet above the river. The gray shades of the rock with the generous sprinkling of pines and the river winding its way between the walls form a constantly changing panorama.

Kingfisher Canyon.—From the mouth of Horseshoe Canyon the river in a sweeping bend changes its course from northwest to southeast as it passes through Neilson Flat and enters Kingfisher Canyon. This canyon is still the habitat of great numbers of kingfishers, and the name as applied to the canyon in 1869 by Major Powell remains very appropriate. The canyon is not much over a mile long and is wonderfully beautiful. The river is like a placid lake, and the beautifully colored canyon walls with their green trees clinging to the slopes are perfectly reflected in the river as in a huge mirror. Sheep Creek, a small crystal stream, empties into the Green from the west near the foot of the canyon, and about half a mile farther down the river makes a sharp turn to the left around Beehive Point. Here a number of posts on each bank and evidence of a trail indicate the location of an abandoned crossing of some sort. The small open area just below Beehive Point is called "Hideout Flat," and is said to have been at one time the retreat of cattle thieves.

Red Canyon.—Many beaver slides and fresh deer tracks were noticed along the banks as the boats drifted through Hideout Flat and into Red Canyon. Within the first 2 miles of this canyon four rapids were run, and in one of them the *Utah* was hung up for a few minutes on a boulder in midstream. About a quarter of a mile below the fourth rapid Carter Creek comes in from the south, and here a camp was made, the rest of the day being taken to survey Carter Creek Canyon and make some repairs of shoes and other equipment. Carter Creek flows in a rugged gorge with steep walls. The whole lower part of the canyon is filled with trees and brush, making it very difficult to traverse. The stream at the time of this visit (July 20, 1922) carried about 100 second-feet or more of clear water and was well stocked with mountain trout, as was demonstrated by the fisherman of the party, who caught 35 in a little more than two hours before dark.

Thus far the question of drinking water had received no consideration, as the river water had been fairly clear and there was no objection to it, but storms at one place and another on the large barren drainage areas above suddenly turned the river into a stream of mud, and for the remainder of the trip one of the prerequisites of a good camp site was a source of good drinking water.

Rapids were encountered immediately after leaving Carter Creek, and the fifth one, about 2½ miles below that stream, was more than half a mile long. The river is spotted with huge boulders, many of which were submerged only a few inches and, although not visible through the muddy water, were marked by eddies, with which the boatmen were familiar. Although each boatman exerted every effort to avoid the rocks, the *Wyoming* became lodged on the top of one in midstream, and all efforts of her boatman to free her were futile. Fortunately the *Utah* was still above the rapid and went to the rescue. The current was swift, and for a few minutes it looked as if the *Utah* would shoot by without getting near enough to give any assistance. Finally, in his effort to get closer, the boatman turned against the current, and the *Utah* bumped the *Wyoming*, knocking her free and solving what might otherwise have been a difficult problem.

The boatmen were all good swimmers, and no camp was much good without a good swimming hole. One camp in Red Canyon was just below a splashy rapid which added an interesting feature to the swimming, as the boys had great fun "shooting the rapids" in the life jackets.

About 11 miles from the head of Red Canyon the river makes a sharp hairpin turn around a low ridge extending down from one of the canyon walls, and just beyond this turn Trail and Allen Creeks enter from the right, only a few hundred feet apart. Both of these streams are small, but they are interesting because of the fact that an old hermit makes his home here and leads these creeks in a series of small ditches onto the few acres of fertile soil that lie between them. A small area was planted to alfalfa, another was in garden, and still another was covered with corn, almost choked by a rank growth of sweet clover. The hermit was at home, and he was as much surprised to see the visitors as they were to see him. He gave his name as Amos Hill and said that he was 71 years old and had lived in the canyon about 20 years. His house or hovel was a crude tepee of boards over a small hole in the ground. It was hardly big enough for one person but might be classed as a good-sized dog kennel. His wardrobe was as meager as the house, consisting of a piece of dirty canvas with a hole cut in the middle for his head to pass through, a ragged pair of overalls, and a unique pair of shoes with soles of large pieces of cowhide about 15 inches long with the hair on the bottom side and uppers apparently cut from old rubber boots and laced to the soles with rawhide strings. It was about noon when the party reached this place, and Mr. Hill was invited to lunch. He conversed freely. Among other things he claimed to have gone through the

Green River canyons on a raft, taking a horse with him—a feat which one who has been through the canyons would be justified in believing impossible. When asked about his occupation, he said that he had a few cattle to care for and that in the winter, when he is not able to dig little ditches around his garden patches, he goes down the river a short distance and pans gold from the river sand and gravel. His nearest post office is Linwood, some 20 miles or more up the river on Henrys Fork, over a rough mountain trail, and Vernal is about 45 miles away. He packs his supplies from either of these towns, making two or three trips a year.

A short distance below the hermit's place the walls of the canyon become a series of high rolling hills, and soon after 3 o'clock Ashley Falls was reached. Here the channel is almost entirely obstructed by huge boulders that have broken loose from the side walls, but the stage of the river was too low to make an abrupt fall such as was mentioned by Ashley, Manly, and Powell. A landing was made a safe distance above the swift water, and the "falls" were studied to determine the best means of getting the boats by. It was finally decided that they could be put through without "lining" them, so the boatmen, one at a time on a schedule of 10 minutes apart, went through Ashley Falls without trouble. However, every precaution for safety was taken before the men started. Each boatman wore his life jacket, the hatches of the boats were all tightly closed, and the other members of the party were stationed below the falls with lines ready for an emergency. The 10-minute schedule was adopted because a projection of the canyon wall obstructed the view from the starting place to safe water below, and 10 minutes was deemed sufficient for each man to get through.

Just above Cart Creek, nearly 2 miles below Ashley Falls, a detailed survey was made of a cross section of the canyon to study its possibilities as a dam site, and at Cart Creek another catch of trout, 25 this time, was made while the party stopped for lunch.

Below Cart Creek the traveler is greatly impressed with the majesty of the canyon walls, which rise about 2,000 feet above the river, wonderfully carved into large amphitheaters and buttresses, with variegated colors of red and spotted with green pine trees clinging to the steep slopes. Suddenly these walls break away into rolling hills forming an open area known as Little Hole, which is about a mile long. Gorge Creek enters from the south at its upper end, and Little Davenport Creek, also from the south, comes into the lower end. Both of these creeks are very small.

The river passes from Little Hole into another narrow canyon, but the walls are not so high as before and they are more broken by ravines. About half a mile up one of these ravines on the north side of the river is a rancher's cabin. During the evening the owner came to visit the camp, requesting that a letter be taken for him to a place where it might be mailed. During his stay he warned the party of a bad rapid ahead and told of the precautions necessary to avoid an upset such as others had had who did not realize until too late what was before them.

The next afternoon Red Creek was reached. It enters from the left and drains a large area of rolling hills. Its flow is torrential, as is shown by the débris and mud along its banks. The water is red, and the high-water marks through its canyon gorge indicate a flood stage 20 to 30 feet deep. The channel is strewn with trees, large boulders, and red mud. Further evidence of its force is seen in the veritable dam of boulders that it has shot out into Green River, extending almost entirely across the river and crowding it against the opposite wall of its canyon. This dam of course backs up the water in the river for some distance and forms a raging rapid when the water finally tumbles over the boulder-strewn channel. Camp was pitched at the head of this rapid, and the rest of the day was spent in mapping Red Creek and in studying the rapid to find a way through it. The next morning five kodaks were stationed along the rapid to get pictures as the boats came down. The channel chosen by the boatmen proved to be a good one, for each boat was put through without mishap. Two of them, however, scraped on rocks, indicating very plainly what could have happened had the river been only a few inches lower.

Immediately below the rough part of the rapid at some stages of the river, the stream divides into two channels, with the greater flow in the left-hand channel. Naturally a boatman goes with the most water, but the rancher had pointed out the danger at the lower end of this channel and advised the party to keep in the other one if possible. Fortunately there was enough water to float the boats in the right-hand channel, and apparently trouble was avoided, for the lower end of the other channel is blocked by a huge boulder, against which the current dashes and makes an abrupt turn to the right, making it practically impossible to go through it without having the boat dashed against the rock.

Red Canyon opens into Browns Park about 3 miles below the mouth of Red Creek. The canyon is about 31 miles long and has a total fall of 360 feet, or a gradient of 11.6 feet to the mile. For its entire length the walls are hard red sandstone grading into quartzite. Wild game is abundant, and where the silence of the wilderness is not broken by the roar of rushing water the pleasing call of the canyon wren thrills the traveler's soul.

Browns Park.—In the upper part of Browns Park, often called Little Browns Park, is the Jarvie ranch, on the north bank of the river. Among the notable improvements at this place is a large current wheel set in the edge of the stream and designed to raise water from the river for irrigation. About 2 miles beyond this ranch is the abandoned site of Bridgeport, which was at one time a post office. A large log dwelling house, a blacksmith shop, and other buildings mark the place, and some piles near the water's edge on each side of the stream appear to be the piers of an old bridge. It is not unlikely that this was the site of the old Fort Davy Crockett at which Dr. Adolph Wislizenus [37] and others stopped in the summer of 1839.

Swallow Canyon.—A few miles farther along a circuitous course through rolling hills and bottom lands brought the party to the head of Swallow Canyon. The Taylor ranch is on the south side of the river, and from it a supply of fresh vegetables was obtained. A splashy rapid marks the entrance to Swallow Canyon, but through the canyon the current is hardly perceptible. All hands at the ranch came down to the river to watch the boats go through the rapid.

The canyon is a short gorge connecting Little Browns Park with the main part of Browns Park. The walls are solid rock rising almost vertically for about 200 feet above the river. Hundreds of swallows' nests are hung under ledges and in crevices, just as they were when Major Powell gave the canyon its name in 1869. In addition to the swallows, however, there are many other kinds of birds and several varieties of owls.

Browns Park below Swallow Canyon is a broad, open basin, with rolling foothills and brush-covered bottom lands. The river flows through it sluggishly in a meandering course. Small groves of cottonwoods are numerous, and in many places the stream has cut away its soft banks, causing hundreds of trees to fall into the channel.

Canyon of Lodore.—Leaving Browns Park the river flows southward into the Canyon of Lodore, and as the boats glided through the "Gate of Lodore" that same feeling of gloom which Ashley noticed on the countenances of his men was experienced by every man in the party. The canyon is a rock gorge with jagged walls that rise almost vertically many hundreds of feet. The coloring is beautiful, comprising delicate tints of red, pink, and ocher, all blending into a wonderful picture in the soft light of the late afternoon and evening. The rapids not only become more numerous, but many of them are also more violent. The fifth one in the canyon is formed by a huge boulder in midstream with other smaller ones scattered liberally about. The current swings around this boulder and forms a large whirlpool below it. Two of the boats passed the rapid without trouble, but the *Utah* was caught in the swift current and rammed into the boulder, crushing a hole in the stern

[37] Wislizenus, A., A journey to the Rocky Mountains, 1839, p. 129, 1912.

just above the water line. This was repaired in about an hour. Later in the day Upper Disaster Falls was reached. Here two rapids about 500 feet apart, full of rocks and having a rocky island between, with shallow rocky channels on either side, furnished another source of diversion. It was here that the Powell party lost one of its boats in 1869.

About half a mile below this rapid is another one which has for some reason unknown to the writer been named Lower Disaster Falls. This rapid is at a sharp turn in the river channel where the stream has cut most of its low-water channel under the sandstone cliff that forms the right-hand wall of the canyon. The current is swift into this undercut channel, and to attempt to take a boat through the rapid without "lining" or "nosing" it would no doubt spell disaster. Camp was made at the head of this rapid. While the cook prepared supper other members of the party made a study of the rapid, and around the bonfire that evening opinions were not wanting as to the best way to get the boats through. Early the next morning the beds and other bulky cargo were packed to a convenient place below the rapid. This work was a great stimulant to the appetites, and no one needed a second invitation to breakfast. After breakfast the boatmen "nosed" the boats with their lightened loads along the shore; wading alongside of them in water just deep enough to float them and at the same time keep them under control. As soon as the danger point was passed one of the boatmen would leap into the boat and bring it into the still water below. An old shirt, several empty tin cans, and the remains of a camp fire below the rapid bore mute evidence that another party had spent some time at this point.

A short distance farther down the canyon Dunns Peak comes into view. It is a flat-topped portion of the east wall consisting of a capping of gray quartzite on top of the characteristic red sandstone through which the canyon is cut. The contrast between the different-colored rocks is very striking and is greatly enriched by the delicate hues of red in the canyon walls. The peak was named by Powell, and it stands more than 2,000 feet above the river.

At the foot of this peak are the Triplet Falls, three rapids within about 800 feet. These rapids are swift and rough, but the stage of the river was high enough to carry the boats through without trouble. Not far below these rapids the river became as placid as a mill pond; then suddenly it plunged with a roar into a long steep stretch of channel that is one confused pile of boulders for nearly half a mile. A landing was made in the still water on the left bank near the head of this stretch, and it became apparent very quickly that a portage would be necessary. A copy of Kolb's book was the principal volume of the party's library, and from the pictures given therein it was possible to identify this rapid as Hells Half Mile.

After a careful study the boatmen were satisfied that the empty boats could be run through the rapid. Accordingly they were unloaded and the hatch covers screwed down tightly. Each boatman donned his life jacket, and when all was ready the other members of the party stationed themselves along the bank at places of vantage, some with kodaks and others with ropes. The *Utah* went through the first plunge of 9 feet fall in a distance of 400 feet and in an eddy along the right-hand bank waited for the other boats. The *Wyoming* ran it successfully, but for a moment everyone expected to see her dashed against one of the huge boulders and capsized. The *Colorado* was less fortunate than the other two and was washed high and dry on a boulder. All efforts of her boatman to dislodge her were futile. After several attempts a line was cast to the boatman from shore, and the boat was finally pulled loose.

The boatmen did some very clever maneuvering to miss as many of the rocks as they did, for to the observer on the banks it appeared impossible to miss them. After the first plunge the river spreads over a channel about 600 feet wide in high water but at this time (August 3, 1922) it was divided into two or three channels, all of them full of boulders. With the exception of about 40 yards of the remainder of Hells Half Mile the boats drifted along under control of the boatmen, but through this 40-yard stretch they were "nosed" because of shallow water and numerous rocks. It was very obvious after the bottom of this rapid was reached that the stage of the river had very much to do with success, for it was easy to see that no end of trouble would have been probable with a stage a few inches lower.

All afternoon the party toiled on the portage of the supplies. The trail led across a small ridge, across a deep red gully, into the high-water channel of the river, over this boulder-strewn course as far as possible, up a steep hillside of loose earth and rocks to a deer trail 75 feet or more above the river, and along this trail around a steep rocky point down to the sand bar, where camp was made. Forty-three trips were necessary to place the cargoes below the rapid, and the course was very close to half a mile long. Each load was about 60 or 70 pounds, and when the work was done every member of the party was quite exhausted. However, a refreshing plunge in the "swimming hole" just off the sand bar and some dry, clean clothes made a great change, and everyone had a good appetite for supper.

The Canyon of Lodore is about 17½ miles long and has a total fall of 269 feet, or about 15.4 feet to the mile. As Major Powell says:

It starts abruptly at what we have called the Gate of Lodore with walls never lower than this until we reach Alcove Brook, about 3 miles above the foot. They are irregular, standing in vertical or overhanging in steep slopes, and are broken by many side gulches and canyons. The highest point on the wall is at Dunn's Cliff, near Triplet Falls, where the rocks reach an altitude of 2,700 feet, but the peaks a little way back rise nearly 1,000 feet higher. Yellow pines, nut pines, firs, and cedars stand in extensive forests on the Uinta Mountains and, clinging to the rocks and growing in the crevices, come down the walls to the water's edge from Flaming Gorge to Echo Park. The red sandstones are lichened over; delicate mosses grow in the moist places, and ferns festoon the walls.

Echo Park.—About 6 miles below Hells Half Mile the canyon walls break away and open into Echo Park, where Steamboat Rock, or Echo Cliff, marks the end of the beautiful Canyon of Lodore. Here the Yampa River empties into the Green River from the east. Echo Park is often spoken of in that vicinity as Pats Hole, because an old hermit known as Pat Lynch made it his home and worked a small farm there in connection with some cattle range adjoining.

Upon entering Echo Park the Green River flows southward at the foot of Steamboat Rock, which is about 700 feet high and a mile long; then it turns abruptly to the right and runs back in a northerly course almost parallel to its former direction for nearly another mile, thus having the opposite sides of a long, narrow rock for its right bank. This tongue of rock resembles in general a huge ship and thus obtained its name. It has a mural escarpment along its entire east side, but broken down in places on the west.

The louder sounds around camp at the mouth of the Yampa River were echoed from the cliff with remarkable clearness, and in some places in the park two and three distinct echoes were audible, with fainter ones following as the sound died away.

Whirlpool Canyon.—Leaving Echo Park the river enters Whirlpool Canyon. The walls are high and vertical, the canyon is narrow, and in places the water fills the gorge from wall to wall. The coloring and the pine trees dotting the steep slopes wherever they can cling are similar to the same features in Red Canyon and the Canyon of Lodore, but this one is much narrower through its upper 3 miles, and the walls are much steeper. The water flows rapidly and is made to eddy and spin in whirlpools by projecting rocks and sharp curves.

Near the Colorado-Utah State line the canyon is wider, with more or less space between the stream bed and the walls. High on the sides crags, pinnacles, and towers add to the architecture of the general scene, and a number of wild canyons enter on each side. About halfway through the canyon Jones Hole Creek enters from the north. It is a beautiful crystal stream that was flowing about 100 second-feet on August 8, 1922, and was well stocked with fine mountain trout. The remains of camp fires and tin cans indicated several old camps at this place, either of one or more parties exploring the river or of fishing and hunting parties that may have come down the creek.

A little more than a mile farther down the canyon Sage Creek comes in, also from the north. It is a smaller creek flowing in a rather broad canyon. Prospector's tools, the remains of an old camp, and several prospect holes in the hillside a short distance down the canyon were noticed.

Three miles below Sage Creek the canyon opens into Island Park. The length of Whirlpool Canyon is 9 miles, and the total fall is 98 feet, or an average fall of 10.9 feet to the mile.

Island Park.—Island Park was so named because of the numerous islands along the course of the river in this stretch. From the mouth of Whirlpool Canyon to the head of Split Mountain Canyon, where the river leaves the open area, it flows in a meandering course 7 miles long, though the air-line distance between these points is only a little over 3 miles. The lower part of the park is cut off from the upper part by a tongue of low rolling hills, and the greater part of this area has been called Rainbow Park. Beyond this area is another smaller open area known as Little Park.

Agriculture incident to ranching is carried on in the upper part of Island Park at the Ruple ranch, and some land is irrigated from ditches taken out of the river. A deserted cabin, about a mile northwest of the Ruple cabin, marks the site of an abandoned homestead, and another one at the edge of a cottonwood grove in the Rainbow Park area, with evidences of attempts to cultivate some of the surrounding ground, marks a similar site.

Many small ravines drain into these park areas and carry water during the spring thaws and local showers, but for the greater part of the year they are dry. The channels in several places show evidences of erratic torrential flow. Through one of these ravines a road leads out to Vernal. A small spring of clear water, heavily impregnated with iron, rises about a mile up the ravine, flows a few hundred feet, and sinks. In many places on the smooth rock faces of the walls of the ravine are Indian pictographs.

Split Mountain Canyon.—On leaving Island Park the river goes back into the mountain spur through which it has cut the lower part of Whirlpool Canyon, and when it has reached the center of the spur it turns abruptly to the right, splitting the mountain longitudinally. On account of this feature the gorge was named Split Mountain Canyon. The canyon has a broad, flaring entrance, similar in structure to the mouth of Whirlpool Canyon. It is broad and rugged, with a line of majestic crags and buttresses standing sentinel on each side.

Rapids follow one another in quick succession through the canyon, but none of them are particularly dangerous at the stage of the river to be expected during August in years of average run-off. There were two rapids that might be called worthy of note. The first one of these is at a point where the river turns abruptly to the right, crossing the canyon in a long chute at right angles and striking the opposite wall, where it has partly cut a channel in the solid rock, somewhat similar to that at Lower Disaster Falls, in the Canyon of Lodore, but not so far under. At the other rapid the river channel is contracted to a very narrow width, with a rather steep slope. The current is swift, and the water surface is choppy. The boulders in the channel were all a safe distance below the water surface, and the boats shot through with almost express-train speed. The ride was decidedly thrilling.

Very good camp sites are numerous throughout the Green River canyons above the Uinta Basin, and among the best ones was the site in Split Mountain Canyon on a large sand bar at the foot of a splashy rapid about 4½ miles down the canyon. The eddy from the rapid was a good swimming hole but not very inviting because the water was so muddy. A clear spring near the upper end of the bar furnished good drinking water, the clean, white sand offered plenty of good places for beds, and a large piñon added to the beauty of the scene, with the vertical rock cliffs rising immediately behind it, and the wonderful buttressed wall receding in the distance down the canyon. The coloring is dull gray with a little red and ocher, and the shadows of the late afternoon, extending artistically over the general scene, add a very beautiful effect.

At the mouth of the canyon about 150 feet above the river in the left wall is a large cave. To reach it one must climb up over a mass of huge boulders that have sloughed off the main cliff and nearly sealed the entrance. The cave is about 20 feet in diameter and roughly circular, and the highest place in the ceiling is 8 to 10 feet above the floor. The floor is covered to an unknown depth with sand as fine as the finest flour, which has drifted in and formed a large mound in the center. Animal bones were strewn around, and from all appearances the place is a resort for wild beasts.

Split Mountain Canyon is 7 miles long and has a total fall of 145 feet, or an average of 20.7 feet to the mile.

Uinta Basin.—After leaving Split Mountain Canyon the river flows with a gentle current in a meandering course among low rolling hills, usually barren of vegetation and lacking in scenic interest. At two or three places, however, attention is drawn by some abandoned machinery and mechanical devices along the banks, marking the sites of old placer operations. At one place a huge dredge was installed and several buildings were erected, but reports indicate that the dredge was never put into operation. Everything is now in a dilapidated condition, and the site is a dismal reminder of an expensive venture.

In its meanderings the river passes within a mile of the Dinosaur National Monument, about 6 miles northeast of the settlement at Jensen. This quarry, as it is commonly called, is one of the world-famous cemeteries of prehistoric giant beasts, and it has furnished a number of very significant specimens of dinosaurs.

About 3 miles above Jensen Brush Creek enters the river from the west. Its waters are used extensively for irrigating the bench lands in the vicinity of Jensen. At Jensen a bridge spans the river on the Victory Highway and there is a general merchandise store that is the last place at which supplies may be purchased on the eastward trip until the small settlements in the Yampa and White River Valleys in Colorado are reached.

About 2.4 miles below Jensen Ashley Creek enters the river from the west, and at a point 1½ miles farther down is a small tract of bottom land with a few acres sloping back from the river. Here a futile attempt has been made to irrigate the higher lands by pumping water with a centrifugal pump driven by a tractor engine.

For miles through the Uinta Basin Green River flows in a channel with vertical cut banks, in some places as high as 20 feet above the water, fringed with willows and here and there small groves of cottonwoods. Back from the banks there are in places broad stretches of apparently level country which join the rolling hills in the distance. At Horseshoe Bend, 17 miles below Jensen, the stream makes a large loop with the two ends not over half a mile apart, separated by a spur running south from Asphalt Ridge. The distance around this loop is 8½ miles, the fall in the river is less than 10 feet, and numerous sand bars greatly retard navigation.

Immediately below the Indian agency at Ouray the Duchesne River empties into the Green, carrying the principal part of the entire run-off of the Uinta Basin. It was at this place that General Ashley left a cache to take with him when he returned from his trip down the Green and proceeded up the valley of the Duchesne. It was here also that Major Powell camped for several days.

Less than 2 miles below the mouth of the Duchesne the White River joins the Green from the east. As the Green continues in its circuituous course toward Desolation Canyon it passes through a barren, uninteresting territory. About 5 miles below the mouth of the White River the Uteland mine is a conspicuous landmark on the west bank. The property is now abandoned, and its several buildings are in a dilapidated condition, but the camp apparently saw considerable activity at one time.

Just where Desolation Canyon begins is difficult to indicate, because of the absence of a well-defined gorge. The broad open river course simply winds among scattered rolling hills. Accordingly, the length of the river course across the Uinta Basin is somewhat arbitrarily taken as 83 miles. In this distance the total fall is 155 feet, or an average fall of 1.87 feet to the mile.

Desolation Canyon.—Desolation Canyon is indeed appropriately named, for, as Major Powell says, "it is a region of wildest desolation." The walls are almost without vegetation. Only here and there are a few dwarf bushes clinging to the rocks and some cedars growing from the crevices, "not like the cedars of a land refreshed with rains, great cones bedecked with spray, but ugly clumps, like war clubs, beset with spines."

At Sand Wash, a broad canyon about 2 miles above Ninemile Creek, are strata of oil shale which have been rather extensively prospected. At Ninemile Creek is a small open area of possibly 100 acres, on part of which considerable work has been done in an attempt at farming. In addition to some tracts that had been plowed, there were several permanent improvements, such as a cabin, barn, corrals, a small reservoir, and a ditch along the side of the canyon taking water out of Ninemile Creek a mile or more above its mouth. The entire area, however, is impregnated with alkali, and this is probably the reason that the enterprise was abandoned.

The canyon walls become higher as the canyon is descended, and numerous side canyons cut the region into a wilderness of gray and brown cliffs. In some places these side canyons are separated from one another by only narrow walls, many of them hundreds of feet high and so narrow in places that the softer rocks have crumbled away and left holes through the wall, making side doors between the canyons. "Piles of broken rock lie against these walls; crags and tower-shaped peaks are seen everywhere, and, away above them, long lines of broken cliffs." In one of these cliffs high above the river was noticed a large natural arch near the sky line.

At the mouth of each of these side canyons is usually a rapid, the roughness of which depends upon the number and size of the boulders washed into the river channel from the canyon. A few of these rapids required extra caution because of shallow water where the river channel was unusually wide, but all of them were passed without trouble and through most of them the passengers remained on the boats.

The streams from many of the side canyons are only wet-weather streams, and those that are perennial derive their dry-season flow from springs. Many of them become only a trickle during the hot, dry summer, flowing but a short distance before they disappear in their beds or are evaporated into the air. The water in nearly all of them is alkaline, and as it evaporates from the rocks along the channels it leaves a white coating on them.

Rock Creek, 54 miles upstream from Green River, Utah, is an exceptional stream of cool crystal water that rises in large springs about 2 miles from its mouth and flows eastward into the Green River. A ranch is located at the junction, and the creek water is used to irrigate some alfalfa, a small peach orchard, and a garden tract. Ingress and egress is effected by pack train over a trail down the canyon to the Green River or out of the canyon over the mountains to Sunnyside.

A little less than 15 miles down the canyon from Rock Creek is the McPherson ranch, on the east side of the river. Here another nook in the canyon is irrigated from a small side stream, and abundant crops of fruit and vegetables are raised in addition to forage for the livestock. A trail leads down the canyon to Green River, Utah, 39.5 miles, and a train of pack mules is the only means of transportation. This fact is somewhat remarkable when it is considered that all sorts of heavy farm machinery, wagons, a large steel range, and many other heavy and cumbersome articles have been taken from Green River to the ranch in that manner. The peaches grown on this ranch are of exceptional quality, as is indicated by the fact that they are carried to Green River by mule pack train and shipped to Chicago and other eastern markets and demand the best prices. For about a mile downstream from the upper end of this ranch the canyon is broad and open; then Gray Canyon begins, cut through gray sandstone and shale.

Desolation Canyon is about 78 miles long, and in that distance the total fall is 355 feet, or an average of 4.55 feet to the mile.

Gray Canyon.—The physiographic features of Gray Canyon are very similar to those of Desolation Canyon, with the walls increasing in height as the descent is made through the canyon. In the vicinity of Coal Creek and for several miles below the river flows in a narrow box gorge with vertical walls that break back into rough, barren slopes. In many places this inner gorge is as much as 100 feet deep. Vegetation is confined to a fringe of willows along the river bank, with here and there a larger tree that has been able to get a footing and survive.

About 18 miles above Green River, Utah, the Price River joins the Green from the west. During the flood stages this stream carries a considerable flow and no mean amount of débris, but during the dry season practically all the flow is diverted for irrigation in the upper part of its basin, and all that reaches the Green River is a small stream of muddy water having a very disagreeable odor.

Gray Canyon is about 27.5 miles long, its total fall in that distance is 187 feet, and the average fall is 6.8 feet to the mile.

Gunnison Valley.—About 6½ miles below the mouth of the Price River the Green emerges into Gunnison Valley, and 11 miles farther down is the city of Green River, Utah, a station on the main line of the Denver & Rio Grande Western Railroad between points in Utah and Colorado.

The mapping from this point down to the mouth of the Green River, a distance of 117.3 miles, was done in 1914 by the United States Bureau of Reclamation, and accordingly the work of the Geological Survey party was completed with the tying of its work to that of the previous survey.

The fall from the mouth of Gray Canyon to the city of Green River is 41 feet, or 3.73 feet to the mile.

OTHER EXPEDITIONS

Another voyage down the Green River from Green River, Wyo., to Green River, Utah, was made in August, 1926, by a party consisting of Webster B. Todd, of New York; M. Ogden West, of Chicago; F. LeMoyne Page, of Pittsburgh; H. E. Blake, jr., of Monticello, Utah; and C. H. Hale, of Manila, Utah. This trip was made as a vacation outing with two of the boats used by the Geological Survey party in 1922. One of them lodged on a partly submerged rock in midstream in the Canyon of Lodore and, after many hours of futile effort to dislodge it, was abandoned.

Mr. Page [38] in describing this scene says:

> The high, confining walls which had seemed so beautiful and grand a day or so before now almost drove me mad, * * * but I could see no advantage in remaining there, hoping for some miracle to pull the boat off the rock. She was on there, and on there to stay, and nothing short of a steel cable with plenty of rope to string across the rapids to hand-over-hand it above the water out to the boat would get her off. So with heavy hearts we broke our last camp in Lodore, the canyon which always seems to exact such heavy toll.

When the party reached Jensen, Messrs. Page and West left it. The others continued to Green River, Utah, where the remaining boat was placed in storage, and the party disbanded.

Below the town of Green River, Utah, many boat trips have been made on the river. The town is on a transcontinental railroad, and is the most convenient starting place for all expeditions down the Colorado River, into which the Green empties at a point about 117 miles below the town. It was also considered in the early nineties a possible shipping point for the products of the Moab Valley, which lies along the Colorado River about 65 miles upstream from the mouth of the Green. For this purpose, however, it was contemplated that the two rivers between the two places should be used as a highway for freight and passenger boats. After several unsuccessful attempts had been made to carry out this plan with the steamers *The Undine*, *Major Powell*, and *Cliff Dweller* (later named the *City of Moab*), appeal was made to Congress to improve the streams for navigation. As a result of a provision in the river and harbor act of March 3, 1909, the channel conditions of the streams between the towns of Green River and Moab were investigated, and an unfavorable report was made by Assistant Engineer D. E. Hughes, of the Corps of Engineers of the War Department. In 1912 the United States Bureau of Reclamation made a river survey including the stretch of the Green River below Green River, Utah; in 1914 and again in 1921 E. C. LaRue, a hydraulic engineer of the

[38] Personal communication.

United States Geological Survey, made studies of this stretch; in 1926 E. T. McKnight and S. S. Nye, geologists of the Geological Survey, made a geologic examination of this portion of the stream; and in 1928 W. G. Hoyt, a hydraulic engineer of the Geological Survey, made additional investigations of the channel and other physiographic conditions along the stream. Later in the fall of 1928 Mr. and Mrs. Glenn R. Hyde, seeking adventure, left Green River, Utah, to boat through the canyons of the Colorado, but they were never seen again after pushing off from the foot of the El Tovar trail.

MAPS AND PROFILES

Topographic maps and profiles based on instrumental surveys of the Green River from Green River, Wyo., to its mouth, a distance of 504.3 miles, are now available, also a reconnaissance plan and profile of 98 miles of the river above Fontenelle, Wyo., and standard topographic maps covering the headwaters of the stream.

The standard topographic maps are those of the Gros Ventre and Fremont Peak quadrangles, printed in three colors on a scale of 2 miles to 1 inch, with a contour interval of 100 feet. These maps can be purchased from the Director, United States Geological Survey, Washington, D. C., at 10 cents each.

The reconnaissance plan and profile of the 98 miles above Fontenelle consists of five sheets lettered A to E and shown on Plates I to V in Geological Survey Water-Supply Paper 396, obtainable from the Superintendent of Documents, Government Printing Office, Washington, D. C., for 50 cents. The horizontal scale is 2 inches to 1 mile, and the vertical scale is 40 feet to 1 inch. These are based on General Land Office plats surveyed in 1909.

The results of the work done by the Geological Survey party in 1922 are published on 16 sheets (10 plans, 6 profiles), lettered A to P. The scale is 2 inches to 1 mile, with a contour interval of 20 feet on the land and 5 feet on the water surface. In addition to the topography of the canyons and the location of the streams, the plans show all land lines, dwelling houses, roads, and other artificial features.. These sheets are obtainable from the Director, United States Geological Survey, Washington, D. C., at 10 cents each, or $1.60 for the set.

The plan and profile of the river below Green River, Utah, is published on 9 sheets (6 plans, 3 profiles), lettered A to I and shown as Plates XIII to XXI of Geological Survey Water-Supply Paper 396, obtainable as indicated above.

While the work was being done on the Green River in 1922 similar work was done on the Yampa River. Five sheets (3 plans, 2 profiles), similar to those of the Green River, show the data for the Yampa from its mouth to a point 111 miles upstream. These are also obtainable from the Director of the United States Geological Survey at 10 cents a sheet, or 50 cents for the set.

TOTAL FALL OF THE GREEN RIVER

The following table shows by sections the fall from Green River, Wyo., to the mouth of the river in Utah.

Length and fall of stretches of Green River between Green River, Wyo., and the mouth

	Distance (miles)	Total fall (feet)	Average fall (feet to the mile
Green River, Wyo., to Flaming Gorge	69	220	3.19
Flaming Gorge	1.5	3	2.00
Horseshoe Canyon	3.5	5	1.43
Neilson Flat	2.5	4	1.60
Kingfisher Canyon	2.0	3	1.50
Hideout Flat	1.5	10	6.67
Red Canyon	31	360	11.60
Little Browns Park	8.5	75	8.83
Swallow Canyon	4	19	4.75
Browns Park	20.5	32	1.56
Canyon of Lodore	17.5	269	15.40
Echo Park	2	8	4.00
Whirlpool Canyon	9	98	10.90
Island Park	8	30	3.75
Split Mountain Canyon	7	145	20.70
Uinta Basin	83	155	1.87
Desolation Canyon	78	355	4.55
Gray Canyon	27.5	187	6.80
Mouth of Gray Canyon to Green River, Utah	11	41	3.73
Green River, Wyo., to Green River, Utah	387	2,019	5.22
Green River, Utah, to mouth	117.3	160	1.36
Grand total	504.3	2,179	4.33

DESCRIPTIVE GEOLOGY OF GREEN RIVER VALLEY BETWEEN GREEN RIVER, WYO., AND GREEN RIVER, UTAH [39]

By John B. Reeside, Jr.

The course of the Green River between Green River, Wyo., and Green River, Utah, lies upon the eroded remains of three major geologic features of the region—a large, elongated troughlike depression in the rocks, with its greater dimension lying north and south, the Bridger Basin; a large archlike uplift, with its longer dimension lying east and west, the Uinta Mountain region; and a second elongated depression with its greater dimension lying east and west, the Uinta Basin.

The Bridger Basin lies mostly west of the Green River, and the stream above Flaming Gorge really passes along the eastern rim, not far within it and parallel to it. The Uinta Mountain uplift over part of its length was in its fundamental plan a simple arch. Where the Green River crosses it, however, there was a main large arch and several smaller subsidiary arches south of the main one, the center line or axis of all the folds trending in an east-west direction. The

[39] More detailed discussion of the geology of Green River Valley and references to other publications will be found in a paper by the writer, Notes on the geology of Green River Valley between Green River, Wyoming, and Green River, Utah: U. S. Geol. Survey Prof. Paper 132, pp. 35-50, 1923.

supporting ends of the main arch were broken by faults, an added complication. The course of the river through this uplift area between Flaming Gorge and the Rim Rock is irregular. It crosses the main arch, whose highest remnants are the present Uinta Mountains, by a very circuitous route through Flaming Gorge, Red Canyon, Browns Park, Lodore and Whirlpool Canyons; the northern minor arch diagonally, through Split Mountain Canyon; then the intervening trough in several meanders and the southern minor arch almost at a right angle to the axis, in the neighborhood of Jensen, Utah. The river cuts squarely across the Uinta Basin between the Rim Rock, south of Jensen, Utah, and the town of Green River, Utah, giving a cross section that shows the basin to be very unsymmetrical. As seen from the river, the rocks of the northern part of the basin form a belt on the surface about 10 miles wide and dip with relative steepness southward to the lowest point or axis; the rocks of the southern part form a belt on the surface about 95 miles wide and dip gently northward to the axis.

It is convenient, in the more detailed description which follows, to divide the three large fundamental units into the smaller units formed by the processes of erosion along the course of the river—the successive canyons and open valleys. These will be considered in order downstream from Green River, Wyo.

Over much of the distance from Green River, Wyo., to Flaming Gorge, a series of beds of yellowish sandstone, light-gray limestone, and gray shale, known to the geologist as the Green River formation, form the bedrock. The gray slopes are at many places capped by a striking bed of brown sandstone, long called the Tower sandstone because of its weathering into towerlike masses. At many places there are terraces covered by river gravel and other gravel deposits that represent former stages of the river higher and older than the present level but still much more recent than the Green River formation. The beds of the Green River formation here lie so nearly flat that the eye can not detect any dip in them. Some 6 miles north of Flaming Gorge, and consequently near the boundary between the Uinta uplift and the Bridger Basin, an appreciable northward dip appears. This dip increases gradually southward until at Flaming Gorge the rock layers stand on end. As a result beds underlying the Green River formation appear successively downstream. First there is a series of white to brown sandstone, gray shale, red shale, and some coal beds, called the Wasatch formation; then a thick mass of rather soft gray shale, the Lewis shale; then a series of interbedded brown sandstone, gray shale, and coal beds, the Mesaverde formation, which here forms low ridges; then a second soft gray shale, the Hilliard shale, eroded down to a broad open lowland. Beneath the Hilliard shale, near Flaming Gorge, there lie in succession a thin sandstone with some lenses of shale and coal, the Frontier formation; a hard, fissile platy gray shale, the Aspen shale; a thick brown pebble-bearing sandstone, the Dakota (?) sandstone; a series of variegated gray, greenish, and purplish shale with some pebble-bearing sandstone near the middle, all together forming the Morrison formation; a thin unit of gray limestone and calcareous shale, the Twin Creek limestone; and finally a great gray-white to brown sandstone, the Nugget sandstone, which forms the backbone of the Boars Tusk Ridge and caps the bluff at the entrance to Flaming Gorge.

From Flaming Gorge to Hideout Flat the Green River zigzags through a series of alternating short, deep canyons and open areas across a belt of rocks that lie underneath the Nugget sandstone. At the entrance to Flaming Gorge the layers are vertical, but they quickly bend over downstream so that they dip north, and in the gorge beneath the Nugget sandstone is displayed a considerable thickness of deep red sandstone and shale which have been divided into the Ankareh, Thaynes, and Woodside formations; then a group of massive gray limestones containing much flint and separated by limy and phosphatic shales, the Park City formation; and under this a very striking thick brown sandstone which makes the walls of Horseshoe and Kingfisher Canyons—the Weber sandstone. At the lower end of Kingfisher Canyon a great fracture has permitted the Weber sandstone to come into contact with very much older rocks. The old rocks have risen relatively and come up to the level of the Weber, whereas their normal position would be far below.

From Hideout Flat to Browns Park, a distance of about 22 miles, the Green River flows through Red Canyon. The walls throughout are formed by beds of dark-red to brown sandstone and quartzite with some layers of conglomerate and shale. The whole series was long ago called the "Uinta quartzite," though the name Uinta properly belongs to another and very different set of much younger rocks which occur to the south in the Uinta Basin. No other name has been proposed, however, and the old name is used here. In Red Canyon the formation contains somewhat more of shaly, thin-bedded constituents than it does at other localities, and the valley is much more open than the Canyon of Lodore, described below. Throughout Red Canyon débris weathered from the walls covers much of the solid rock, with the result that tree-clad slopes appear rather than sheer cliffs, in marked contrast to some of the other canyons.

Below Red Canyon the river crosses a broad open area about 20 miles long, known as Browns Park. The greater part of the area is underlain by rather soft, very light colored sandstone which constitutes the Browns Park formation. At some places the river leaves the soft beds and flows again on the hard "Uinta" quartzite. One of these stretches is Swallow Canyon, where a dam would have strong, solid walls and foundation.

Downstream from Browns Park the river passes into the Canyon of Lodore, a deep gorge extending about 13 miles (in a straight line) southward from Browns Park to Echo Park. The north half of this canyon shows only the striking deep-red to brown "Uinta" quartzite, here standing at most places in bare cliffs. Then high on the canyon walls and resting on the "Uinta" quartzite appears a thick dark-red sandstone, breaking into flagstones, and above it a considerable thickness of red and green sandy shale. These beds, constituting the Lodore formation, dip downstream and descend in the canyon walls until at Alcove Brook they reach river level. As they descend there comes into view above them a sheer wall of massive gray to brown limestone with many layers of chert, and in turn above this a thick series of interbedded gray limestone, red shale and sandstone, and gray shale and sandstone. Neither the massive limestone nor the variable beds above it have yet received modern distinctive names, though early explorers gave them names not now accepted. Above the variable beds appears the same thick brown Weber sandstone which makes the walls of Horseshoe and Kingfisher Canyons. The rocks of the Canyon of Lodore are therefore progressively younger downstream. (See fig. 2.)

Below the Canyon of Lodore, at the mouth of the Yampa River, a small U-shaped area called Echo Park is shut in by sheer walls of Weber sandstone. A great fracture in the rocks has cut across the north side—the open end of the U. The rocks south of the break have been dropped, and those north of it raised. The result is that older rocks appear immediately downstream in Whirlpool Canyon.

Whirlpool Canyon extends from Echo Park to Island Park, an air-line distance of about 7 miles. At the upper end several hundred feet of the "Uinta" quartzite rises above the river, having been elevated in the movement that made the fracture mentioned above. Above the "Uinta" quartzite lies the same succession of

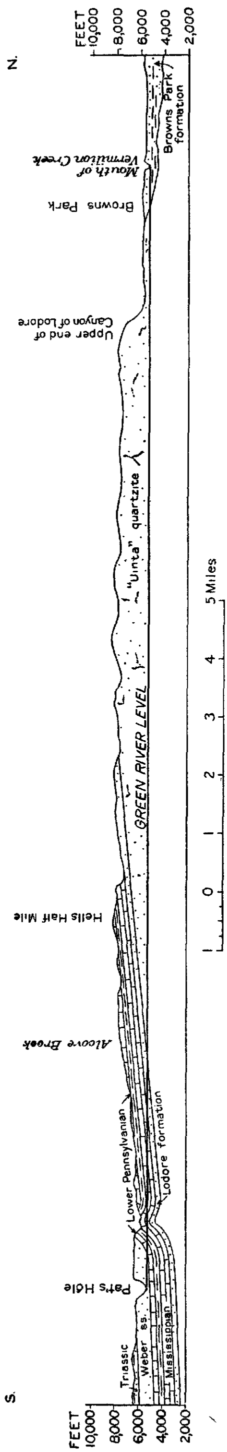


FIGURE 2.—Formations from Browns Park along the Canyon of Lodore to Echo Park

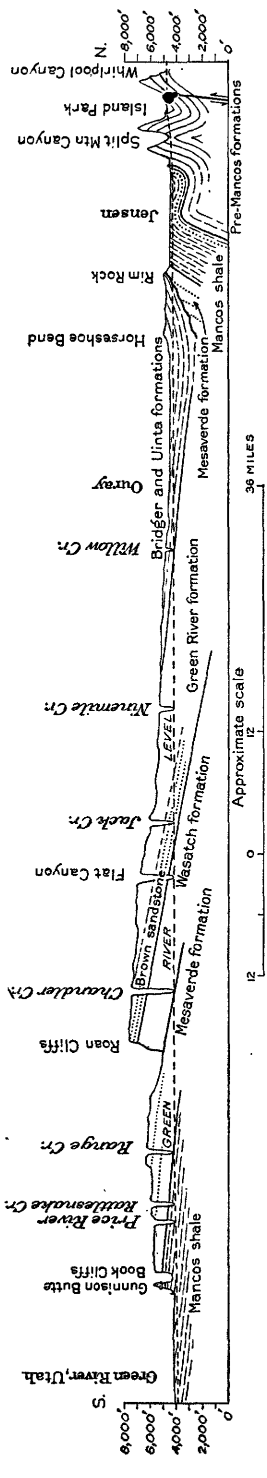


FIGURE 3.—Formations of Green River Valley from Whirlpool Canyon to Green River, Utah

formations as occur in the lower part of the Canyon of Lodore—the Lodore formation, the massive limestone, the variable series of limestone, shale, and sandstone, and the Weber sandstone. The beds dip gently downstream and come down to river level one after another until at the end of the canyon the Weber sandstone is again at river level. It is bent sharply downward, however, along another fracture in the rocks which has permitted the rocks upstream to rise relatively to those downstream in Island Park. (See fig. 3.)

Island Park, Rainbow Park, and Little Park are part of an area in which the rocks have the form of an unsymmetrical trough with its axis plunging toward the west. This trough lies between the main Uinta arch and the Split Mountain arch (the northern minor arch). The rocks of the south half of the trough dip very steeply northward; those of the north half dip gently southwestward. The eastern nose, the higher end, of this plunging trough is cut off by the fault at the lower end of Whirlpool Canyon. The formations present in this trough include a series of beds younger than the Weber sandstone and in large part the same as those in the neighborhood of Flaming Gorge. In ascending order there are the Park City formation of phosphatic shale and limestone; the red sandstone and shale of the Ankareh, Thaynes (?), and Woodside formations; the thick brown to white Nugget sandstone; the gray and greenish impure limestone and shale of the Twin Creek formation; the purplish and greenish shale and dark-brown conglomerate of the Morrison formation; and the massive sandstone and dark shale of the Dakota (?) formation. Above the Dakota (?) sandstone come rocks much like those called near Flaming Gorge the Aspen shale, Frontier formation, and Hilliard shale but here all grouped together as the Mancos shale.

The Green River leaves Island Park to plunge abruptly into Split Mountain Canyon, cut through what was once the second arch of the Uinta Mountain uplift. At the present time erosion has cut out much of the central part, leaving only the supporting ends of the arch standing high. The river first passes directly across the north abutment of the arch to the axis, then turns sharply and runs along this middle line, then turns sharply again to cross the southern abutment. It therefore passes through the Weber sandstone and the variable series of limestone, shale, and sandstone and reaches the massive brown to gray limestone, the oldest rock exposed in Split Mountain Canyon. Then the river passes through the same beds in reverse order, emerging through a gap cut in Weber sandstone.

Between Split Mountain Canyon and the Rim Rock, a ridge 6 miles south of Jensen, Utah, the Green River crosses first a trough-like depression in the rocks and then the southernmost minor arch of the Uinta uplift. Both of these folds dip toward the west and complicate the surface distribution and attitude of the rock layers. The trough lies between Split Mountain and Jensen and is very unsymmetrical, the north side dipping much more steeply than the south side. Owing to this difference in dip the beds near Split Mountain stand in a narrow belt of hogback ridges and intervening depression in which the river passes in a short distance across the same series of rocks described as underlying Island Park, including the formations from the Weber sandstone to the Dakota(?) sandstone. The actual bed of the river most of the way from Split Mountain to the Rim Rock is upon the soft material of the Mancos shale eroded down to a wide open valley. At Jensen, nearly on the axis of the arch, a thick sandstone layer in the lower part of the Mancos shale forms a bluff a short distance east of the river. There are also some striking gravel benches and river terraces in the area, remnants of former higher and older river levels.

Below Jensen the river is crossing the south limb of the arch, and the beds dip downstream. The valley is wide, and exposures of bedrock are few. However, the river passes younger and younger beds of Mancos shale until at the Rim Rock the top of the formation is reached, and the ridge is made up of interbedded sandstone and shale composing part of the Mesaverde formation described as occurring near Flaming Gorge. Probably part of the formation as originally deposited is no longer present, for upon it rest very much younger beds, and the Mesaverde rocks must have suffered erosion before the younger beds were laid down upon them.

These younger beds are irregular lenses of dark-brown sandstone and mauve or wine colored shale and constitute part of the Bridger and Uinta formations. They seem to form the bedrock of the valley downstream for a considerable distance, but dip more and more gently until at Horseshoe Bend they lie flat on the midline of the Uinta Basin. South of Horseshoe Bend the dip, though very gentle, is distinctly northward, and the river passes over beds progressively older downstream. Near Desert Spring Wash the highly colored Bridger and Uinta formations rest upon light-colored beds—yellowish and gray shale, oil shale, thin-bedded light-colored sandstone and limestone—which together make up the Green River formation noted along the river north of Flaming Gorge.

The valley of the Green River from the lower end of Split Mountain Canyon down to the mouth of Willow Creek, a distance of about 40 miles, is rather open, and the relief is generally low. From Willow Creek to Ninemile Creek, a distance of about 16 miles in a direct line southwestward, the relief increases and becomes very marked, though not strictly of canyon type. The banks of the river below Desert Spring Wash are made by the beds of the Green River formation.

From Ninemile Creek to the Roan Cliffs, just below the McPherson ranch, a distance of about 30 miles downstream in a straight line, the Green River flows through Desolation Canyon. The rocks of the canyon dip very gently northward, so that the river in passing southward runs upon progressively older rocks. From Ninemile Creek to Tabyago Creek the rocks in sight are the Green River formation. Then there appears at river level and rising downstream higher and higher on the walls a formation of brown sandstone with which a minor amount of reddish and greenish shale is interbedded. At Jack Creek a group of rather variable beds of reddish-brown sandstone and red shale with some gray shale appear at river level, rising on the walls downstream. These beds are the Wasatch formation, noted before above Flaming Gorge. The brown sandstone series above the typical Wasatch beds and beneath the typical Green River beds may be really a part of either the Wasatch or the Green River, but there is doubt where it should be placed. It is probable that the lower part of the Green River formation at some places, the upper part of the Wasatch at other places, and the brown sandstone series were deposited at the same time, the differences being due to local differences in conditions of sedimentation, and that the three different types of rock would pass into one another along the bedding planes if exposures were adequate to permit such tracing of the beds. In the Roan Cliffs all three are well shown.

From the Roan Cliffs downstream to the point where the Green River emerges from the Book Cliffs, near Gunnison Butte, a distance of a little more than 20 miles in a straight line, the river flows through Gray Canyon. The walls are composed of a variable succession of hard, cliff-making brown sandstone, soft gray shale, brown carbonaceous shale, and some coal beds. This series of beds is the Mesaverde formation, lying immediately beneath the Wasatch formation and resting upon the Mancos shale.

From the Book Cliffs to Green River, Utah, about 10 miles to the south, the valley of the Green River is low and open and was cut in the soft easily eroded beds of the gray Mancos shale. This shale has a gentle northward dip. On it in places rest terrace and other deposits of gravel, remains of former stages of the river higher and older than the present level but still much more recent than the Mancos shale.

FORESTATION

The headwaters of the Green River lie within the Wyoming National Forest, which now includes the area formerly within the Bridger National Forest; those of Blacks Fork lie within the Wasatch National Forest; those of the Yampa River lie within the Routt, White River, and Hayden National Forests; those of the White River in the White River National Forest; those of the Duchesne and its principal tributaries in the Ashley and Uinta National Forests; and those of the Price and San Rafael Rivers in the Manti National Forest. The total area of national-forest land within the Green River drainage basin is more that 4,500,000 acres.

Lodgepole pine is the predominating species in the forests at the Green River headwaters, and there is also a considerable amount of it in the forests on the Yampa and White Rivers, but it does not extend south of the Uinta Basin. Much aspen is found in the Manti National Forest, and also considerable stands of Douglas fir, yellow pine, Engelmann spruce, and alpine fir at the higher altitudes. In addition to the lodgepole pine on the headwaters of the Yampa and White Rivers there are Engelmann spruce, Douglas fir, alpine fir, and blue spruce in commercial quantities, and throughout the lower portions of the forest areas a very considerable amount of aspen makes a fringe several miles wide just within the forest boundaries.

All these forests are for the most part virgin and have not suffered greatly from forest fires. The forest cover is not dense, because of the relative low rainfall of the region, but much forage is produced in the open timber, in the parks, and on the open ridge tops.

At the present time lodgepole pine is being used to an increasing extent by the Union Pacific Railroad for ties. The trees are cut on the high mountains of the upper Green River Basin and hewn into ties during the winter. In the spring they are floated down the tributaries of the Green River to railroad points, from which they are shipped to the tie-preserving plants for treatment. Summer grazing is of great importance in these forests and supports large numbers of sheep and cattle. The number and management of the flocks and herds are so supervised as to avoid the evils of overgrazing, and every precaution is taken to protect the drainage areas.

Data on national-forest areas within Green River Basin

Forest	Area in Green River Basin (acres)	Amount of timber (thousands of board feet)	Grazing	
			Number of cattle and horses	Number of sheep and goats
Ashley	987, 673	1, 643, 030	9, 293	89, 699
Bridger (added to Wyoming)	701, 971	1, 512, 359	44, 434	82, 925
Hayden	167, 880	105, 000	550	60, 650
Manti	473, 014. 26	1, 641	8, 400	82, 700
Routt	606, 890	835, 000	13, 360	75, 150
Uinta	608, 286. 83	546	7, 900	11, 200
Wasatch	56, 126. 92	326	200	15, 400
White River	562, 920	559, 517	24, 830	23, 500
Wyoming	408, 137. 88	13, 142	12, 700	141, 000
	4, 572, 899. 89	4, 676, 561	111, 667	582, 224

SCENIC AND RECREATIONAL FEATURES

With the great diversity of physical features such as high, rugged mountain ranges, high mountain plateaus, large forests, picturesque canyons, and mountain lakes, the Green River Basin is replete with scenic and recreational attractions.

In the upper basin especially, along the west slopes of the Wind River Mountains, several beautiful lakes are easily accessible by automobile, and good camp sites are available everywhere around them. The streams leaving the lakes are well stocked with trout, the summer climate is delightful, and to the lover of boating and water sports these crystal-clear lakes are inviting playgrounds. To those who enjoy mountain climbing and adventure the Wind River Mountains have a strong appeal, for they are extremely rugged and are cut by picturesque canyon gorges with cascades and waterfalls. Along the crest of the range, far above the timber line, are many glaciers, and scattered among the majestic peaks are hundreds of small glacial lakes, some isolated and others joined by a network of beautiful little streams. The slopes below timber line are densely forested and furnish a retreat for elk, moose, deer, bear, wolves, and other kinds of big game. In and around the streams otter, beaver, and muskrat are not uncommon, and in the lower valley grouse, sage hens, ducks, and geese are abundant. A good automobile road leading north from Rock Springs, Wyo., extends through this basin and down the Hoback River to Jackson Hole and Yellowstone Park, with delightful scenery along most of its length.

In the basins of the White and Yampa Rivers a number of hunting lodges and summer resorts have been established in the picturesque parks on some of the streams and near Trappers Lake, at the head of the White River. The beautiful scenery of the headwater areas of these two rivers and the good fishing in the clear, sparkling tributaries and lakes have become widely known among seekers of outdoor recreation. Good roads have made many of these places easily accessible by automobile, and fish and game of all kinds are abundant. One of the places of historic interest in this region is the old Hahns Peak mining camp, with its charming setting at the foot of the great peak of the same name. A good automobile road follows up the picturesque valley of the Elk River and over the Willow Creek divide into Hahns Peak Basin, about 28 miles north of Steamboat Springs.

The town of Steamboat Springs is popular as a summer and health resort, because of its delightfully cool summer climate and the many mineral springs within and around it. It is also the site of the annual Midwinter Sports Carnival which has been held for many years. Skiers throughout the country are familiar with the winter sports here, and besides ski jumping, cross-country races on skis, tobogganing, skating, and other sports are enjoyed.

In the Uinta Basin in Utah the scenic features are confined largely to the Uinta Mountains, whose crest is a forest-covered region of rounded glacier basins studded by hundreds of small lakes. According to Hague and Emmons,[40]

> The scenery of this elevated region is singularly wild and picturesque, both in form and coloring. In the higher portions of the range, where the forest growth is extremely scanty, the effect is that of desolate grandeur; but in the lower basinlike valleys, which support a heavy growth of coniferous trees, the view of one of these mountain lakes, with its deep-green water and fringe of meadowland set in the somber frame of pine forests, the whole inclosed by high walls of reddish-purple rock whose horizontal bedding gives almost the appearance of a pile of cyclopean masonry, forms a picture of rare beauty.

A panoramic view from any one of the lofty peaks includes scores of beautiful glacial lakes. At least 70 can be seen from Bald Mountain, and more than 500 are scattered throughout the great amphitheatral areas near the crest of the range. Some of the lakelets lie in solid rock basins; others are in drift basins formed by the irregular distribution of morainic deposits. Many of these occur in chains, usually connected by small turbulent streams. Most if not all of the lakes support a variety of water plants, and successive stages of vegetal fillings are apparent. Some lakes have long-stemmed pond lilies, working out from shore, others with pond lilies in the center have zones of rushes and grasses advancing from the margins. Finally the grasses reach the center, and a meadow succeeds the lake. In some canyons chains of these meadows now mark the former location of chains of lakes. The great forests covering the mountain range furnish homes for a variety of birds and a shelter for deer, antelope, mountain sheep, and brown bear. Feathered game is usually abundant in the lower valleys, and many of the streams are stocked with mountain trout and herring. The daily work of numerous colonies of beaver is also no mean natural attraction. The mountain region is an ideal camping and hunting

[40] Hague, Arnold, and Emmons, S. F., U. S. Geol. Expl. 40th Par. Rept., vol. 2, p. 194, 1877.

ground. In the valley area of the basin the villages and native haunts of the Ute and White River Indian tribes are very interesting. Several Indians famous in history are still living and will converse freely concerning early happenings in their country. Another wonderful and interesting experience was, until recently, a visit to the world's greatest dinosaur quarry, about 15 miles southeast of Vernal. The trip from Vernal to the quarry is an easy one by automobile, but unfortunately no work is now being done at the quarry, and earth slides have covered much of the workings where bones were exposed. In speaking recently of this great cemetery of prehistoric giants, Dr. Earl Douglass [41] says:

It is now over 12 years since the quarry was discovered, when the seven large vertebrae of the anterior portion of the tail of a large dinosaur were seen weathered out in relief on the face of the sandstone, in articular position. It was hoped that a complete skeleton could be obtained. This hope was realized but for the fact that the skull of the animal was not found. Beneath this skeleton were other bones, and another skeleton as complete as the first, but smaller, was uncovered. Indeed, one could not excavate far in any direction in this stratum without striking bones. So the work has continued year after year, going along the bone layer westward to the western slope of the hill, then downward and eastward again at a lower level, always finding new and interesting things and parts not found before. Practically complete skeletons of species not known have been found with limbs and ribs articulated and skulls nearly or quite in place.

As a rich quarry like this with such complete and satisfactory material has never been found before in any part of the world, these remains should furnish several chapters in the history of an age unknown. These huge skeletons excited popular interest, and the Carnegie Museum has been lured on year by year to continue its excavation work. As a result, the extreme length of the quarry is now about 400 feet and its maximum width is about 50 feet. Nearly a half million pounds of these fossils in the rock have been shipped to the Museum at Philadelphia. Probably a hundred thousand pounds more are now out in preparation for shipment, and nearly as much more remains in sight in the rocky ledge.

Instead of there being signs of its "playing out," the quarry seems to be getting better and the complete and interesting skeletons more numerous.

In October, 1915, the quarry was set aside by the Federal Government as a national monument, and it is visited by hundreds of visitors each season. To the northward as one travels from Vernal are the beautiful Uinta Mountains with their snowy peaks; to the eastward the Split Mountain uplift through which the Green River has cut its deep and rugged canyon, making it look like a huge volcano; and far to the southward spreads the wilderness of gray bad lands. Upon reaching Green River one sees a broad terraced valley terminating abruptly on the north by a nearly vertical uplift which presents wall after wall of massive rocks, between which are slopes of softer rock of a great variety of tints and colors.

The quarry is situated in the midst of this picturesque range of hills with the rugged Split Mountain in the background, and when fitted up as it should be it will be one of the most attractive national monuments, especially to all disciples of geology and those interested in the prehistoric inhabitants of the earth.

[41] Personal communication.

In the lower Green River Basin the natural beauty spots are fewer than in the other basins and are confined to the canyons of the tributaries of the San Rafael and Price Rivers in the forested portion of the Wasatch Plateau. Hunting and fishing are enjoyed as in the other basins but not to the same extent, because of the smaller area of the playgrounds. To those who are interested in geology this basin is unique in its exposures of geologic formations and the fantastic results of weathering.

Last but not least of the scenic and recreational features of the Green River Basin is the river itself, with its picturesque canyon gorges and alternate stretches of placid and turbulent waters. To those who like adventure a boat trip down the Green River should appeal, but as set forth in the account of the early expeditions down the river, such a trip is hazardous and accordingly should be arranged and conducted with adequate care.

Visitors to national forests within Green River Basin, 1926

Forest	Campers	Picnickers	Transient tourists	Other guests	Total
Ashley	2,616	1,050	933	50	4,649
Manti	5,200	1,700	1,425	----------	8,325
Routt	2,555	1,460	21,085	290	25,390
Uinta	3,840	2,150	45,760	80	51,830
White River	1,390	450	835	605	3,280
Wyoming	1,075	1,000	675	180	2,930
	16,676	7,810	70,713	1,205	96,404

CLIMATE

GENERAL CONDITIONS

The several minor basins drained by the Green River and its tributaries form, as a whole, a region which is somewhat isolated and sheltered from average storm tracts and whose subdivisions have similar climatic characteristics. Most of the area is comparatively free from sudden or severe meteorologic changes due to storm movement, though, owing to the general high altitude and the preponderance of clear dry air, temperature ranges are rather wide, the frost-free season is short, the percentage of annual precipitation in the form of snow is large, and the rainfall as a rule is comparatively light.

The basin floors are particularly deficient in precipitation, though there is a pronounced increase in precipitation with altitude from the foothills to the mountain tops. The lowland precipitation, though more than half in the form of snow, which might tend to accumulate, does not contribute greatly to the stream flow but sinks largely into the soils. There is a much greater run-off from the late summer and early autumn thundershowers, though these are too light and infrequent to contribute greatly to the general stream flow, which originates mainly from the mountain exposures.

Much the greater percentage of the mountain precipitation is in the form of snow and is conserved to a certain extent, though early summer warmth carries the snow away rapidly, and spring freshets appear in all the streams. The accumulation of the mountain snowfall is rather gradual from month to month, and thus the snow stores are probably more constant from year to year than if the maximum amounts were received in a briefer period. There are however, years of abundance and years of dearth arising from variations in the general meteorologic conditions. There are also wide variations in the spring temperature and amounts of spring rain, which affect to some extent the rapidity with which the spring run-off occurs and the duration of the high water, though owing to the high altitude of the headwaters the effect of these variations is not great.

The agricultural areas are dependent almost wholly on irrigation, the rains and snows on the farm soils lending comparatively little aid. In addition to the light precipitation, factors that contribute to a low duty of water are the large number of sunshiny days, the moderately high daytime temperature, the increased wind velocities over the plains, the generally dry and desiccating atmosphere, and the excessive evaporation. These conditions are especially apparent over the lower Green River Basin, where as a matter of fact irrigation water at the time when it is needed is also more deficient.

The weather stations and records from which this information is obtained do not cover the area with geometric precision and regularity, being mostly confined to the settlements. Thus wide areas of bottom land, plateaus, and plains, as well as most of the mountainous sections, are without direct meteorologic record. However, as the climatic conditions do not change abruptly, the number and distribution of the stations listed herewith make the records fairly representative of both temperature and precipitation conditions over the Green River Basin as a whole and excellently representative for the inhabited districts.

UPPER GREEN RIVER BASIN

The nine weather stations in the upper Green River Basin represent the area very well geographically. They have an average altitude of about 7,000 feet, or about the greatest altitude at which any form of agriculture may be successfully practiced, though, they are as a rule in the settlements or the more sheltered locations.

The basin is protected by substantial mountain ranges from the warm southerly winds from the desiccated southwestern deserts, the storm-bearing winds from the west or northwest, or the intensely cold winds from the north or northeast. Thus the area as a whole is comparatively free from vigorous and sudden changes in temperature such as occur at the same latitude east of the Rocky Mountains.

However, being on the edge of the average path of storms that cross this part of the country, it is visited by an occasional storm which brings severe conditions of precipitation, wind and cold, though these are likely to be of brief duration. When a storm center crosses this area the portion north of the storm center experiences intensely cold weather, with conditions approaching the blizzard of the plains States, if the storm is severe and energetic.

Temperature ranges are comparatively large, owing to the prevailing clear skies, low humidity, and high altitude, the minima especially going very low under certain circumstances. The average annual temperature for six stations that have an average altitude of about 6,800 feet and are fairly well distributed geographically is about 37° or 38°. This is about the same as the mean annual temperature for a similar area in extreme northern Minnesota or North Dakota. However, the variation in mean annual temperature over the basin is rather great, being, for example, about 33° at Kendall and 43° at Green River.

The average midsummer maximum temperature at Green River, the warmest place, is about 86°, and the corresponding minimum about 49°; at Daniel, Kendall, and Pinedale the average midsummer maximum ranges around 75° or 78°, and the corresponding minimum is 36° to 39°, giving a high daily range generally. The extreme highest temperatures of record are 100° at Green River and 90° at Kendall. The average midwinter minimum varies considerably, being about −6° at Eden and from −2° to −4° at Kendall, Daniel, and Pinedale; the corresponding maximum is about 28°. The town of Green River, Wyo., experiences midwinter minima from 5° to 7°, with corresponding maxima of 32° to 35°, showing a much shorter daily range in winter than in summer. The extremes of record are −51° at Daniel and −40° at Green River.

Only small portions of the land at the lower altitudes are free from freezing weather more then two months in summer; and much of the area suffers frost every month in the year. The accompanying statistical tables show the so-called crop-growing season, between the latest killing frost in spring and the earliest killing frost in autumn, to be about 90 days at Green River, where the altitude is 6,083 feet; but at Kendall, where the altitude is 7,725 feet, the growing season is only 40 or 45 days long. The cool nights during the summer further operate against successful general agriculture.

The annual precipitation for the stations in this basin, which have an average altitude of about 7,000 feet and a fairly satisfactory distribution, averages about 10.40 inches, ranging from 6.34 inches at Green River to 17.82 inches at Kendall. The monthly distribution through the year is rather uniform, there being no striking periods of comparative excess or deficiency. The annual snowfall for these stations averages about 60 inches, ranging from about 29 inches at Green River to 103 inches at Kendall and Hole in the Rock, exclusive of some short records. Snow falls every month in the year except July and August at some of these weather stations. The amount in both June and September is considerable, but it does not usually remain long on the ground. The heaviest snow usually comes in December to March. Snow forms about 60 per cent of the total annual precipitation, but of course the proportion is very much greater at the higher altitudes, where the accumulation is relatively gradual. The number of days in the year with 0.01 inch or more of precipitation averages about 55, ranging from about 45 at the lower stations to 80 at some of the higher ones. The prevailing winds are from the west or southeast over the basin generally.

Length of growing season in upper Green River Basin

Station	County	Altitude (feet)	Length of record (years)	Date of average killing frost		Average time between killing frosts (days)
				Latest in spring	Earliest in autumn	
Daniel, Wyo	Sublette	6,740	16	July 1	Aug. 20	50
Eden, Wyo	Sweetwater	6,577	9	June 17	Sept. 1	76
Green River, Wyo	do	6,083	16	June 9	Sept. 6	89
Hole in the Rock, Utah	Summit	8,600	8			
Kendall, Wyo	Sublette	7,725	8	July 10	Aug. 22	43
Lyman, Wyo	Uinta	6,800	2	June 8	Sept. 26	110
Manila, Utah	Dagget	6,225	8	June 22	Sept. 8	78
Opal, Wyo	Lincoln	6,681	4			
Pinedale, Wyo	Sublette	7,167	14	July 3	Aug. 23	51

Average monthly and annual maximum, minimum, and mean temperature in upper Green River Basin, in degrees Fahrenheit

Station	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual
Daniel, Wyo	28.4	29.3	37.4	48.9	58.8	67.3	75.3	75.3	66.3	56.3	41.6	31.2	51.3
	−3.6	−4.2	5.2	18.7	27.3	33.8	38.1	35.3	27.3	19.8	11.8	.5	17.5
	12.4	12.6	21.3	33.8	43.0	50.6	56.7	55.3	46.8	38.0	26.7	15.8	34.4
Eden, Wyo	26.9	29.4	40.2	54.4	63.7	74.6	81.8	80.9	69.8	57.9	41.9	26.7	54.0
	−5.8	−2.0	11.6	22.9	30.2	39.0	45.4	42.0	33.6	23.1	9.1	−5.8	20.3
	10.6	13.7	25.9	38.6	47.0	56.8	63.6	61.4	51.7	40.5	25.5	10.4	37.2
Green River, Wyo	32.2	35.6	46.3	56.9	66.6	78.6	86.9	85.6	74.3	59.1	46.7	32.1	58.4
	4.9	8.9	19.8	27.4	34.9	42.1	49.4	46.7	38.0	27.1	17.2	5.6	26.8
	18.6	22.2	33.0	42.2	50.8	60.4	68.2	66.2	56.2	43.1	32.0	18.8	42.6
Kendall, Wyo	26.4	27.7	33.5	41.5	54.7	67.3	74.0	73.2	64.2	50.6	39.0	27.2	48.3
	−1.4	−1.6	7.4	15.2	25.7	31.8	36.5	36.9	29.6	20.0	8.9	.1	17.4
	12.5	13.0	20.4	28.3	40.2	49.6	55.2	55.0	46.9	35.2	24.0	13.6	32.8
Manila, Utah	33.1	37.6	46.2	53.9	62.5	74.5	82.9	81.7	71.6	60.7	47.8	32.6	57.1
	2.3	8.7	17.3	25.8	32.5	42.0	47.9	44.8	37.1	29.2	16.2	3.8	25.6
	17.7	23.2	31.8	39.9	47.5	57.9	65.4	63.2	54.4	50.0	32.0	18.2	41.8
Pinedale, Wyo	25.9	30.1	37.9	49.8	60.7	72.2	80.4	78.0	67.9	54.5	40.5	27.1	52.1
	−1.7	−1.1	7.2	19.8	27.5	34.7	40.6	36.3	30.6	21.9	10.8	.3	18.9
	12.1	14.5	22.6	34.8	44.1	53.4	60.5	57.2	49.2	38.2	25.6	13.7	35.5

Average monthly and annual precipitation in upper Green River Basin, in inches

Stations	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual
Daniel, Wyo	1.15	1.20	1.19	0.75	1.23	1.11	0.83	1.02	1.06	0.80	0.54	0.74	11.62
Eden, Wyo	.26	.46	.37	.54	.71	.95	.71	.40	.84	.53	.16	.24	6.17
Green River, Wyo	.35	.49	.54	.68	.94	.37	.28	.49	.68	.89	.32	.31	6.34
Hole in the Rock, Utah	.72	.95	1.09	1.81	1.76	.63	1.19	1.16	.99	1.84	.76	.81	13.71
Kendall, Wyo	1.62	1.74	2.26	1.20	1.60	1.22	1.22	1.37	1.54	1.02	.99	2.04	17.82
Lyman, Wyo	.62	1.10	1.42	2.20	1.12	.30	.62	1.22	1.12	2.31	.62	.76	13.41
Manila, Utah	.37	.53	.48	1.65	1.15	.73	1.04	.65	1.10	1.46	.50	.43	10.09
Opal, Wyo	.31	.70	.91	.75	.20	.04	.06	.14	.03	.50	.80	.80	5.24
Pinedale, Wyo	.74	.73	.68	.48	1.05	.85	.92	.99	1.06	.75	.50	.63	9.38

Average monthly and annual snowfall in upper Green River Basin, in inches

Stations	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual
Daniel, Wyo	12.2	12.4	12.0	5.3	3.2	0.9	0	0	1.5	1.5	5.0	7.9	61.9
Eden, Wyo	2.1	5.4	3.4	2.7	.4	Tr.	0	0	.3	1.0	1.2	2.9	19.4
Green River, Wyo	4.7	5.2	5.9	3.5	1.0	Tr.	0	0	.2	2.4	3.0	3.1	29.0
Hole in the Rock, Utah	9.3	10.5	15.0	20.7	8.5	.1	0	0	2.2	12.8	12.3	11.5	102.9
Kendall, Wyo	16.6	19.7	21.6	10.0	2.9	.4	0	0	.6	5.1	10.4	16.2	103.5
Lyman, Wyo	7.1	9.4	14.6	13.3	Tr.	0	0	0	0	11.8	8.1	11.2	75.5
Manila, Utah	5.0	7.2	4.3	8.1	1.8	0	0	0	.4	1.9	4.0	7.4	40.1
Opal, Wyo	3.7	7.5	10.4	12.0	1.5	0	0	0	Tr.	9.2	8.0	9.8	62.1
Pinedale, Wyo	9.4	9.5	7.9	3.9	2.9	Tr.	0	0	.8	1.9	4.3	8.3	48.9

YAMPA AND WHITE RIVER BASINS

The broad high region that includes the basins of the Yampa and White Rivers is somewhat exposed to winds from the northwest, west, and southwest, though the average storm tracts are fairly well to the north of the region in winter, and thus weather changes are seldom sudden or severe. There is much clear, open weather in winter, with comparatively uniform temperature conditions from day to day. The temperature is moderately high in summer and pleasant in daytime in winter, though radiation conditions are good and night temperatures are moderately low, especially in winter, when snow covers the basin and when cold waves move in from the north or northwest.

The mean annual temperature for six stations having an average altitude of about 6,100 feet and a good geographic distribution is about 42.5°, or about the same as that for a similar area in extreme northern Wisconsin. The mean maximum temperature in midsummer is about 85° and the corresponding minimum about 45°; the highest of record is about 99° at Watson, Pagoda, and Steamboat Springs, 101° at Lay, 103° at Meeker, and 106° at Rangely. The average midwinter minimum for the basin is about 3°, and the corresponding maximum about 33°. The lowest temperatures recorded are −23° at Watson, −39° at Pagoda, −37° at Rangely, −43° at Meeker, −47° at Lay, and −54°, the coldest of record for the entire Green River Basin, at Steamboat Springs.

The length of time between the latest killing frost in spring and the earliest in autumn averages about 90 days but ranges from

55 days at Steamboat Springs to 123 days at Watson. The prevailing winds blow from the southwest in every month of the year. The average number of days with 0.01 inch or more of precipitation is about 85 a year, distributed rather uniformly through the twelve months and over the basin.

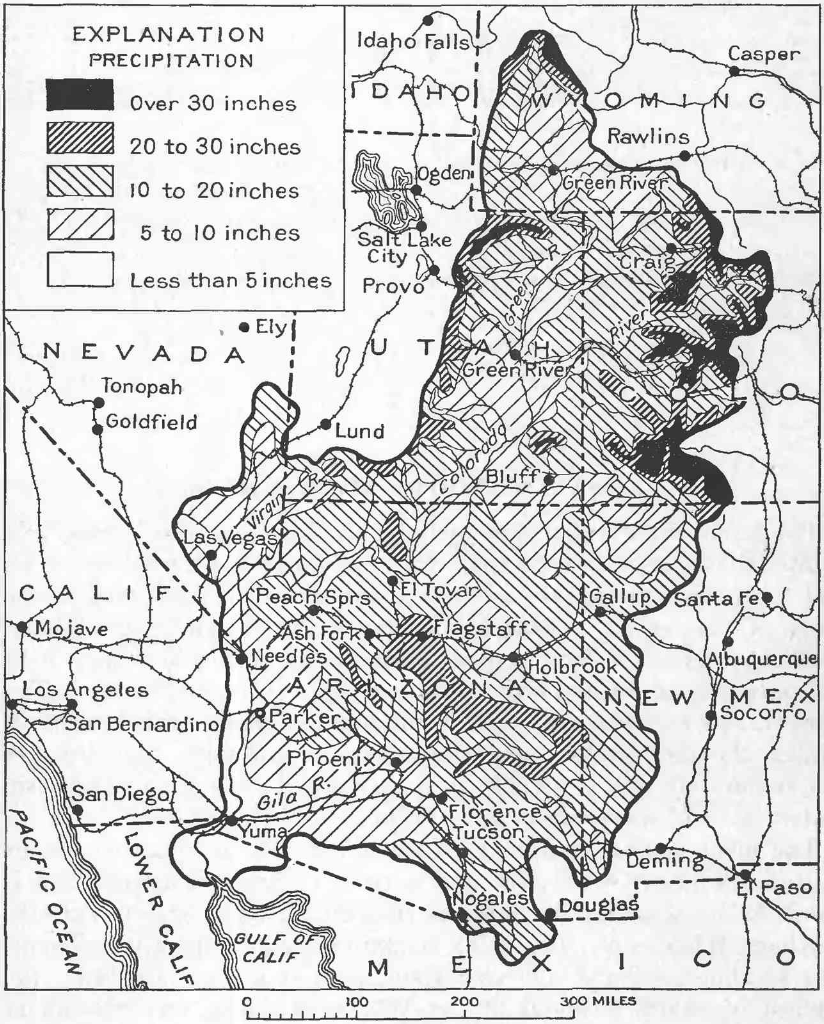


FIGURE 4.—Map of Colorado River drainage basin showing precipitation

The annual precipitation, determined from ten weather stations having an average altitude of 6,780 feet and a good geographic distribution, averages about 17.32 inches, ranging from 10.16 inches at Rangely to 23.48 inches at Pyramid. This is the wettest subdivision of the Green River drainage area. The amounts are fairly uniform from month to month, there being no periods of conspicuously greater or less precipitation.

The average annual snowfall varies greatly, from about 41 and 43 inches respectively at Watson and Rangely to 195 inches at Columbine and 215 inches at Pyramid, where the altitude is 8,000 feet or more. More or less snow falls in every month in the year except July and August, but the fall is a little heavier from November to April. About 62 per cent of the annual precipitation falls in the form of snow at the stations listed herein; at the higher altitudes the proportion is much greater.

Average dates of killing frost and length of growing season in Yampa and White River Basins

Station	County	Altitude (feet)	Length of record (years)	Dates of average killing frost		Average time between killing frosts (days)
				Latest in spring	Earliest in autumn	
Columbine, Colo	Routt	8,766	8			
Hayden, Colo	do	6,337	6	June 12	Sept. 11	91
Lay, Colo	Moffat	6,172	22	June 13	Sept. 5	84
Meeker, Colo	Rio Blanco	6,182	24	do	Sept. 11	90
Pagoda, Colo	Routt	6,500	18	June 16	Sept. 6	82
Pyramid, Colo	Rio Blanco	8,000	6	June 23	Sept. 5	74
Rangely, Colo	do	5,050	12	May 26	Sept. 18	115
Steamboat Springs, Colo	Routt	6,683	15	July 5	Aug. 29	55
Watson, Utah	Uinta	6,210	10	May 23	Sept. 23	123
Yampa, Colo	Routt	7,884	9			

Average monthly and annual maximum, minimum, and mean temperatures in Yampa and White River Basins, in degrees Fahrenheit

Station	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual
Lay, Colo	34.2	25.8	45.1	57.1	66.8	78.2	85.7	84.1	73.9	61.3	50.2	35.1	59.0
	1.4	4.7	18.6	27.0	32.9	39.6	46.9	45.9	36.9	26.7	15.0	5.9	25.1
	18.0	20.0	31.1	42.1	49.6	58.9	66.4	65.3	55.9	43.6	31.3	19.2	41.8
Meeker, Colo	35.8	39.1	48.1	59.7	68.7	78.9	84.3	81.8	73.4	61.2	49.8	35.4	59.7
	5.4	8.1	20.0	27.3	33.1	38.6	45.0	44.7	36.3	26.4	16.7	5.5	25.6
	20.4	23.8	34.1	43.7	51.1	58.8	64.9	63.5	55.2	43.8	33.2	20.1	42.7
Pagoda, Colo	35.5	36.9	46.2	57.5	66.9	77.6	84.7	83.2	75.6	63.0	49.0	35.6	59.3
	6.7	7.8	18.6	26.8	32.4	37.3	43.0	43.5	35.4	26.2	17.0	6.3	25.1
	20.4	22.5	32.0	42.0	49.7	57.4	63.8	63.4	55.6	44.4	32.8	20.8	42.1
Rangely, Colo	31.9	37.8	49.5	64.1	71.4	83.5	89.4	87.2	78.0	64.4	49.9	33.3	61.7
	—1.4	3.1	19.7	29.3	36.2	43.2	50.1	48.7	39.3	28.2	16.1	1.4	26.2
	15.0	21.1	34.6	46.6	54.1	63.5	69.7	67.9	58.6	46.3	33.6	16.7	44.0
Steamboat Springs, Colo	29.8	33.5	43.2	56.9	68.6	77.2	82.5	80.5	73.5	61.2	46.9	32.5	57.2
	.8	2.0	10.9	23.3	29.1	33.3	38.7	38.0	31.4	22.4	11.9	5.7	20.6
	14.8	17.7	26.7	39.2	48.2	55.2	61.0	59.4	53.1	42.4	30.3	16.3	38.7
Watson, Utah	32.7	37.4	47.7	58.1	68.8	81.0	86.3	84.9	75.0	61.1	48.4	33.4	59.6
	9.1	13.6	22.7	30.6	40.7	49.7	56.0	53.8	44.6	33.5	22.3	11.8	32.4
	20.3	26.5	35.9	44.5	54.2	65.6	71.0	69.3	59.8	47.3	35.4	22.6	46.0

Average monthly and annual precipitation in Yampa and White River Basins, in inches

Stations	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual
Columbine Colo	2.22	2.91	2.17	1.90	1.85	1.18	1.92	1.28	2.17	1.35	1.33	2.94	23.22
Hayden, Colo	2.18	1.17	.82	1.48	1.80	.92	1.49	2.00	2.31	1.61	1.28	1.36	18.42
Lay, Colo	1.17	1.22	1.44	1.15	1.33	.69	1.00	.98	1.35	1.10	.80	.87	13.10
Meeker, Colo	1.09	1.05	1.42	1.52	1.44	.93	1.45	1.60	1.73	1.50	1.02	1.08	15.83
Pagoda, Colo	1.31	1.85	1.95	1.87	1.44	1.09	1.31	1.58	1.82	1.68	.97	1.62	18.49
Pyramid, Colo	1.69	2.42	2.75	2.88	1.37	1.31	1.26	1.72	1.44	1.99	2.22	2.43	23.48
Rangely, Colo	.61	.80	.93	.55	.74	.54	.66	1.33	1.45	1.13	.66	.76	10.16
Steamboat Springs, Colo	2.54	2.58	1.72	1.84	2.03	1.40	1.28	1.61	1.60	1.69	1.52	2.45	22.26
Watson, Utah	.76	.64	.86	.89	.83	.76	1.35	.96	1.18	1.23	.76	.67	10.89
Yampa, Colo	2.20	1.56	1.23	1.48	1.11	.93	2.05	1.58	1.46	1.22	.92	1.56	17.30

Average monthly and annual snowfall in Yampa and White River Basins, in inches

Station	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual
Columbine, Colo	32.4	36.5	28.0	19.8	10.2	Tr.	0	0	2.8	13.2	20.9	31.4	195.2
Hayden, Colo	26.3	20.0	11.1	8.4	1.5	0	0	0	2.0	2.9	12.7	28.6	113.5
Lay, Colo	15.1	15.9	11.4	6.5	1.8	.2	0	0	.6	3.7	6.9	11.7	73.8
Meeker, Colo	14.0	11.8	12.0	5.6	.9	.1	0	0	.6	3.5	8.2	13.0	69.7
Pagoda, Colo	16.4	22.7	18.2	11.2	1.3	Tr.	0	0	1.0	7.1	8.5	19.8	106.2
Pyramid, Colo	21.1	30.9	38.6	33.6	5.2	.5	0	0	1.6	16.0	32.5	35.4	215.4
Rangely, Colo	7.8	9.5	7.5	1.8	Tr.	0	0	0	Tr.	.4	4.4	9.4	40.8
Steamboat Springs, Colo	32.2	28.4	17.7	10.9	2.2	.2	Tr.	0	2.1	5.2	14.7	27.9	141.5
Watson, Utah	5.6	4.7	10.3	5.6	.4	0	0	0	.5	.9	5.2	10.2	43.4
Yampa, Colo	15.9	14.2	9.7	8.8	3.4	.2	0	0	1.1	3.1	7.6	13.3	77.6

UINTA BASIN IN UTAH

The compact and well-sheltered Uinta Basin is crossed by comparatively few general storms of the type that cause high precipitation and abrupt changes in the weather, as the main storm tracks are well to the north. The generally clear skies, the light, dry air, and the high altitude tend to favor wide extremes in temperature, due to radiation at night and to insolation and protection in daytime. The temperature sometimes falls comparatively low when barometric conditions are such as to drain cold air southwestward from northern Colorado and southern Wyoming, especially when this basin is covered with snow.

The mean annual temperature for seven stations representing the principal settlements in this province and having a good geographic distribution and an average altitude of about 5,850 feet, is about 44.7°, or about the same as that for a similar area in southern Wisconsin. The midsummer maximum averages about 88°, ranging from 81° at Fruitland to 94° at the dinosaur quarry (short record); the corresponding minimum is about 53° for the basin, ranging from 47° at Fruitland to 58° at the dinosaur quarry. The midwinter minimum averages about 3°, ranging from zero at Fort Duchesne to 7.4° at Fruitland, on a long slope where as a rule air movement prevents excessively low temperature. The corresponding midwinter maximum is about 29.5° for the basin. The temperatures recorded at the East

Portal station, on the crest of the Wasatch Range, have been omitted in computing the averages given above because of its isolated, mountain exposure. The mean annual temperature at this station is about 34.6°, the average midsummer maximum about 75°, and the midwinter minimum about −4°. The highest temperatures of record are 106° at Vernal, 104° at Fort Duchesne, and 86° at East Portal. The extreme lowest temperatures are −50° at East Portal, −39° at Duchesne, −36° at Fort Duchesne, −29° at Vernal, −26° at Myton, and −25° at Fruitland.

The season free from killing frosts is about 110 days in length over the basin proper, but killing frost occurs every month in the year at East Portal. Fairly good agricultural possibilities are permitted by frost conditions in the Duchesne and Ashley Valley bottoms, where the growing season between the latest killing frosts in spring and the earliest in autumn is about 130 days.

The annual precipitation for ten stations, well distributed and having an average altitude of about 6,150 feet, averages about 11.71 inches, ranging from about 7 inches in the Duchesne bottoms and 8.75 inches in the Ashley bottoms to 22.26 inches at East Portal. Similarly heavy amounts doubtless fall in the crest regions of the Uinta Mountains, north of the basin. The distribution of precipitation through the months shows slight deficiencies in June, November, and December, and slight excesses by comparison in September and October, June being the driest month and October somewhat the wettest.

The average annual snowfall ranges from about 15.2 inches at Myton to 136.8 inches at East Portal; the valley floors receive a little more than 24 inches in an average winter. June, July, and August are without snow over the basin generally, but there is a fairly even distribution through the winter months. The annual number of days with 0.01 inch or more of precipitation for six long-record stations averages about 60, ranging from 40 at Fort Duchesne and 50 at Myton to 61 at Duchesne and Fruitland and 95 at East Portal.

A 7-year evaporation record, from a so-called standard class A Weather Bureau installation and equipment at Myton, gives an average loss from a free water surface during the ice-free season of about 47.86 inches, with a range from 41 to 53 inches, or from 7 to 10 inches per summer month. The reservoir equivalent for the evaporation rate at this station is shown in the table of "Mean annual reservoir equivalents of evaporation in and adjacent to the Colorado River Basin" on page 166.

The prevailing winds come from the west across the basin.

Average dates of killing frost and length of growing season in Uinta Basin, Utah

Station	County	Altitude (feet)	Length of record (years)	Dates of average killing frost		Average time between killing frosts (days)
				Latest in spring	Earliest in autumn	
Dinosaur quarry	Uinta	4,830	7	May 16	Oct. 1	138
Dry Gulch ranger station	Duchesne	8,000	7	----------	----------	----------
Duchesne	do	5,528	13	June 3	Sept. 11	100
East Portal	Wasatch	7,606	7	(a)	(a)	----------
Elkhorn ranger station	Uinta	6,657	10	----------	----------	----------
Fort Duchesne	do	4,941	20	May 29	Sept. 20	114
Fruitland	Duchesne	7,000	15	June 14	Sept. 18	96
Mountain Home	do	6,575	5	June 5	Sept. 12	99
Myton	do	5,030	9	May 25	Oct. 3	131
Trout Creek ranger station	Uinta	9,200	14	June 20	Aug. 30	72
Vernal	do	5,266	19	May 21	Sept. 25	127

[a] Frost every month.

Average monthly and annual maximum, minimum, and mean temperatures in Uinta Basin, Utah, in degrees Fahrenheit

Station	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual
Dinosaur quarry	30.5	38.4	49.2	58.6	72.0	86.2	93.8	89.4	81.7	66.5	48.9	32.1	62.3
	2.5	8.7	22.0	32.6	45.5	51.8	58.5	55.5	44.4	35.4	23.9	9.1	32.5
	16.5	23.9	35.6	45.4	59.0	68.8	76.2	72.5	63.0	51.1	36.4	20.6	47.4
Duchesne	30.0	35.8	48.3	60.7	69.9	80.1	86.0	84.3	75.6	61.8	46.8	31.9	59.3
	2.0	8.4	21.1	29.5	36.2	43.0	51.1	48.9	39.9	30.1	18.8	6.1	27.9
	16.0	22.1	34.7	45.1	53.0	61.5	68.6	66.6	57.7	45.9	32.8	19.0	43.6
East Portal	25.8	29.7	36.8	45.1	57.3	69.0	75.0	73.1	65.2	53.2	38.5	27.0	49.6
	−3.9	1.0	8.0	18.4	28.7	34.2	41.3	39.2	32.1	24.4	12.2	2.4	19.8
	10.9	15.3	22.4	31.3	43.0	51.6	58.2	56.0	48.5	38.8	25.4	14.3	34.6
Fort Duchesne	27.3	34.1	50.0	63.3	72.8	83.2	90.4	88.2	78.5	63.5	48.6	32.2	61.0
	−.1	5.1	20.9	30.7	38.0	44.8	51.4	49.9	40.5	29.3	18.9	6.5	28.0
	12.9	19.5	35.8	47.1	55.4	64.4	70.9	69.1	60.1	46.5	33.6	18.0	44.4
Fruitland	34.4	36.7	42.7	53.5	65.8	77.2	81.0	79.8	70.8	59.9	46.9	33.5	56.8
	7.4	11.2	18.4	26.0	32.4	39.4	47.4	48.6	37.0	28.4	18.5	7.4	26.8
	20.8	23.7	30.6	39.8	49.1	58.3	64.2	64.1	53.9	44.1	32.7	20.6	41.8
Mountain Home	28.1	40.6	46.9	58.2	69.0	76.8	83.9	81.3	75.9	59.2	46.5	33.3	58.3
	2.7	8.0	24.5	36.0	41.6	52.2	51.7	50.1	44.7	37.2	13.8	4.4	30.6
	15.4	24.3	35.7	47.2	55.3	62.4	69.0	65.7	59.8	50.2	30.2	18.9	44.5
Myton	27.3	36.2	49.5	61.1	73.3	85.7	89.7	86.9	78.2	63.4	46.6	32.2	60.8
	.9	10.3	21.5	30.4	40.2	48.4	55.1	52.5	43.7	33.4	21.2	9.1	30.6
	14.4	23.2	35.0	45.8	57.0	67.0	72.4	69.7	60.9	48.4	33.9	20.6	45.7
Vernal	28.8	35.6	48.1	61.7	71.6	83.5	88.1	85.3	75.5	61.6	47.7	30.3	59.8
	6.6	10.5	23.3	32.8	39.4	47.2	53.0	51.5	42.2	31.7	24.1	8.7	30.9
	18.0	22.9	35.5	47.5	55.5	65.4	70.7	68.4	58.9	46.2	35.3	19.1	45.3

Average monthly and annual precipitation in Uinta Basin, Utah, in inches

Station	Jan.	Feb.	Mar.	Apr	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual
Dinosaur quarry	0.65	0.44	0.68	1.30	1.21	0.25	0.75	0.64	0.63	1.29	0.52	0.66	9.02
Dry Gulch ranger station	.97	1.35	1.15	1.44	1.65	.39	1.76	1.80	1.52	2.05	1.24	.72	16.04
Duchesne	.69	.59	.75	.66	.68	.61	.92	1.10	1.15	1.05	.62	.59	9.41
East Portal	2.50	2.41	2.34	1.54	1.72	1.06	1.83	1.70	1.83	2.14	1.35	1.84	22.26
Elkhorn ranger station	1.05	.76	.86	1.15	1.33	.67	1.07	1.04	1.60	1.09	.65	.75	12.02
Fort Duchesne	.50	.41	.65	.65	.72	.30	.53	.69	1.07	.69	.41	.52	7.14
Fruitland	1.24	1.00	1.04	.81	.82	.77	1.18	1.33	1.21	1.68	.68	1.04	12.80
Mountain Home	2.05	.75	.65	.98	.89	.75	1.21	.91	1.45	1.35	.57	.63	12.19
Myton	.48	.27	.38	.65	.84	.20	.94	.90	1.09	.90	.46	.36	7.47
Trout Creek ranger station	-----	-----	-----	-----	-----	1.50	2.14	2.28	1.69	2.75	.87	.84	-----
Vernal	.71	.59	.79	.83	.94	.29	.65	.64	1.12	.90	.68	.58	8.72

Average monthly and annual snowfall in Uinta Basin, Utah, in inches

Station	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual
Dinosaur quarry	8.9	4.2	2.7	1.1	0	0	0	0	0	Tr.	1.8	4.6	23.3
Dry Gulch ranger station	12.5	------	------	10.3	5.2	0	0	0	1.0	6.7	12.9	14.2	------
Duchesne	7.0	5.6	4.6	1.1	.5	0	0	0	Tr.	1.2	3.5	5.5	29.0
East Portal	26.1	27.2	23.1	10.3	4.0	.1	0	0	1.1	7.0	12.3	25.6	136.8
Elkhorn ranger station	8.7	6.7	10.7	8.4	4.0	0	0	0	1.1	3.1	7.3	10.5	60.5
Fort Duchesne	4.5	4.4	2.8	1.2	.1	0	0	0	0	1.1	2.3	4.6	21.0
Fruitland	18.5	13.9	10.5	4.9	1.0	0	0	0	.3	2.8	4.4	14.8	71.1
Mountain Home	14.2	7.8	5.9	5.5	.4	0	0	0	.4	.1	6.8	4.8	45.9
Myton	7.3	1.7	2.8	.2	0	0	0	0	0	Tr.	.4	2.8	15.2
Trout Creek	------	------	------	------	------	.5	0	0	3.5	14.9	13.1	11.2	------
Vernal	5.0	5.9	4.0	1.0	.2	0	0	0	Tr.	1.0	2.8	4.6	24.5

LOWER GREEN RIVER BASIN

The lower Green River Basin is sparsely settled, and the weather stations cover it only fairly well, but weather conditions are not greatly different for adjacent stations, and both the number and the distribution of the stations are ample to give a good idea of the climatic conditions prevailing over the area generally. This area is somewhat lower and therefore somewhat warmer, especially in summer, than the other subdivisions of the Green River Basin.

The average annual temperature for the eight basin-floor stations in the area is about 48°, or approximately the same as that for a similar area in middle Iowa or northern Illinois, though at Winter Quarters, where the altitude is 7,750 feet, the annual mean is 35.9°. The annual mean is 45° or 46° at Wellington, Castle Dale, and Emery and 52° at Thompsons and Green River. The midsummer maximum temperature, outside the mountains, averages 89° or 90°, ranging from 82° or 85° near the foothills to 94° or 98° over the more exposed plains. The corresponding minima are about 52° or 53° along the foothills and 56° to 58° on the plains.

The range in temperature is rather large, owing to the dry, clear atmosphere and the high altitude. The highest temperatures of record have occurred as follows: Green River 112°, Thompsons 106°, Castle Dale and Woodside 104°, Wellington 102°, Price 100°, Emery 99°, and Winter Quarters 98°. The lowest temperatures of record are as follows: Winter Quarters −41°, Castle Dale −35°, Green River −31°, Wellington −30°, and Emery, at the foot of the mountains, −20°. These figures show that on the plains the ranges are much greater, being 143° at Green River, 119° at Emery, and 118° at Price.

The midwinter minima average 7° or 8°, ranging from 1.5° at Winter Quarters to 16.1° at Sunnyside, with corresponding maxima of 34° or 35°. The growing season is appreciably longer than in the portions of the Green River drainage basin farther upstream, the 10-station average being about 120 days, though this includes a season of only 57 days at Winter Quarters. The longest seasons are at Thompsons, where there is 170 days between the latest killing frost in an average spring and the earliest killing frost in an average autumn, and at Green River, where there is 150 days.

The average annual precipitation for 12 stations having an average altitude of about 5,900 feet is about 9.90 inches, this being the driest subdivision of the Green River drainage area; the range is from 5.76 inches at Green River to 19.55 inches at Winter Quarters. The monthly distribution shows slight deficiencies in June, November, and December and slight excesses in July, August, and September, especially in August as a result of summer thundershowers.

The average annual snowfall for eight stations outside the mountains is about 20 inches, and Green River has only 10 inches; but Winter Quarters, at an altitude of 7,750 feet, has 122.2 inches, and Hiawatha, at 7,300 feet, has 96.9 inches. June, July, and August are free from snow outside the mountains, and little falls in April, May, September, and October at most of the stations. The Winter snowfall is rather uniformly deposited during December, January, and February. The annual number of days with 0.01 inch or more of precipitation, including rain and melted snow and other frozen forms of moisture, averages about 45, varying widely from 19 at Emery, 26 at Wellington, and 27 at Victor and Green River to 87 at Hiawatha and 112 at Winter Quarters.

Average dates of killing frost and length of growing season in lower Green River Basin, Utah

Station	County	Altitude (feet)	Length of record (years)	Dates of average killing frost		Average time between killing frosts (days)
				Latest in spring	Earliest in autumn	
Castle Dale	Emery	5,500	18	June 4	Sept. 17	105
Emery	do	6,260	18	June 6	Sept. 18	104
Green River	do	4,087	15	May 4	Oct. 1	150
Hiawatha	Carbon	7,300	3	May 25	Sept. 29	127
Mohrland	Emery	7,000	4			
Price	Carbon	5,507	12	May 27	Sept. 27	123
Sunnyside	do	6,700	17	May 24	Oct. 12	141
Thompsons	Grand	5,150	10	Apr. 30	Oct. 17	170
Victor	Emery	5,250	9			
Wellington	Carbon	5,540	9	June 2	Sept. 11	100
Winter Quarters	do	7,750	15	July 4	Aug. 30	57
Woodside	Emery	4,645	6	May 14	Sept. 18	127

Average monthly and annual maximum, minimum, and mean temperature in lower Green River Basin, Utah, in degrees Fahrenheit

Station	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual
Castle Dale	34.4	40.0	51.9	62.0	72.5	82.4	87.4	84.3	76.9	64.8	51.4	37.2	62.1
	3.8	12.1	22.3	28.7	37.2	45.2	51.8	50.5	40.5	29.8	20.3	9.4	29.3
	19.2	25.8	37.1	45.5	54.6	63.8	69.6	67.8	58.8	47.4	36.1	23.4	45.8
Emery	38.6	43.3	50.9	59.3	68.6	77.4	81.8	80.6	74.8	64.2	53.1	42.6	61.3
	10.2	15.4	22.3	29.0	36.2	44.0	50.5	49.5	40.0	30.3	22.2	12.2	30.2
	24.4	29.1	36.6	44.1	52.4	60.7	66.2	65.3	57.4	47.2	37.6	27.4	45.7
Green River	36.6	47.9	60.4	70.8	80.7	92.6	98.0	95.0	85.5	70.7	56.8	39.3	69.5
	8.5	18.6	28.1	35.2	44.2	52.0	60.0	58.0	46.2	33.9	21.5	10.6	34.7
	22.6	33.3	44.3	53.0	62.4	72.5	79.0	76.3	66.0	52.0	39.0	25.2	52.1
Hiawatha	30.3	34.0	37.5	49.7	63.4	76.2	80.9	76.7	69.1	54.0	41.0	33.0	53.8
	12.0	16.4	18.8	28.8	39.7	49.9	56.5	53.7	45.2	34.0	25.2	16.7	33.1
	21.1	25.2	28.2	39.3	51.5	63.1	68.7	65.2	57.1	44.0	33.0	24.8	43.4
Price	34.5	41.8	50.6	61.2	71.8	83.6	88.7	86.7	79.1	65.2	52.6	38.4	62.8
	6.2	16.8	24.9	30.3	39.8	48.8	54.2	52.2	42.4	33.3	22.9	12.3	32.0
	20.1	29.3	37.4	45.9	55.8	66.2	71.5	69.5	60.7	49.2	37.5	24.8	47.3
Sunnyside	33.8	38.5	44.1	52.6	67.5	78.8	85.8	80.5	73.8	59.9	45.8	35.8	58.1
	16.1	20.9	24.5	30.4	41.9	48.6	56.8	55.6	48.2	38.7	28.7	21.2	36.0
	24.9	29.7	34.2	41.5	54.7	63.8	71.3	68.1	61.0	49.3	37.2	28.5	47.0
Thompsons	35.0	45.1	55.9	65.7	77.4	87.4	93.5	92.3	81.4	67.6	54.5	39.5	66.3
	11.4	22.0	29.2	35.3	46.7	54.3	62.0	59.1	48.3	38.1	27.3	15.1	37.4
	23.2	33.5	42.6	50.4	62.0	70.8	77.7	75.7	64.8	52.9	40.9	27.3	51.8
Wellington	36.7	41.4	53.8	62.9	72.5	82.8	88.0	87.1	77.6	65.5	51.8	40.9	63.4
	5.3	9.3	21.4	28.1	35.9	42.8	48.5	48.2	38.0	28.1	15.8	6.6	27.3
	21.0	25.3	37.6	45.5	54.2	62.8	68.3	67.8	57.7	46.0	33.8	23.7	45.3
Winter Quarters	30.9	33.2	38.7	48.5	59.9	71.6	77.5	75.3	66.7	52.0	41.1	30.9	52.2
	1.5	3.9	10.5	20.7	27.1	31.8	39.2	37.6	29.7	20.4	11.1	3.0	19.7
	16.2	18.5	24.6	34.6	43.5	51.7	58.4	56.5	48.2	36.2	26.1	16.3	35.9
Woodside	36.1	44.4	58.7	69.3	77.8	85.8	91.6	93.4	79.6	66.5	53.0	37.0	66.1
	3.3	11.6	24.0	31.6	38.8	45.8	53.3	52.6	41.2	30.4	19.9	8.5	30.1
	20.7	28.0	41.4	50.5	58.9	66.1	72.1	73.1	61.6	48.5	36.5	23.6	48.4

Average monthly and annual precipitation in lower Green River Basin, Utah, in inches

Station	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual
Castle Dale	0.84	0.74	0.54	0.63	0.49	0.54	0.90	1.29	0.81	0.83	0.70	0.69	9.00
Emery	.47	.66	.40	.43	.53	.36	.87	1.19	1.08	.69	.36	.49	7.53
Green River	.41	.35	.38	.48	.51	.35	.40	.78	.74	.54	.47	.35	5.76
Hiawatha	.60	1.44	1.55	1.24	1.34	.18	1.32	2.32	.78	.84	1.14	.82	13.57
Mohrland	.36	1.37	.59	.83	1.41	.91	1.41	1.51	1.61	.40	.57	.65	11.62
Price	.93	.82	.71	.84	.70	.59	.94	1.17	1.00	.64	.56	.88	9.78
Sunnyside	1.16	.95	1.09	1.12	1.17	.59	1.46	1.68	1.52	1.06	1.07	.81	13.68
Thompsons	.36	.44	.81	.49	.47	.37	.76	.82	.91	.85	.88	.60	7.76
Victor	.56	.50	.30	.36	.46	.39	1.06	.95	.98	.72	.35	.52	7.15
Wellington	.53	.59	.47	.53	.52	.19	.27	.91	.90	.35	.55	.58	6.39
Winter Quarters	2.56	1.70	1.38	1.60	1.42	1.16	1.81	2.06	1.49	1.54	1.23	1.60	19.55
Woodside	1.05	.55	.62	.20	.31	.49	.57	.32	1.14	.66	.48	.53	6.92

Average monthly and annual snowfall in lower Green River Basin, Utah, in inches

Station	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual
Castle Dale	3.6	5.2	1.1	0.5	0.7	0	0	0	0	Tr.	1.2	2.9	15.2
Emery	4.4	6.6	3.0	1.0	1.3	0	0	0	.1	.8	2.0	5.0	24.2
Green River	2.7	2.6	.4	.2	.3	0	0	0	0	Tr.	.7	2.9	9.8
Hiawatha	9.9	16.0	21.8	7.7	5.3	0	0	0	.3	3.6	15.8	16.5	96.9
Mohrland	4.5	10.0	2.5	4.0	Tr.	0	0	0	0	.3	3.0	5.6	29.9
Price	6.3	6.1	1.0	.6	1.1	0	0	0	0	.1	1.9	5.7	22.8
Sunnyside	11.5	9.8	9.2	6.9	3.5	0	0	0	.1	3.0	8.6	8.3	60.9
Thompsons	2.8	3.9	2.8	.4	Tr.	0	0	0	0	.2	.4	6.9	17.4
Victor	3.0	7.0	1.3	1.6	1.0	0	0	0	0	0	Tr.	2.0	15.9
Wellington	5.9	8.0	2.4	2.5	.7	0	0	0	0	0	2.3	5.8	27.6
Winter Quarters	23.9	21.1	19.9	10.6	3.4	1.0	0	0	.2	7.5	13.3	21.3	122.2
Woodside	11.8	6.3	3.0	0	.7	0	0	0	0	0	1.2	5.0	28.0

WATER SUPPLY

GENERAL CONDITIONS

By no means the least of the factors of prime importance that are involved in the growth and development of every region is the water supply. The available supply of water within economical reach of irrigable lands, of cities, or of manufacturing or mining and milling enterprises limits the extent to which such projects may be developed. The use of streams for developing hydroelectric power is also limited by the quantity of water available, but it is often feasible to build a hydroelectric plant in a rather remote and isolated place, where the physical conditions and stream flow are favorable, and to transmit the energy from such a plant to distant industrial centers.

Important conditions are inherent in the use of water for various purposes. Its use for power affects neither its quality nor its quantity, but its use for irrigation depletes its quantity, and its municipal or domestic use not only depletes its quantity but impairs its quality. In many localities, however, the several uses are compatible, and in others there may be only a partial conflict. This is especially true since the advent of modern long-distance transmission, which permits the development of power sites in the canyon sections of the streams, where the slopes are steepest and where there is little or no probability of demands being made for other uses.

Water that is thus used for generating power is available for all other uses below the power plant, and if the stream flow is equalized in connection with the power project the result will, in general, increase the value of the stream for municipal use. This is also true under some circumstances of irrigation use, where the natural flow is increased during the growing season. However, the use of a stream for irrigation requires the concentration of flow during the season of growth, and if there is sufficient irrigable land to use the entire flow, and the power plant is below the diversions for irrigation, a serious conflict between power and irrigation use would result. On the other hand, the two uses may be compatible if the power market is such that the peak demand coincides with the concentrated irrigation demand and the power plant is above the diversions for irrigation.

The run-off characteristics of the Green River and its principal tributaries are shown graphically in Figure 5. These graphs are based upon all stream-flow records that are continuous for several years, and they show the relation of the mean monthly run-off to the mean yearly run-off, or the manner in which the annual flow is distributed throughout the year. For example, a little more than 3 per cent of the mean annual flow of the Green River at Green River, Wyo., runs off in October, less than 2 per cent in each of the months Decem-

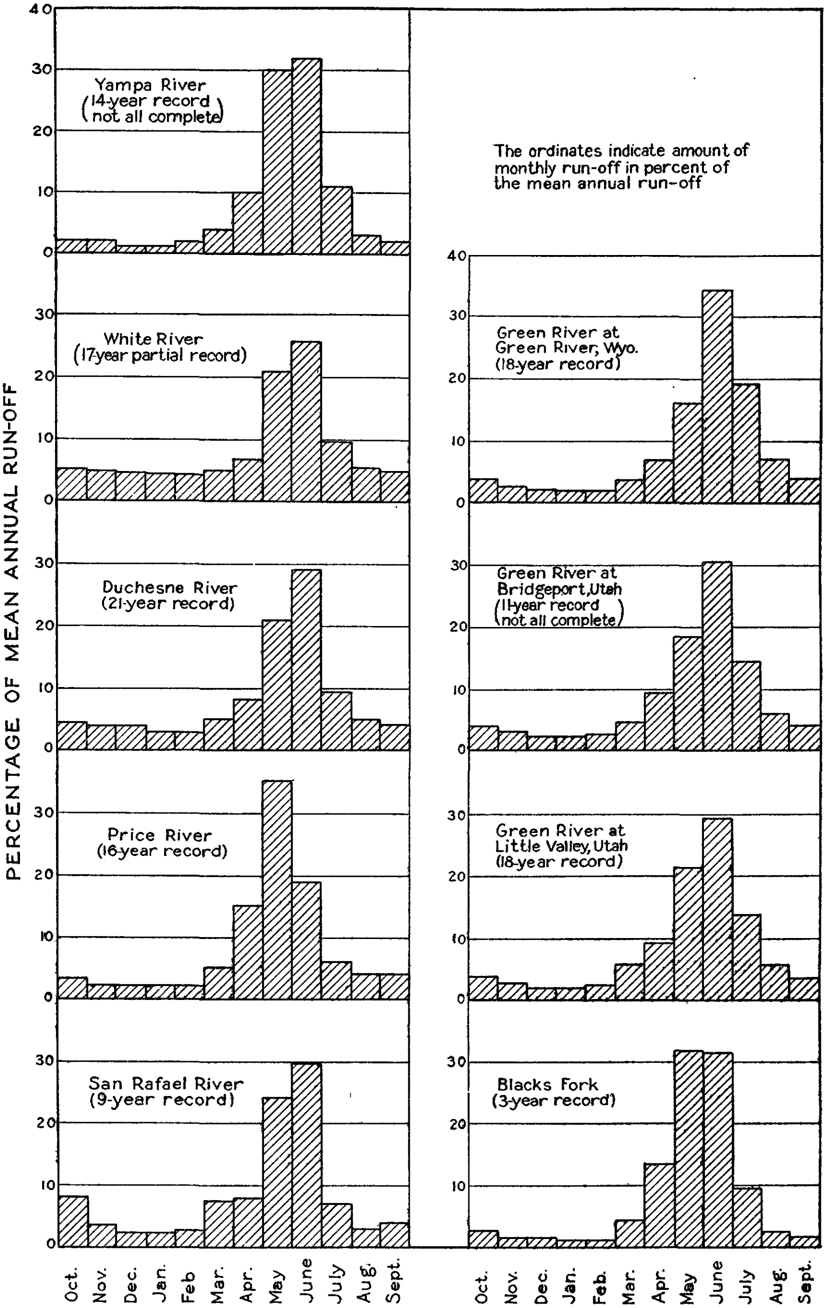


FIGURE 5.—Run-off characteristics of the Green River and principal tributaries

ber, January, and February, 34 per cent in June, and 19 per cent in July.

These graphs show a striking similarity in view of the diversified climatic conditions and physiographic features within the basin. The low-water season throughout the basin occurs during the winter, when the sources of supply are largely frozen up. May and June are the high-water months, with the peak occurring in June on nearly every stream. The Price River, however, is an exception to this general rule. Its flood stage occurs in May, with a decided drop in June to a discharge only about 4 per cent greater than that in April. However, the Price River is too small to have any appreciable effect upon the total flow of the Green River. At the Little Valley gaging station, which records all the run-off from the Green River Basin with the exception of the San Rafael River and a few wet-weather streams, the high-water period is very definitely confined to the month of June. The records at this station, as illustrated by the graph, also show that 74 per cent of the mean annual run-off from the basin occurs in April, May, June, and July, a fact which strongly emphasizes the need for storage in any scheme that involves the complete utilization of the streams. For irrigation use some of this water must be held back to maintain an adequate supply from the later part of July until the end of the growing season, which ranges from August 20 in the upper basin to October 12 in the lower basin. On the other hand, power and domestic use may better be subserved by an equalized stream flow, and, as already explained, this may or may not cause a serious conflict with irrigation use. The nature and extent of storage will, of course, depend not only upon the proposed use for which the water is to be stored but also upon the availability of suitable storage sites, and this is one of the most perplexing problems in the maximum utilization of all the streams in the arid region.

Although the general run-off characteristics of the streams in this basin are similar, each individual stream has its own peculiarities, which may be traced to one or more of the natural or artificial features of its drainage basin. For example, heavy rains are common in some places but not in others, and the diverse controlling features such as topography, forest cover, barren hills, steep rocky mountain slopes, geologic formations, ground storage, snow storage, lake storage, and artificial storage all play an important part in the regimen of each stream.

It is quite obvious, therefore, that the best analysis of the water supply of any river basin must depend upon the available stream-flow records, and an abundance of such records on all sources of water supply under consideration is always to be desired. There is a continual need for more stream-flow data on all the streams throughout the country, but the need is especially urgent in the arid regions, and in this respect the streams of the Green River Basin are no exception. This condition exists not because of lack of realization of the necessity and value of such information but from lack of funds to carry on the work.

At a few stations, however, very good records have been obtained of the flow of the Green River and also of some of the principal tributaries, but at most of the stations in the basin the records are fragmentary and of short length, yet they are useful. A list of the gaging stations that have been maintained in the Green River Basin by the United States Geological Survey and cooperating organizations or persons and tables showing the monthly maximum, minimum, and mean discharge in second-feet and the run-off in acre-feet at these stations are given in the appendix of this report.

Run-off at the base gaging stations in the basin is shown in the following table.

Annual discharge, in thousands of acre-feet and percentage of the mean, of principal streams in Green River Basin at certain gaging stations

[Only first three significant figures used in columns headed "Acre-feet"]

Year	Green River				Yampa River				White River at Meeker, Colo.		Duchesne River at Myton, Utah		Price River at Helper, Utah		San Rafael River near Green River, Utah	
	At Green River, Wyo.		At Green River, Utah		At Steamboat Springs, Colo.		At Maybell, Colo.									
	Acre-feet	Per cent of mean	Acre-feet	Per cent of mean	Acre-feet	Per cent of mean	Acre-feet	Per cent of mean	Acre-feet	Per cent of mean	Acre-feet	Per cent of mean	Acre-feet	Per cent of mean	Acre-feet	Per cent of mean
1895			4,440	78												
1896	1,450	98	4,160	73												
1897	1,650	111	5,980	105												
1898	1,580	107	[a] 5,910	104												
1899	2,500	169	[a] 7,830	137												
1900											467	74				
1901	1,300	88									504	80				
1902	1,040	70							369	78	467	74				
1903	1,310	88							426	90	522	83				
1904	1,870	126							466	99	671	106				
1905	1,010	68			328	87	1,050	78	475	100	530	84	61	51		
1906	1,490	101	6,360	112	413	112	1,700	126	524	111	803	127	131	110		
1907			8,950	157			2,230	165			1,270	201	145	122		
1908			4,290	75			1,040	77			589	93	78	65		
1909			8,580	151			1,870	139			1,090	173	179	150		
1910			4,710	83	298	80	1,050	78	407	86	793	126	155	130	233	119
1911			4,160	73	292	79	870	64	428	91	608	96	104	87	157	80
1912			6,160	108	474	128	1,640	121	579	123	591	94	95	80	189	96
1913			5,370	94	289	78	1,260	93	367	78	500	79	109	92	192	98
1914			7,070	124	410	111	1,680	124	481	102	746	118	170	143	264	135
1915	834	56	3,620	64	280	76	811	60	343	73	441	70	77	65	101	52
1916	1,750	118	5,740	100	349	94	1,220	90	484	103	622	99	149	125	182	93
1917	2,080	141	8,430	148	506	137	2,070	153	588	125	886	140	178	150	318	162
1918	1,750	118	5,110	90	393	106	1,290	96	478	101	454	72	60	50	126	64
1919	685	46	3,230	57	290	78	940	70	367	78	403	64	91	76		
1920	1,480	100	5,950	104	462	125	1,570	116	572	121	588	93	128	108		
1921	1,760	119	7,220	127	530	143	1,780	132	707	150	853	135	184	155		
1922	1,790	121	6,250	110	277	75	1,130	84	485	103	954	51	198	166		
1923	1,680	114	6,340	111	419	113	1,410	104	479	101	752	119	167	140		
1924	1,070	72	3,830	67	322	87	951	70	420	89	320	51	48	40		
1925	1,410	95	4,050	71	322	87	996	74			300	47	53	44		
1926	1,110	75	4,380	77	385	104	1,150	85			324	51	64	54		
Mean	1,480	100	5,700	100	370	100	1,350	100	472	100	631	100	119	100	196	100

[a] Records published in U. S. Geol. Survey Twentieth and Twenty-first Ann. Repts., but accuracy questionable.

NOTE.—Some of the figures in this table are estimated from partial records and from simultaneous records obtained at other stations in the Green River Basin. Where no figures are shown, the available data are considered insufficient to justify an estimate comparable in accuracy to those given.

In Figure 6 the relation of the mean flow of some of the principal tributaries to that of the Green River at Little Valley is shown graphically for the period 1918–1922, for which simultaneous records on the several streams are available. Apparently about 37 per cent of the mean annual run-off of the Green River at Little Valley originates in the upper Green River Basin above Bridgeport; about 25 per cent is contributed by the Yampa River from that part

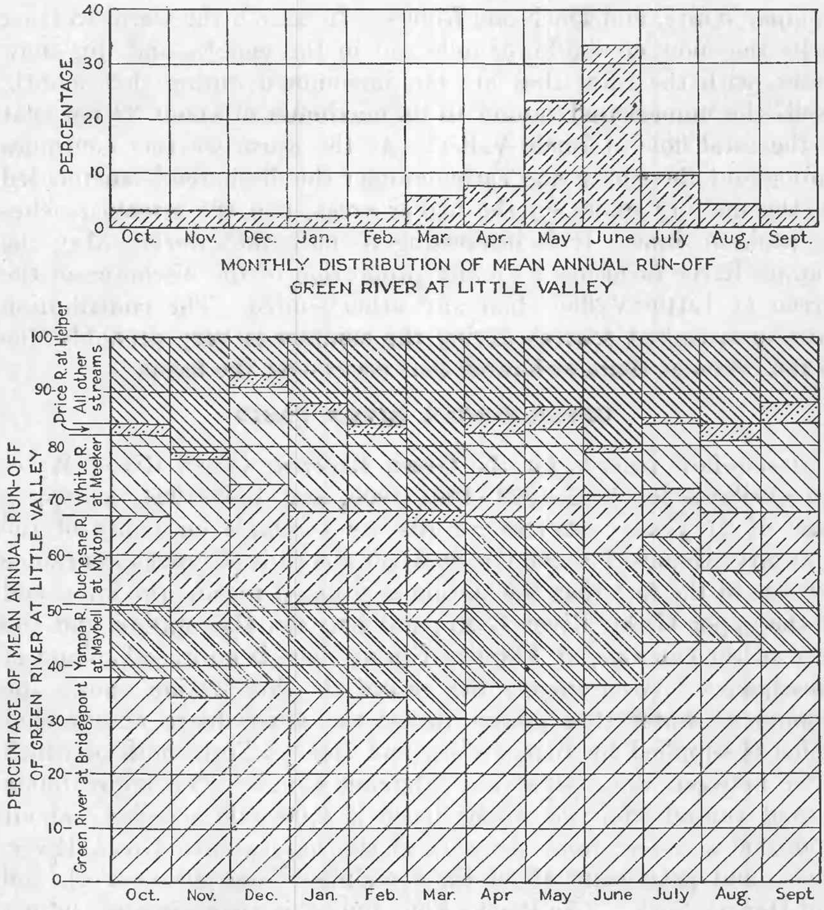


FIGURE 6.—Contributions to mean annual run-off of the Green River at Little Valley, Utah

of its basin above Maybell; about 12 per cent by the Duchesne above Myton; about 9 per cent by the White above Meeker; and about 2 per cent by the Price above Helper, making a total of about 85 per cent. The remaining 15 per cent may be classified as unmeasured flow, although a part of it is measured—for example, Ashley Creek, which empties directly into the Green near Jensen, Utah, and the Uinta River, which enters the Duchesne below the Myton station. However, during parts of the year much of this 15 per cent is carried in wet-weather channels as a result of thundershowers and the melting of the snow cover on the valley areas during the early spring.

From October until March virtually all the precipitation in the basin is in the form of snow, and the percentage of run-off from the unmeasured sources decreases very materially, reaching a minimum of about 7 per cent in the month of December. During this period the greater part of the flow of the Green River at Little Valley comes from the Yampa, White, and Duchesne Rivers. In March the warm weather melts the snow on the lower hills and in the valleys, and this snow water, with the rains that are not uncommon during that month, swells the unmeasured run-off to its maximum of about 32 per cent of the total flow at Little Valley. As the warm weather continues throughout the spring and early summer the discharge is augmented by the melting snows on the higher areas, and the stream reaches its peak in June. It is interesting to note that during May the Yampa River furnishes a greater proportion of the discharge of the Green at Little Valley than any other source. The contribution from unmeasured sources during the summer is very probably due to the frequent thundershowers that occur over the basin.

UPPER GREEN RIVER BASIN

Stream-flow records for the Green River at Green River, Wyo., are available for 1895–1899, 1901–1906, and 1915–1924, making a total of 21 years. Shorter records are available on many of the tributary streams, but the Green River record is of great importance because of the fact that the station is situated toward the lower end of the upper Green River Basin, and between this station and the head of the canyons, at Flaming Gorge, there is no irrigable land of consequence. Accordingly, the record at this station shows the amount of water that passes out of the upper basin except that which is supplied by Blacks Fork and Henrys Fork, both of which enter between the station and Flaming Gorge. The approximate annual run-off from the upper basin is 2,000,000 acre-feet—about 1,500,000 acre-feet from the part of the basin above Green River, Wyo., and practically all of the remainder from Blacks Fork and and Henrys Fork. The Blacks Fork run-off is approximately 26 per cent of that of the Green River at the Green River station.

The oldest irrigation ditches in Wyoming were taken out of Blacks Fork and its tributaries about 1854, and the agricultural demands on the water supply have been much in excess of the natural low-water flow of these streams for many years. Even before 1900 the State authorities of Wyoming recognized the necessity of reservoirs to impound some of the flood waters of these streams before irrigation development could be expanded to any great extent, and that necessity still exists. The maximum run-off from the Blacks Fork drainage basin comes somewhat earlier than that from the part of the Green River Basin above the Green River station. About 45 per cent of the mean annual discharge of Blacks Fork occurs during April and May, when the proportion at the Green River station is only about 22 per cent. June is the high-water month at each station, with about 31 per cent of the total annual discharge on Blacks Fork and about 34 per cent at Green River. The Green River station then drops to 19 per cent in July and 7 per cent in August, while Blacks Fork drops to about 10 per cent and 2 per cent respectively.

This very low percentage of run-off in August was keenly felt in the Blacks Fork Basin in 1924. That year was a year of low run-off generally throughout the arid region, and Hams Fork, one of the principal tributaries of Blacks Fork, got so low in August that it was almost impossible, at Kemmerer, to supply the railroad company with water for its engines, although every late water right was turned off, and the stream was under strict supervision of the water commissioners. Under these conditions of stream flow, irrigation development has apparently reached its limit in the Blacks Fork Basin until reservoirs are provided. According to the stream-flow records many thousand acre-feet of flood flow now passes into the Green River unused during April and the early part of May.

In the portion of the upper basin above the Green River station irrigation development has not reached the stage with respect to the water supply that it has in the Blacks Fork Basin except perhaps on some of the small tributary streams. Accordingly there is an average annual run-off at the Green River station of about 1,500,000 acre-feet, virtually all of which passes out of the upper basin. A number of investigations have been made by the State of Wyoming and the United States Bureau of Reclamation, to determine the ultimate limits of future irrigation in this upper basin; and although these studies indicate that much of this surplus water may eventually be used, it is very probable that the net depletion of the quantity which now flows out of the basin will be comparatively small because of the limiting physical conditions, which preclude the possibility of a 100 per cent regulation of the stream flow by storage reservoirs, and the adverse climatic conditions, which preclude a high consumptive use of the water.

YAMPA AND WHITE RIVER BASINS

Stream-flow records are available for a number of gaging stations in the basins of the Yampa and White Rivers, but records for the winter months are almost entirely lacking. Observations of the height of water in the White River were begun in May, 1895, near

White River City, a frontier settlement, which was about 18 miles down the river from Meeker. The first records in the Yampa Basin, other than some miscellaneous measurements, were begun on the Yampa at Craig in May, 1901.

The records now available for stations in these basins indicate that the run-off of the Yampa in December and January is very low, and a marked fluctuation in stage occurs between October and April. (See fig. 5.) On the White River, however, the run-off for this same period is remarkably uniform. The high-water period on both streams occurs in May and June, during which about 62 per cent of the mean annual discharge of the Yampa and about 46 per cent of that of the White runs off.

The catchment areas of the headwaters of these streams are regions of high precipitation and also of high run-off per unit of area. The White River at Meeker and the Yampa River at Steamboat Springs have a mean annual run-off of about 764 and 778 acre-feet respectively to the square mile of drainage area. The Elk River, which joins the Yampa a few miles below Steamboat Springs and drains a region to the north and east of that point, has a mean annual run-off of about 1,090 acre-feet to the square mile. The importance of this stream to the Yampa River in further shown from the fact that although its drainage area is only about 83 per cent of that of the Yampa above Steamboat Springs its mean annual discharge is about 16 per cent greater.

The question of sufficiency of water supply for the present agricultural needs apparently gives the farmers of these basins only occasional concern, except along a few of the smaller tributary streams, which become rather low after June.

A number of large irrigation projects that propose to use the surplus water in the White and Yampa Rivers have been investigated by Federal and other agencies. These projects will involve the use of storage reservoirs, but there is apparently enough unappropriated water in the streams to irrigate several times the amount of land that is now being irrigated if proper storage facilities are provided. The stream-flow records indicate that the mean annual discharge from these two streams into the Green is about 2,000,000 acre-feet. The Yampa River at Maybell, Colo., has a mean annual discharge of about 90 per cent of that of the Green River at Green River, Wyo., and its drainage area above the station is only about 49 per cent as large.

UINTA BASIN IN UTAH

The Duchesne River and its tributaries furnish the principal water supply of Uinta Basin as considered in this report. Stream-flow records are available for different places on the main stream as well as for some of the principal tributaries. The run-off characteristics of the Duchesne are shown in the graph in Figure 5. Although January and February are the months of low flow, it is interesting to note that they have a somewhat higher flow than that on the Yampa and at the three Green River stations, and but little lower than that of the three preceding months. Accordingly the stream has a well-sustained low-water flow, and its sources apparently remain open during the winter and flow at a rather uniform rate. May and June are months of high run-off; the high water ordinarily begins in the later part of May, and the maximum stage is reached about the middle of June.

The principal streams of the basin drain the southern slopes of the Uinta Mountains, and the range is deeply cut by numerous canyons of typical U-shaped cross section. At the upper ends of these canyons there are numerous glacial basins containing lakes of different sizes. These lakes are a controlling factor in the late summer flow of the streams and afford, in general, the main possibilities for storage reservoirs. The capacity of many of them has been investigated, and they are fully described elsewhere in this report. During the spring floods on these streams enormous loads of gravel and boulders are carried downstream, and fresh gravel bars are deposited in the stream beds as the high water recedes. The lower Uinta River Basin, including Whiterocks Creek, consists of a maze of small intersecting channels occupying a stretch of bottom land from 2 to 4 miles in width. On account of these small channels and ponds and the loose deposits of glacial débris in the streams, seepage and evaporation losses are heavy during the low-water season, but the rough channels make precise discharge measurements quite impossible. Stream-flow records have been collected in the Uinta Basin since 1899, but many of them are incomplete. The Myton station on the Duchesne, however, has been maintained continuously since that time and serves as a "base station." It does not show the natural or undiverted flow of the river, because irrigation diversions above the station have continually increased since 1906, but a fairly complete record of this irrigation development since 1913 is available and an analysis of it indicates that at present a considerable amount of water flows from the Duchesne into the Green River unused. On some of the tributaries, however, the low-water flow is taxed even beyond its capacity, and further expansions of irrigation will require storage. This will be necessary on all the streams long before the present initiated rights are perfected and satisfied. The same condition exists on Ashley Creek, which empties directly into the Green River near Jensen.

The storage capacity that might be developed in connection with the streams of the Uinta Basin is so limited by the physical features of the basin that it would apparently be inadequate to effect complete control of the run-off of the streams, so that it could be put to irrigation use within the basin, and accordingly there will always be considerable amount of water discharged into the Green River each year from this area.

LOWER GREEN RIVER BASIN

In the lower part of its drainage basin the Green River is a comparatively large stream, and its run-off is far in excess of the amount of water that would be required to irrigate all the irrigable lands within its valley.

The stream-flow records of the Green River near Green River, Utah, for 1906–1926, show an average annual run-off of about 5,700,000 acre-feet, all of which passes on into the Colorado River with no apparent hope of its being utilized within the Green River Basin, except perhaps for the generation of power. This fact was noted as early as 1879, when A. H. Thompson,[42] in writing of the "irrigable lands of the Colorado drainage," said concerning the waters of the Green River: "There seems to be no arable land to which it is possible to take this great surplus, and probably for many years to come it will be suffered to flow 'unvexed to the sea.'"

With the additional amount that is added to the Green River by the San Rafael River and some minor creeks and wet-weather channels, the average annual discharge of the Green into the Colorado for the 21-year period 1906–1926 was about 5,900,000 acre-feet. However, this does not take into consideration the series of years of low run-off, 1900 to 1905, for which stream-flow records near Green River, Utah, are not available. When allowance is made for these years, based upon a careful study of records at all other stations in the basin, the average annual discharge of the Green River at its mouth is estimated at about 5,730,000 acre-feet.[43]

The principal streams in this part of the basin are the Price and San Rafael Rivers, both of which drain eastward into the Green River. Their run-off characterisitcs are similar in some respects. The mean conditions are shown in the graphs of Figure 5. The Price River is an exception to the general rule of the entire Green River Basin in that its high-water period occurs in May instead of June. Its April flow is proportionately greater than that of the other streams, and its June flow is only about 4 per cent greater than the April flow. The May run-off is about 35 per cent of the annual, and that for May, June, and July about 70 per cent of the annual. The low-water period occurs during November, December, January, and February, but the discharge during this period is well sustained at a uniform rate of about 2 per cent of the annual for each month.

---

[42] Powell, J. W., Report on the lands of the arid regions, 2d ed., p. 163, 1879.
[43] LaRue, E. C., U. S. Geol. Survey Water-Supply Paper 556, p. 108, 1925.

During the summer thunderstorms strike across the Price and San Rafael Basins, and both streams have one or more floods in that season, as shown by the hydrographs in Figure 7. The duration of these floods is only from one to three days, but the discharge in the San Rafael jumps from practically nothing to more than 3,000 second-feet in just a few hours.

June is the mean high-water month on the San .Rafael River, although in some years, such as 1910, most of the high water occurs

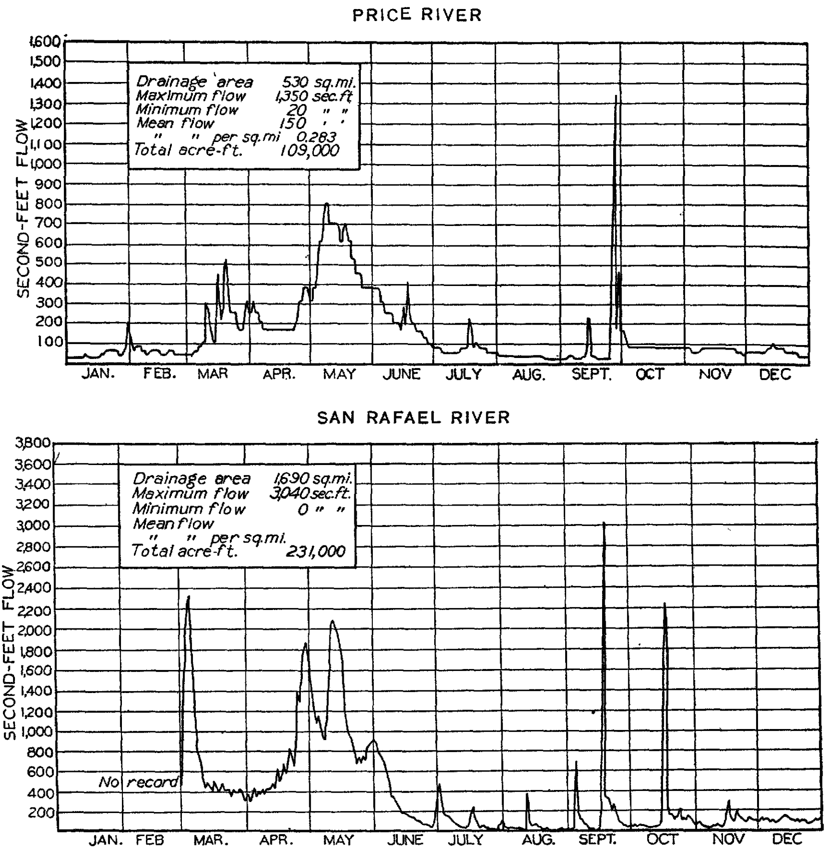


Figure 7.—Typical regimen of the Price and San Rafael Rivers. Summer floods due to thunderstorms

in May. The late summer flow of both of these streams is usually insufficient to supply the irrigation demands that have already been established, and for that reason storage will be a prerequisite to any further utilization of the streams for irrigation. It is also desirable that the flashy floods be controlled to permit the greatest power use.

TRANSMOUNTAIN DIVERSIONS

The question of taking water from the Green River Basin into the Great Salt Lake Basin has been considered at different times by private, State, and Federal agencies, but the results of the studies and investigations designed to increase the number of such diversions have been disappointing. At the present time the outstanding development of this kind is the Strawberry Reservior, which was built to serve lands in the Utah Lake Valley. The topography and the available stream flow make any other project of this magnitude economically not feasible, and those that have been suggested are too small to have any appreciable effect on the regimen of the Green River. The present transmountain diversions and the amount of water to be used ultimately by them are shown in the following table:

Present transmountain diversions from Green River Basin

Project	Location by drainage basins		Amount of water claimed		Direct source of supply	Period of use		Remarks
	From—	To—	Second-feet	Acre-feet		From—	To—	
Beck	San Rafael	Sevier	10		Reeder Canyon Creek, tributary to Cottonwood Creek.	Mar. 1	July 15	Project completed Nov. 20, 1929.
Strawberry project of U. S. Bureau of Reclamation.	Duchesne	Utah Lake		160,000	Trail Hollow, Indian Creek, Horse Creek, and Strawberry River.	Apr. 1	Sept. 1	Project prepared to deliver water to 53,890 acres. About 48,000 acres irrigated in 1925. About 67,000 acre-feet diverted in 1926.
Madsen	San Rafael	Sevier	41	120	Seely Creek, tributary to Cottonwood Creek.	May 1	Sept. 30	State engineer's certificate issued for 6 second-feet. Project to be completed November, 1930.
Larsen Irrigation Co.	do	do	30	500	Olsen Creek and Little Canyon, tributaries to Cottonwood Creek.	May 15	Oct. 15	Project to be completed November, 1930.
Gooseberry-Cottonwood Irrigation Co.	Price and San Rafael.	do		2,000	Gooseberry Creek, tributary to Price River, and Boulger Creek, tributary to Huntington Creek.	June 10	Sept. 15	Diligence right.[a] Used as supplemental supply.
Spring City Tunnel	San Rafael	do	9		Black Canyon and Soren Peterson's meadow, tributary to Cottonwood Creek.	May 1	Oct. 1	Diligence right.
P. Y. Jensen et al	do	do	9		Black Canyon, tributary to Cottonwood Creek.	May 10	Oct. 1	Do.
Daniel Irrigation Co.	Duchesne	Provo		3,400	Willow, Hobble, and Strawberry Creeks, tributaries to Strawberry River.	(b)	(b)	Do.
Horseshoe Tunnel Irrigation Co.	San Rafael	Sevier	8		Horseshoe Flat, tributary to Cottonwood Creek.	Apr. 30	Oct. 1	Do.

[a] Right acquired through appropriation and use prior to the time when the State engineer was given jurisdiction over the acquiring of water rights, 1903.
[b] Irrigation season.

NOTE.—Data furnished by State engineer and U. S. Bureau of Reclamation. Amounts specified in second-feet are diverted only when they may be available during the period of use. No records of flow are available.

Surveys have been made to determine the feasibility of diverting water from the upper tributaries of Blacks Fork into the Bear River and from the North Fork of the Duchesne River into the Provo River, and of increasing the amount of water taken from Gooseberry Creek into the Sevier River Basin.

The survey on Blacks Fork contemplated diversion from East, Middle, and Blacks Forks to Mill Creek and into a small reservoir site and thence into the Bear River. For this project 11 miles of canal and 4.4 miles of tunnel would be required. The water from about 108 square miles of drainage area would be intercepted, but the amount available is very uncertain. Adjudicated rights on the stream below amount to more than 600 second-feet, and shortages are now experienced during some years. The project was classed as unfeasible by the United States Bureau of Reclamation after some study in 1923.

The plan to take water from the North Fork of the Duchesne River into the Provo was surveyed a number of years ago. Some time was devoted to a rather careful study of it by the Knight Power Co. Stream-flow records were obtained at the proposed place of diversion for a period of several months and disclosed the fact that the available water supply is small. A canal diverting from the Duchesne River at about 8,900 feet above sea level, as shown on the Hayden Peak topographic map, was proposed, to extend along the west wall of the canyon a distance of about 4½ miles and connect with a tunnel that would extend directly westward into the Provo River drainage basin. This tunnel would be about 2½ miles long. Under this plan about 14 square miles of headwater drainage area of the upper Duchesne River would be intercepted. The stream-flow records on this river at the mouth of Hades Canyon, as well as those obtained by the power company, indicate that possibly 25,000 acre-feet would run off from this area annually, but in order to control this run-off completely a large canal would be necessary to carry the floods in the spring, and for this reason the cost of the project was considered prohibitive for the amount of water that could be diverted to beneficial use.

Studies are now in progress through the State engineer as secretary of the Utah Water Storage Commission to determine the feasibility of an additional project to take more water from the headwaters of the Price River into San Pete County. It is known as the San Pete water project and contemplates a reservoir on upper Gooseberry Creek having a storage capacity of 36,000 acre-feet with a 100-foot depth of water at the dam. A tunnel 5,640 feet long would carry the water into Cottonwood Creek, on the west side of the divide. The feasibility of this enterprise depends on the amount of water available, and this particular question is now under study. This proposed reservoir is above the Pleasant Valley Reservoir and water stored in it would deplete the supply available to the lower reservoir as well as to other water users on the Price River. For this reason the practicability of the project is being seriously considered, and thus far conclusions as to its feasibility are not justified, although the company's plans contemplate building the dam only high enough to store 19,000 acre-feet.

Another project that has been mentioned is that of diverting water from Hams Fork through the pass west of Kemmerer into the Bear River Basin. This project is physically possible without any difficult engineering problems, but severe shortages of water are now experienced on Hams Fork, and there is no economic need for making such a diversion.

FUTURE DEPLETION

As irrigation in the Green River Basin increases, there will be a depletion of the present stream flow, which will be augmented by losses through evaporation from new reservoirs. In the past irrigation has been confined mainly to the valley areas along the streams, and return flow from seepage readily finds its way back into the stream channels below. No opportunities remain for relatively cheap projects of this sort, and the future irrigation development will be some distance back from the streams, on the bench lands or even outside of the basin. Furthermore, many regulating reservoirs will be required to insure an adequate water supply, and each of these will contribute to the increased losses from evaporation. Accordingly the consumptive use of water for these new projects is a problem involving many indeterminate variables, and the estimates here given of the probable stream depletion by future use should be used only with that fact in mind.

The estimated additional irrigable land within the Green River Basin is as follows:

	Acres
Wyoming	520, 000
Colorado	342, 900
Utah	267, 400
	1, 130, 300

The consumptive use of water by these areas will probably average 1 to 1.5 acre-feet to the acre. Accordingly, the total run-off from the Green River Basin may eventually be depleted by increased irrigation use, by an amount ranging from 1,130,300 to 1,696,000 acre-feet. The estimated average annual discharge of the Green River at its mouth for the period 1895–1922 is 5,730,000 acre-feet.[44] Accordingly the future depletion may be from 20 to 30 per cent of the

[44] LaRue, E. C., U. S. Geol. Survey Water-Supply Paper 556, p. 108, 1925.

present discharge. It is doubtful, however, whether this degree of utilization will ever be attained. Lack of reservoir sites in some parts of the basin adds another limiting factor to irrigation development, besides those of climate, available lands, soil conditions, etc. A more detailed discussion of additional irrigable lands is given in the section on "Present development and future possibilities" on pages 173–192.

The effect on the present regimen of the streams of the Green River Basin of past and present irrigation use is at best a matter of conjecture and a complex problem of variable factors. For example, the stream flow is different every year; the number of acres irrigated is different also, and no data are available as to new areas added from year to year; the water duty is also a changeable factor, varying with the kind of crops grown, climatic conditions, soils, etc.

Reference to the records of discharge of the Green River near Green River, Utah, discloses no tendency toward diminishing run-off each year, as might be expected from increased irrigation use, and the average annual discharge for the 21-year period 1906–1922 is virtually the same as the estimated discharge at the mouth when the period of low discharge 1900–1906 is used in the computations.

LaRue,[45] in discussing the run-off from the Colorado River Basin, says:

> In the Colorado River Basin a study of stream-flow records reveals the fact that the period 1911 to 1923 yielded a mean annual discharge 6 per cent larger than the 29-year period 1895 to 1923, even without making any allowance for the increased consumption of water by irrigation in the upper basin in recent years over that of the earlier years of the 29-year period. If such a correction for increased irrigation consumption is applied, the mean annual discharge for the 13-year period is 11 per cent larger than that for the 29-year period. Therefore, to obtain a more reliable estimate of water supply it is necessary to extend the 13-year period of continuous stream-flow records back to include the preceding period of years of low run-off. This can be done in terms of estimated annual discharge only, as the measured records in the upper basin during these years, upon which such an estimate must be based, are incomplete.

Studies of irrigation demands in the upper Green River Basin in Wyoming indicate that the consumptive use of the water will not exceed 1½ acre-feet to the acre irrigated, and it is believed that on much of the area that may be irrigated in the future 1 acre-foot to the acre irrigated will be sufficient.

If it is assumed that all of the 508,000 acres listed as irrigable in the upper Green River Basin will be irrigated at some future time and that the average consumptive use of water will be 1 acre-foot to the acre, the present flow of the Green River at the Wyoming-Utah line will be depleted to the extent of 508,000 acre-feet, or about 25 per cent of the average annual discharge. If the consumptive use

---

[45] Idem, p. 107.

were 1.5 acre-feet to the acre the total depletion would be 762,000 acre-feet, or about 38 per cent of the present average annual discharge. This percentage will fluctuate widely because of the variations in the annual run-off from the basin, which at present ranges from 46 to 169 per cent of the mean.

In the Yampa River Basin the estimated additional irrigable land amounts to 255,000 acres, which with a consumptive use of water of 1 acre-foot to the acre would ultimately deplete the present run-off by 255,000 acre-feet. This is about 17 per cent of the estimated mean discharge of the Yampa River into the Green River.

Applying this same method of analysis to the White River indicates that the depletion would be about 87,000 acre-feet, or about 20 per cent of the present mean annual discharge.

It is estimated that in the Uinta Basin by utilizing all available storage sites water supply can probably be made available for 200,000 acres additional of irrigable land. In this basin the consumptive use is about 1.5 acre-feet to the acre. Accordingly, the ultimate depletion of the present flow is estimated to be about 25 per cent.

The conditions assumed above and the stream-flow records at the several "base" stream-gaging stations within the Green River Basin indicate that the present and future mean annual discharge of the river is as shown in the table below.

Estimated present and future mean annual discharge of Green River, in acre-feet

Point	Present	Future
At Flaming Gorge	2, 000, 000	1, 240, 000–1, 490, 000
Below mouth of Yampa River	3, 600, 000	2, 600, 000–2, 840, 000
Below mouth of White River	5, 000, 000	3, 600, 000–3, 850, 000
At mouth	5, 730, 000	4, 030, 000–4, 600, 000

STREAM REGULATION

Without regulation of stream flow it is quite impossible to utilize fully the possibilities of the streams of the arid region, because the annual fluctuations in demands for irrigation, power, and other uses are not coincident with the fluctuations in the natural regimen of the streams. Accordingly, the maximum use to which these streams may be put depends primarily upon the extent to which the high-water run-off can be stored and used to supplement the low-water run-off. This involves not only the question of favorable physical conditions such as dam sites, reservoir sites, and available lands for irrigation, but the equally important question of economic feasibility, which is too often disregarded in the analysis of these projects, a monument to failure being the result.

What is the chief value of stream regulation is a question not easy to answer. In the past it has been rather generally conceded throughout the arid region that irrigation has a preferential right to the use of the streams over power and other industrial uses. Now, however, the rapidly increasing uses and demands for power in industry make the industrial development contingent upon the available supply of power, and instead of power being of only secondary importance in the growth of a region it takes its place as one of the primary factors. Each stream, therefore, offers an individual problem, and the question as to the best plan for its utilization must be determined upon the relative merits of the possible projects, such as domestic use, irrigation, power, and flood control.

BENEFITS TO IRRIGATION AND POWER

Irrigation and power are the principal uses to which would accrue the benefit of stream regulation in the Green River Basin. There are no densely populated sections to make any problem of domestic water supply nor any localities that are endangered by possible floods from the high-water run-off of the streams. Before serious consideration was given to the building of a large reservoir on the Colorado River somewhere between Glen Canyon and Black Canyon the larger reservoir sites on the Green River were often mentioned in connection with the problem of flood control in the lower Colorado River Basin, but these later projects on the Colorado River itself have precluded further serious consideration of the sites on the Green River for that purpose.

In the upper basin in Wyoming the principal storage sites are glacial lakes that are so situated that the water from them might be used for power and then for irrigation. The greater benefit, however, would inure to irrigation, for the reason that the power possibilities are comparatively small. It is therefore not improbable that all the feasible power might be developed incidentally without any serious effect upon the irrigation development and at the same time supply the region with the power necessary for its industrial growth.

In the Yampa and White River Basins the largest potential power projects are situated on the main streams below nearly all proposed irrigation projects. Several irrigation enterprises have been proposed in these basins, all of them involving reservoirs on the upper reaches of the streams. In some localities this storage water might be used for power before it reaches the irrigation diversion dam, but broadly speaking it is primarily valuable for irrigation use. Such use, however, will not materially affect the power value of the main streams below, for there are reservoir sites on these streams large enough to regulate them for the development of power.

In the Uinta Basin in Utah most of the power resources are situated in the canyons of the tributaries of the Duchesne River that drain the south slopes of the Uinta Mountains. They are above the irrigation diversions, and accordingly the power plants would be in a position to use all water that might be stored in the numerous glacial lakes, which are the principal reservoir sites on these streams. Developed storage on these streams would thus be beneficial to both irrigation and power enterprises, and it is not unreasonable to assume that the two uses might be so coordinated as to eliminate any serious conflict between them. This would be especially true if the power developments were interconnected with other plants, so that local fluctuations in stream flow would not seriously affect the operation of the system as a whole.

The conditions in the lower Green River Basin with respect to power and irrigation benefits to be derived from storage on the streams are similar to those in the Uinta Basin in Utah, but the greater benefit would accrue to irrigation because of the greater possibilities in that field.

On the main stem of the Green River the benefits to be derived from storage would be decidedly in favor of power developments, the irrigation possibilities being practically negligible.

RESERVOIRS AND RESERVOIR SITES

UPPER GREEN RIVER BASIN

More than 135 reservoir permits have been issued by the State engineer's office of Wyoming for building reservoirs in the upper Green River Basin. These permits specify capacities ranging from a fraction of an acre-foot to more than 100,000 acre-feet, but 80 or more of them are for reservoirs of less than 100 acre-feet capacity, and these are not considered in this report. A number of reconnaissance investigations of storage possibilities in the basin have been made by Federal, State, and private agencies, and surveys have been made of some of the reservoir sites that have been considered most feasible. The salient facts obtained by these studies are shown in the following table, and a more detailed description of the most valuable sites is given in the text.

Reservoirs and reservoir sites in upper Green River Basin

Constructed reservoirs

Name	Index No.	Minor drainage basin	Source of supply	Location	Approximate height of dam (feet)	Approximate area (acres)	Capacity (acre-feet)	Remarks
Sixty Seven	9AD R2	North Piney Creek	North Piney Creek	T. 30 N., R. 112 W., Wyoming	30	333	4,330	Earth dam built for Carey Act segregation of 2,160 acres.
Eden No. 1	9AE R2	Sandy Creek	Sandy Creek	T. 26 N., R. 105 W., Wyoming	125	1,360	25,000	Earth dam, Carey Act project. Original segregation 95,658 acres. Built to capacity sufficient to irrigate 28,000 acres.
Elkhorn	9AE R1	Little Sandy Creek	Little Sandy Creek	T. 31 N., R. 103 W., Wyoming	15	145	1,450	State permit 1025 Res.
Van Tassel Lake	9AH R1	Blacks Creek	Blacks Creek	T. 12 N., R. 117 W., Wyoming	15	70	850	State permit 202 Res.
Patterson Lake	9AH R2	do	do	T. 16 N., R. 114 W., Wyoming	15	200	2,000	State permit 443 Res. Feeder canal from Blacks Fork.
Uinta No. 3	9AH R3	do	do	T. 17 N., R. 114 W., Wyoming	40	1,200	18,000	Earth dam. Present capacity 4,000 acre-feet.

Reservoir sites

Name	Index No.	Minor drainage basin	Source of supply	Location	Approximate height of dam (feet)	Approximate area (acres)	Capacity (acre-feet)	Remarks
Green River Lakes	9AA 1		Green River	T. 39 N., R. 108 W., Wyoming	130	3,680	[a] 160,000	See p. 102.
Dads Lake	9AB 1	East Fork of Green River.	Dads Creek	T. 31 N., R. 106 W., Wyoming	17	72	740	State permit 3943 Res.
Boulder	9AB 2	do	East Fork	T. 32 N., R. 105 W., Wyoming	45	57	1,625	State permit 3666 Res.
Silver Lake	9AB 3	do	Silver Creek	T. 33 N., R. 105 W., Wyoming	12	157	1,220	State permit 3970 Res.
East Fork	9AB 1	do	East Fork	T. 31 N., R. 106 W., Wyoming	50	80	2,100	State permit 3953 Res.
New Fork Lake	9AC 1	New Fork River	New Fork	T. 36 N., R. 110 W., Wyoming	35	1,604	45,937	Was constructed to capacity of 23,000 acre-feet in 1925, but dam washed out in 1927. See p. 103.
Willow Lake	9AC 2	do	Willow Creek	T. 35 N., R. 109 W., Wyoming	20	2,200	19,000	See p. 105.
Fremont Lake	9AC 3	do	Pine Creek	T. 34 N., R. 109 W., Wyoming	19	5,390	100,000	See p. 105.
Half Moon Lake	9AC 4	do	Pole Creek	T. 34 N., R. 108 W., Wyoming	70	1,680	95,000	See p. 106.
Burnt Lake	9AC 5	do	Fall Creek	T. 34 N., R. 107 W., Wyoming	8	855	6,560	See p. 107.
Boulder Lake	9AC 6	do	Boulder Creek	T. 33 N., R. 107 W., Wyoming	100	1,450	130,000	See p. 108.
North Piney Lake	9AD 1	North Piney Creek	North Piney Creek	T. 31 N., R. 115 W., Wyoming	45	170	3,580	Altitude about 8,600 feet, mean annual run-off about 5,000 acre-feet, drainage area 5 square miles, area of lake 64 acres. Dam site narrow cross section. Filed on in State engineer's office.

Taylor	9AD 1	do	do	T. 31 N., R. 115 W., Wyoming	57	240	[a] 8,880	Site surveyed as part of Cottonwood North Piney project. Mean annual run-off about 27,000 acre-feet, drainage area 27 square miles. State permit 1427. Site used to some extent in 1900 for milling operations.
Middle Piney Lake	9AD 2	Middle Piney Creek	Middle Piney Creek	T. 30 N., R. 115 W., Wyoming	68	244	11,000	Altitude about 8,800 feet, mean annual run-off about 4,500 acre-feet, drainage area about 6 square miles, crest length of dam 250 feet. State permit 1362.
Labarge	9AD 2	Labarge Creek	Labarge Creek	T. 29 N., R. 116 W., Wyoming	60	177	[a] 4,030	Drainage area about 8 square miles, crest length of dam 330 feet, mean annual run-off about 8,000 acre-feet. State permit 2246.
Eden No. 2	9AE 1	Sandy Creek	Sandy and Little Sandy Creeks.	T. 30 N., R. 104 W., Wyoming	105	1,660	105,000	Estimated mean annual run-off 60,000 acre-feet. State permit 947.
Hams Fork	9AG 1	Hams Fork	Hams Fork	T. 21 N., R. 116 W., Wyoming	90	2,018	69,925	See p. 109.
No. 2	9AH 1	Blacks Creek	Headwaters	T. 2 N., R. 11 E., Utah	25	331	6,300	Small mountain meadow. Drainage area about 30 square miles.
No. 3	9AH 2	do	do	T. 2 N., R. 11 E., Utah	50	154	4,600	Do.
No. 1	9AH 3	do	do	T. 2 N., R. 12 E., Utah	25	62	900	Small mountain meadow. Drainage area about 5 square miles.
Basin	9AK 1	Henrys Fork	do	T. 3 N., R. 16 E., Utah	([b])	1,520	107,000	See p. 109.
Flaming Gorge	9AK 2	Green River	Green River	Utah and Wyoming dam site, T. 2 N., R. 20 E., Utah.	225	37,214	3,476,390	See p. 110.

[a] Capacity from data in State engineer's office.
[b] Low dam across divide.

NOTE.—Lakes which might be developed as reservoirs are shown in solid blue on Plate I. Undeveloped reservoir sites are shown in blue hachure on Plate I.

GREEN RIVER LAKES (9AA 1)

Location.—On the Green River where it emerges from the Wind River Mountains. The proposed dam site is about 5½ miles below the lakes, in secs. 4 and 9, T. 39 N., R. 109 W. (See fig. 8.)

Dam site.—Between rolling foothills through which the river flows for several miles after leaving Green River Lakes. (See pl. 2, *B*.) Foundation conditions not known. Crest length of dam 130 feet high would be over 1,500 feet. This is the same site suggested as the Big Bend power site.

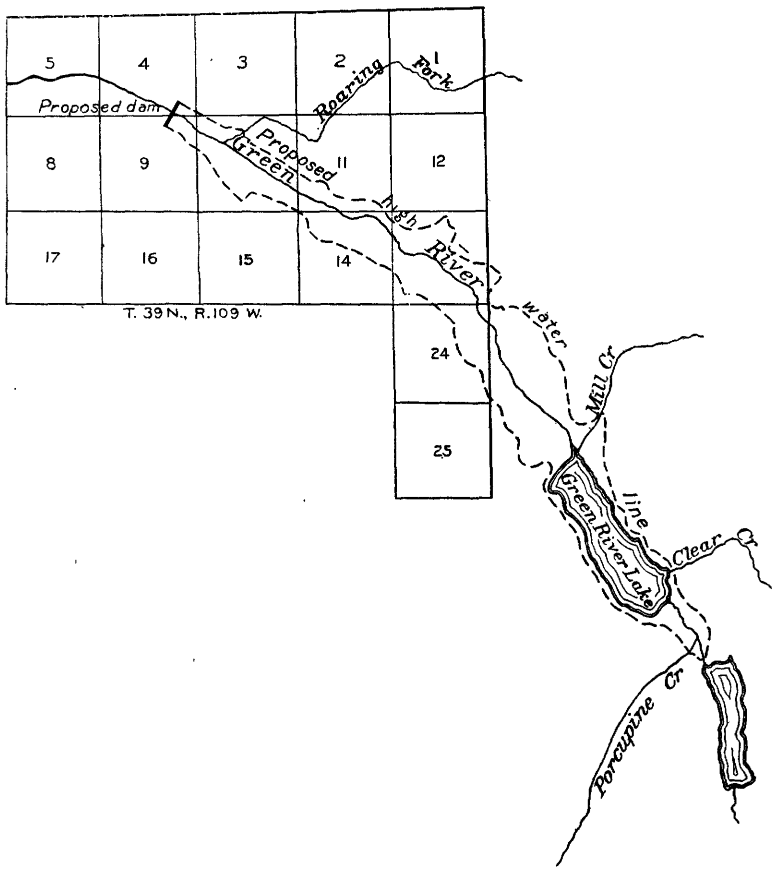


FIGURE 8.—Green River Lakes reservoir site

Basin.—Narrow river valley about 10 miles long and three-quarters mile in maximum width at proposed water surface. Two lakes, known as Green River Lakes, at its upper end. (See pl. 2, *A*.)

Capacity.—With a maximum depth of water at the dam of 130 feet the surface area of the reservoir would be about 3,680 acres, and the capacity would be about 160,000 acre-feet.

Drainage area.—115 square miles of rough mountainous area along the west slope of the Continental Divide in the Wind River Mountains. Altitude 7,900 to 13,785 feet above sea level. Dotted with numerous small glacial lakes and some areas of perpetual snow.

Water supply.—Mean annual run-off estimated from partial records at Kendall, a few miles downstream from the dam site, at 160,000 acre-feet.[46]

Remarks.—Area and height of dam determined from Fremont Peak topographic map. These lakes were filed on for reservoir purposes by the State Board of Land Commissioners of Wyoming in 1915. At that time, however, a dam site was selected at the outlet of the lower lake. Apparently the proposed dam at that place would have a crest length of about half a mile, and for this reason the site farther down the river is suggested in this report.

This site is in the northern part of sec. 2, T. 38 N., R. 110 W. sixth principal meridian. A dam 100 feet high would have a crest length of about 900 feet. The area of the resulting reservoir would be 2,790 acres and the capacity about 111,600 acre-feet. About 9 miles downstream from the dam site here suggested the hills again close in and indicate another possible site which upon detailed investigation may prove as good as this one or even better.

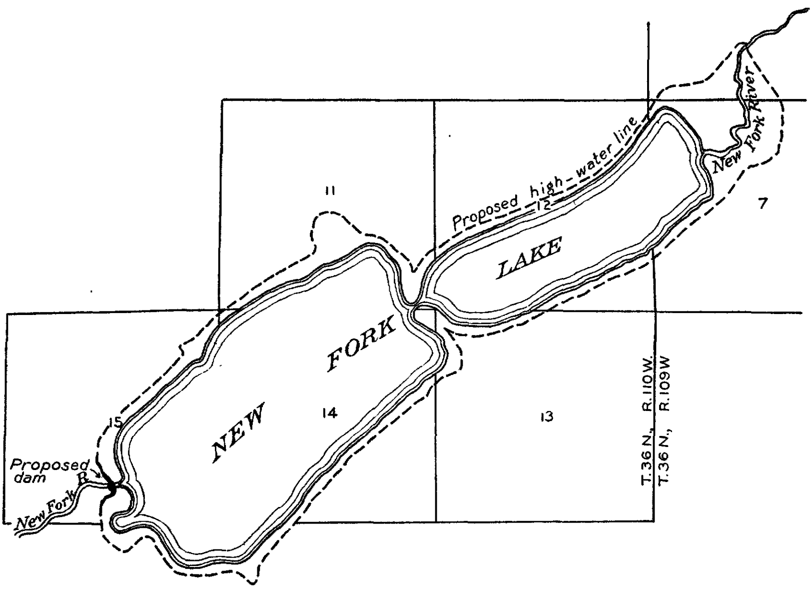


FIGURE 9.—New Fork Lake reservoir site

A few miles below Kendall, in sec. 34, T. 36 N., R. 111 W. sixth principal meridian, the topography suggests another dam site where the river cuts across the southeastern part of the Aspen Ridge. Here a dam 125 feet high would have a crest length of about 800 feet. The resulting reservoir would have a capacity of about 77,000 acre-feet. These two sites are suggested as alternate possibilities with the Green River Lakes site. Water stored at the Green River Lakes site would be usable on lands in the Bonneville irrigation project.

NEW FORK LAKE (9AC 1)

Location.—On the New Fork River where the stream leaves the mountains. The outlet is in sec. 15, T. 36 N., R. 110 W. (See fig. 9.) Topography shown on Fremont Peak topographic map.

Dam site.—At the outlet of the lake between low hills of alluvium having smooth slopes heavily covered with quaking aspen. Stream channel composed of loose boulders. A dam 35 feet high would have a crest length of 1,400 feet, about

[46] Follansbee, Robert, U. S. Geol. Survey Water-Supply Paper 469, p. 293, 1923.

1,100 feet of which would be dikes of an approximate maximum height of 10 feet. A 15-foot concrete gravity-type dam was built at this site in 1925 but was washed out in 1927. (See pl. 3, *A*.) Crest length 220 feet.

Basin.—Two glacial lakes connected by a narrow strait. Total length about 3.5 miles; area about 1,235 acres. A 33-foot rise in the water surface would increase the area to 1,604 acres.

Capacity.—

Contour (feet)	Area (acres)	Capacity (acre-feet)	Contour (feet)	Area (acres)	Capacity (acre-feet)
-3	1,210	----------	15	1,407	23,360
0	1,235	3,670	20	1,487	30,495
5	1,277	9,950	25	1,543	38,070
10	1,340	16,490	30	1,604	45,937

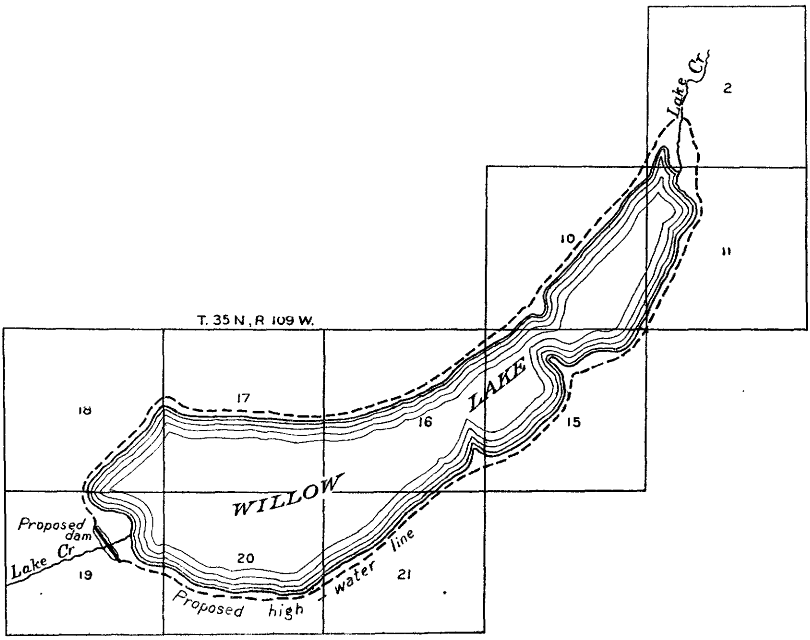


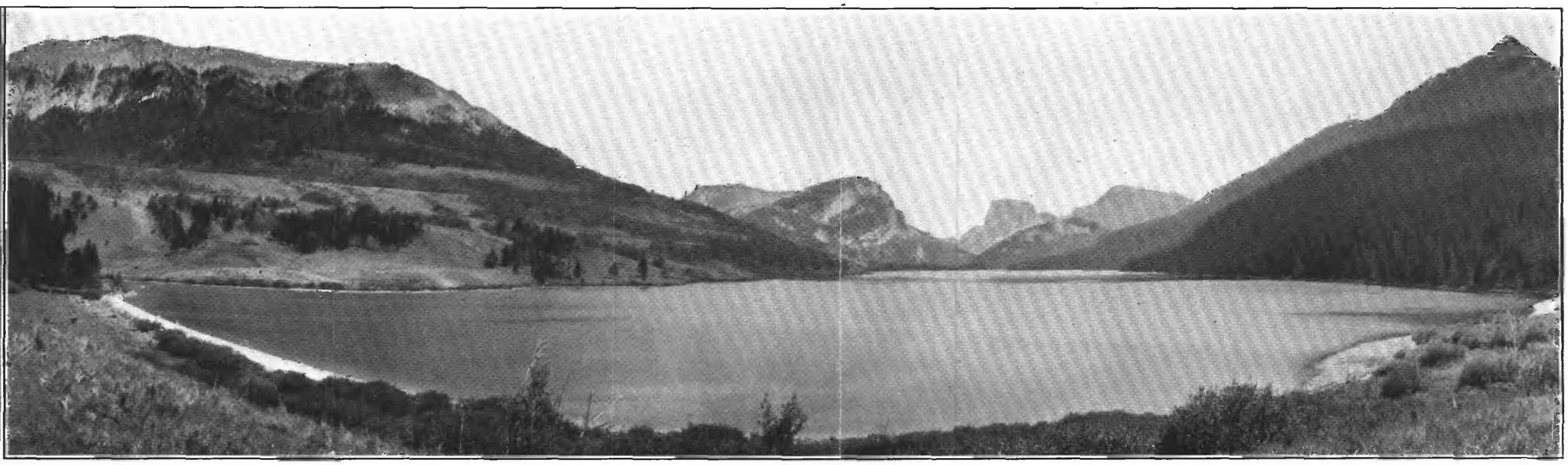
FIGURE 10.—Willow Lake reservoir site

Drainage area.—About 36 square miles of the rugged west slopes of the Wind River Mountains. Altitude 7,760 to 11,500 feet above sea level. Upper catchment area dotted with numerous small glacial lakes.

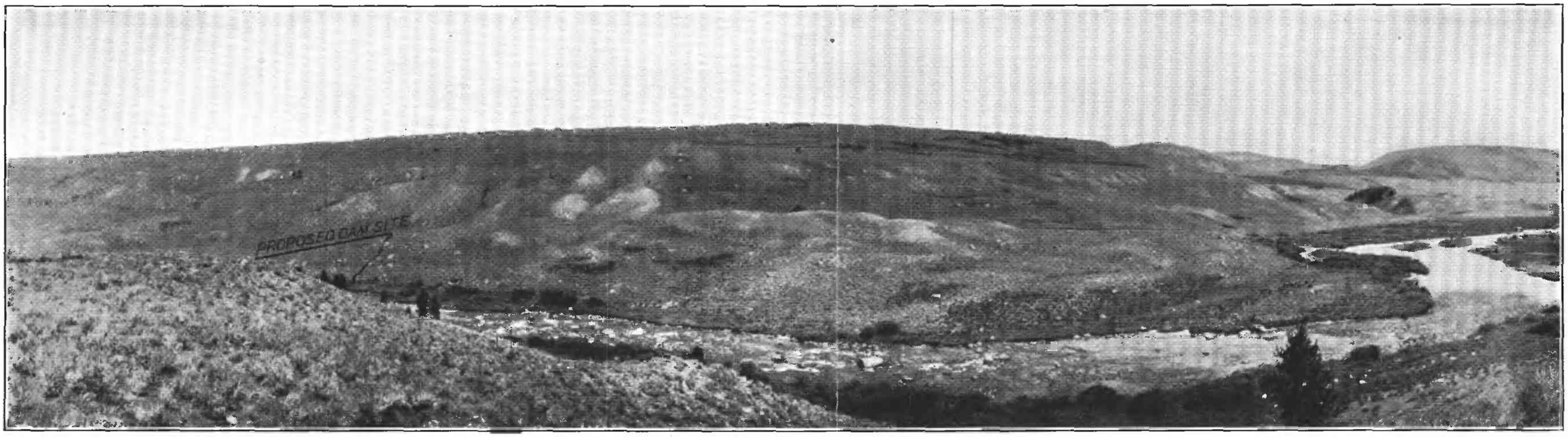
Water supply.—No stream-flow records are available at the outlet of New Fork Lake, but by comparing its drainage area with similar ones, such as those of Pine Creek and Boulder Creek, where some records have been kept, it has been estimated that the mean annual run-off at New Fork Lake is 50,000 acre-feet.[47]

Remarks.—About 23,000 acre-feet of storage was developed in 1925 by the New Fork Lake Irrigation District, and the water was used to irrigate about 15,000 acres in the vicinity of Cora, Wyo. The State Board of Land Commissioners of Wyoming also made application with the State engineer in 1915, to use this lake as a reservoir.

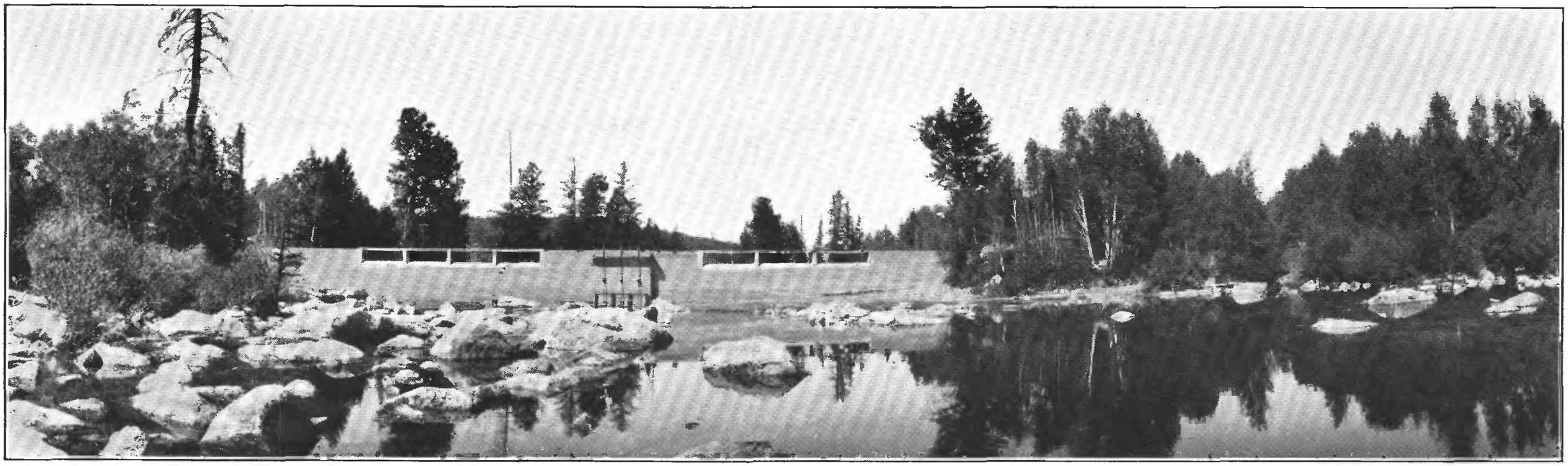
[47] Follansbee, Robert, op. cit., p. 293.



A. VIEW UPSTREAM OVER GREEN RIVER LAKES, ON THE UPPER GREEN RIVER IN WYOMING

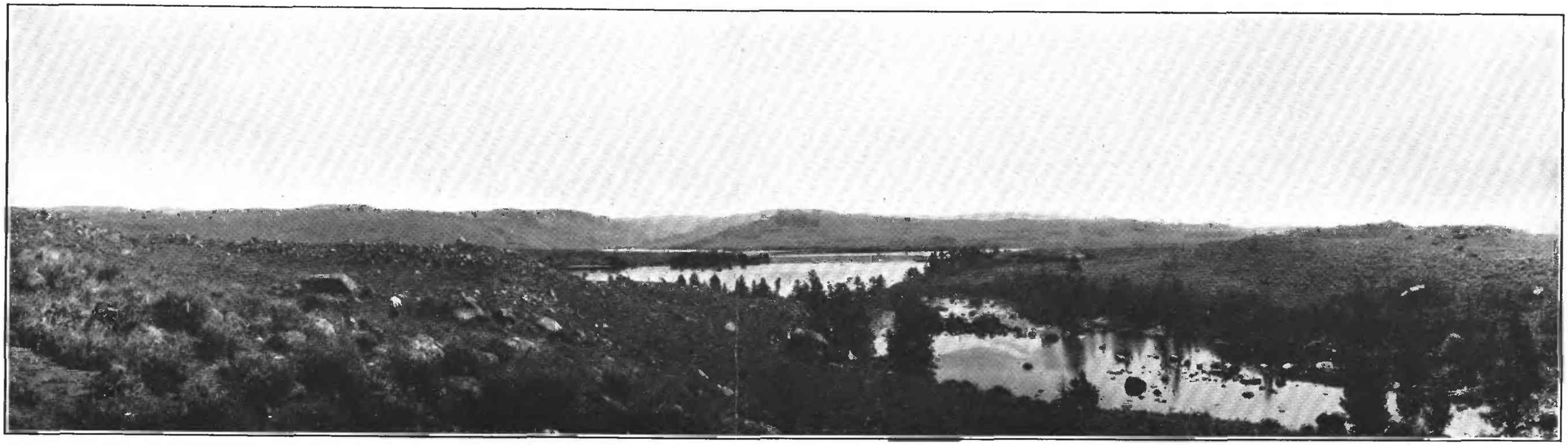


B. VIEW UP THE GREEN RIVER AT A SUGGESTED DAM SITE ABOUT 5½ MILES BELOW GREEN RIVER LAKES



A. DAM AS COMPLETED AT OUTLET OF NEW FORK LAKES NEAR CORA, WYO.

The dam was used to store water in the lakes for irrigation but was washed out in December, 1927.



B. VIEW UPSTREAM AT THE OUTLET OF BOULDER LAKE, NEAR BOULDER. WYO.

Showing character of topography involved in building a dam.

WILLOW LAKE (9AC 2)

Location.—On Lake Creek, a tributary of Willow Creek. Outlet is in sec. 19, T. 35 N., R. 109 W. (See fig. 10.) Topography of part of lake shown on Fremont Peak topographic map.

Dam site.—About 1,300 feet downstream from the lake outlet. A dam 20 feet high would have a crest length of 350 feet and would raise the lake surface about 15 feet. The stream channel is filled with loose glacial boulders. A timber-crib rock-filled dam 6 feet high and 150 feet long is now in use.

Basin.—A glacial lake having a surface area of 1,890 acres and a length of 4½ miles. The shore line is comparatively steep nearly all around the lake, so that the area increases slowly with a rise in the water surface. The area of the proposed reservoir would be about 2,200 acres.

Capacity.—With a 10-foot rise in the water surface of the lake the estimated usable storage capacity would be 19,000 acre-feet. With a 15-foot rise it would be about 30,000 acre-feet.

Drainage area.—33 square miles of the rugged west slopes of the Wind River Mountains, ranging in altitude from 7,600 to 10,867 feet above sea level. Many small glacial lakes are scattered over the headwater catchment areas.

Water supply.—No stream-flow records are available at the outlet of Willow Lake, but by comparing its tributary drainage area with that of Pine Creek, which is adjacent and for which some records are available, it is estimated that the mean annual run-off of Lake Creek at Willow Lake is 40,000 acre-feet.[48]

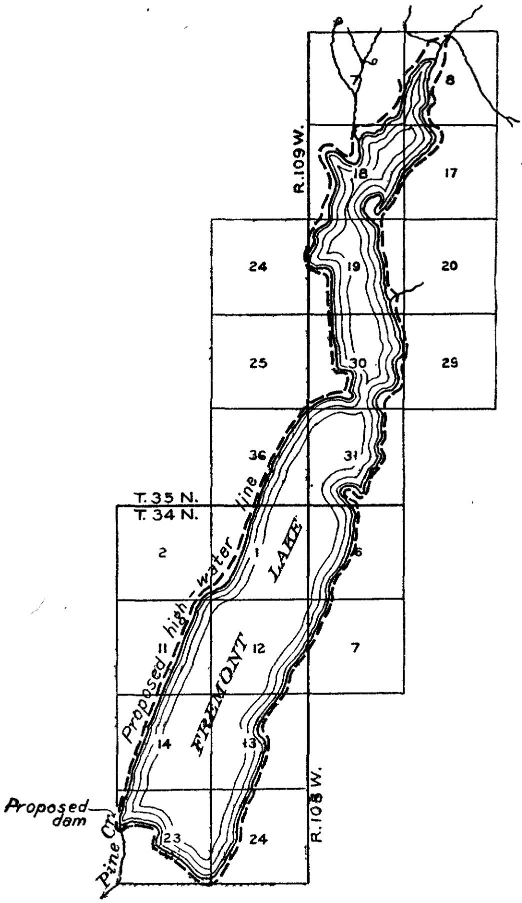


FIGURE 11.—Fremont Lake reservoir site

Remarks.—This lake is one of a number of lakes that were filed on by the State Board of Land Commissioners of Wyoming in 1915, to be used as storage reservoirs for irrigation on lands in the Bonneville project.

FREMONT LAKE (9AC 3)

Location.—On Pine Creek about 2 miles northeast of Pinedale, Wyo. The outlet is in sec. 23, T. 34 N., R. 109 W. (See fig. 11.)

[48] Follansbee, Robert, op. cit., p. 293.

Dam site.—At the outlet of the lake between low hills of alluvium covered with trees. The stream channel as it leaves the lake is filled with loose boulders. Foundation conditions are not known. A dam 19 feet high would have a crest length of 900 feet. A dam of this height would necessitate three dikes at low saddles along the south rim of the lake basin. One of these would be 600 feet long with a maximum height of 6 feet, another 400 feet long with a maximum height of 12 feet, and the third 350 feet long with a maximum height of 10 feet, thus making a total of 1,350 feet of dike. The maximum height to which the water might be raised in the lake without needing any dikes is about 10 feet.

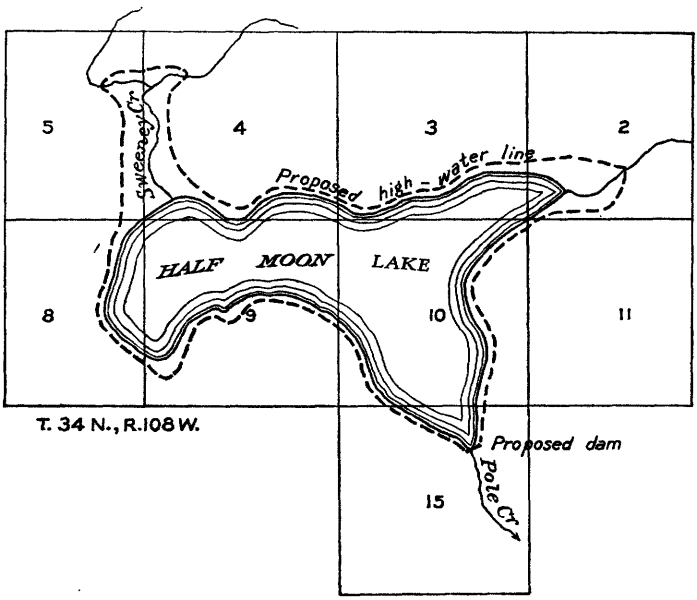


FIGURE 12.—Half Moon Lake reservoir site

Basin.—A glacial lake with a surface area of 4,840 acres and a total length of about 9 miles. A 19-foot rise in the water surface would increase the area to about 5,390 acres.

Capacity.—Estimated usable storage with 19-foot rise in water surface is 100,000 acre-feet.

Drainage area.—114 square miles, ranging in altitude from 7,462 to 11,943 feet above sea level. Numerous small glacial lakes are scattered over the headwater catchment areas.

Water supply.—Some stream-flow records are available for Pine Creek just below the lake outlet. The mean annual run-off at this place is believed to be about 148,000 acre-feet.

Remarks.—This is one of the largest lakes in Wyoming. It has been considered as a storage reservoir site many times in connection with studies of the irrigation and power possibilities of the upper Green River Basin. In 1915 it was filed on along with others for reservoir purposes by the State Board of Land Commissioners of Wyoming.

HALF MOON LAKE (9AC 4)

Location.—On Pole Creek about 7 miles northeast of Pinedale. The outlet is in sec. 15, T. 34 N., R. 108 W. (See fig. 12.)

Dam site.—About 400 feet downstream from Half Moon Lake, in the constricted channel connecting this lake with Little Half Moon Lake, which is about half a mile farther down. A dam at this place, 35 feet high, would have a crest length of 560 feet, and one 70 feet high would have a crest length of about 970 feet. Foundation conditions are unknown. The dam site is formed by glacial hills, and the creek channel is strewn with glacial boulders.

Basin.—A glacial lake in the foothills flanking the Wind River Mountains. It is a little more than 2 miles long and is roughly crescent-shaped. The area is 1,030 acres; that of the reservoir with a 70-foot rise in water surface is estimated to be 1,680 acres.

Capacity.—With a 70-foot rise in the lake surface the usable storage capacity is estimated at 95,000 acre-feet.

Drainage area.—73 square miles of rough mountain slopes, much of it heavily timbered. The catchment basin is dotted with small glacial lakes connected

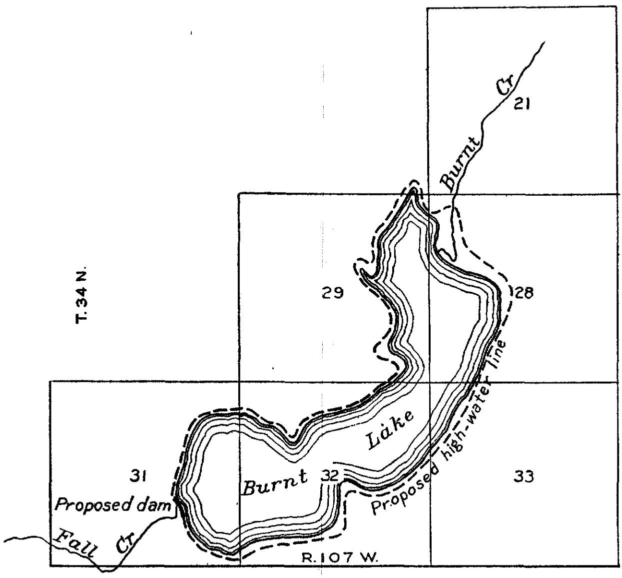


FIGURE 13.—Burnt Lake reservoir site

in chains to the main stream. The altitude ranges from 7,590 to 13,000 feet above sea level.

Water supply.—No stream-flow records are available on Pole Creek, but its drainage area is comparable with that of Pine Creek, where some records have been made. By making this comparison it is estimated that the mean annual run-off of Pole Creek at Half Moon Lake is 106,000 acre-feet.[49]

Remarks.—Filing was made on this lake for a reservoir in 1915 by the State Board of Land Commissioners of Wyoming. It was expected that the site would be used for storage for irrigation, on lands of the Bonneville project.

BURNT LAKE (9AC 5)

Location.—On Fall Creek about 10 miles east of Pinedale. The outlet is in sec. 31, T. 34 N., R. 107 W. (See fig. 13.)

Dam site.—A flat cross section in glacial material. Outlet about 2,000 feet wide with several shallow channels. Some marshy areas; heavy growth of trees and smaller forms of vegetation; no good section for a dam.

[49] Follansbee, Robert, op. cit., p. 293.

Basin.—A glacial lake with a surface area of 760 acres, surrounded by wooded hills. Its total length is a little more than 2 miles.

Capacity.—With a rise of water surface of 8 feet the area of the lake would be increased to about 855 acres, and the storage capacity above the present level of the outlet would be about 6,560 acre-feet. A dam of this height would be about 2,000 feet long. Considerable work has been done at this place toward building such a dam of sheet piling, brush, and earth, but it is in dilapidated condition (1926). Topographic conditions are not suitable for a dam at this lake, although suggestions that contemplete a dam 35 feet high have been made in filings with the State engineer.

Drainage area.—About 39 square miles of the foothills and west slopes of the Wind River Mountains, ranging in altitude from 7,747 to 11,500 feet above sea level. The area is heavily wooded, and a number of smaller glacial lakes are scattered over the headwater catchment area.

Water supply.—No stream-flow records are available on Fall Creek, but by comparison of its drainage area with similar ones, such as that of Pine Creek,

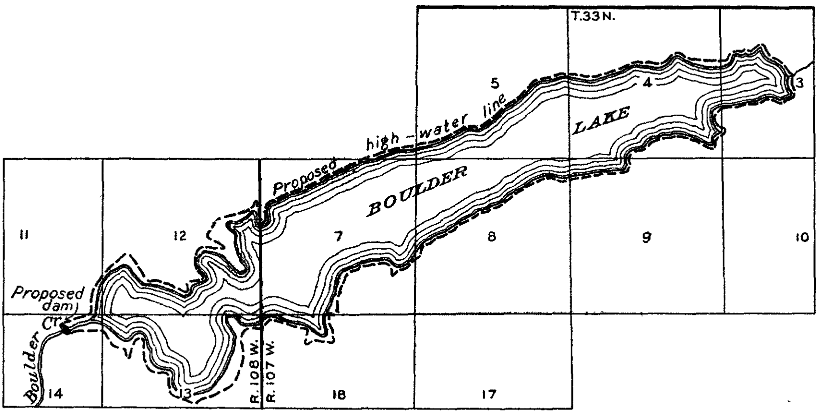


FIGURE 14.—Boulder Lake reservoir site

where some records are available, it is estimated that the mean annual run-off of Fall Creek at the outlet of Burnt Lake is about 62,000 acre-feet.

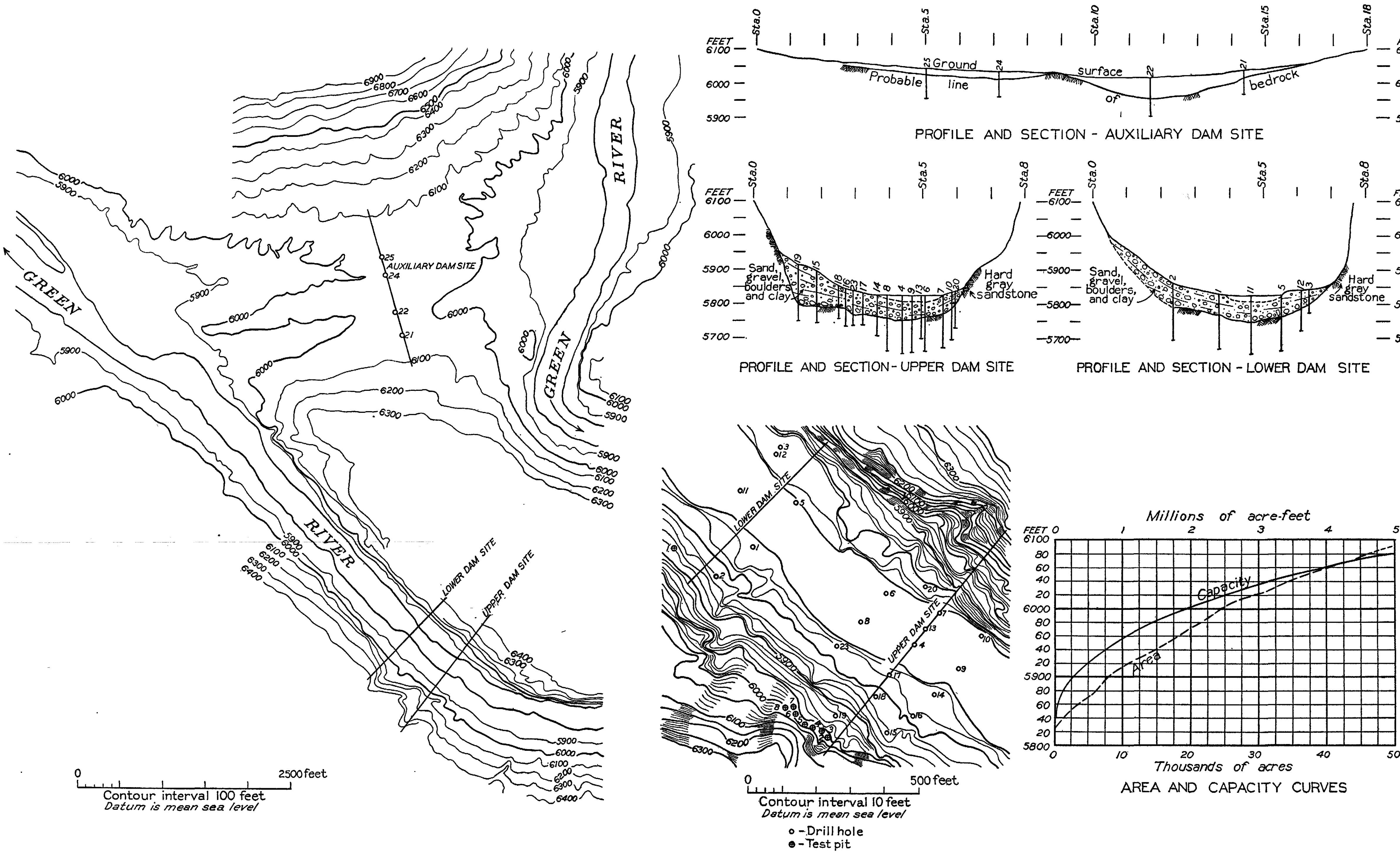
Remarks.—This lake has been considered along with others for storage in the numerous studies of irrigation projects that have been made in the upper Green River Basin. It was also filed on in 1915 by the State Board of Land Commissioners of Wyoming, to be developed as a reservoir. It has no good dam site, but the possibility of lowering the outlet channel and obtaining storage by lowering the natural lake level suggests itself as perhaps a feasible way to use the lake as a reservoir.

BOULDER LAKE (9AC 6)

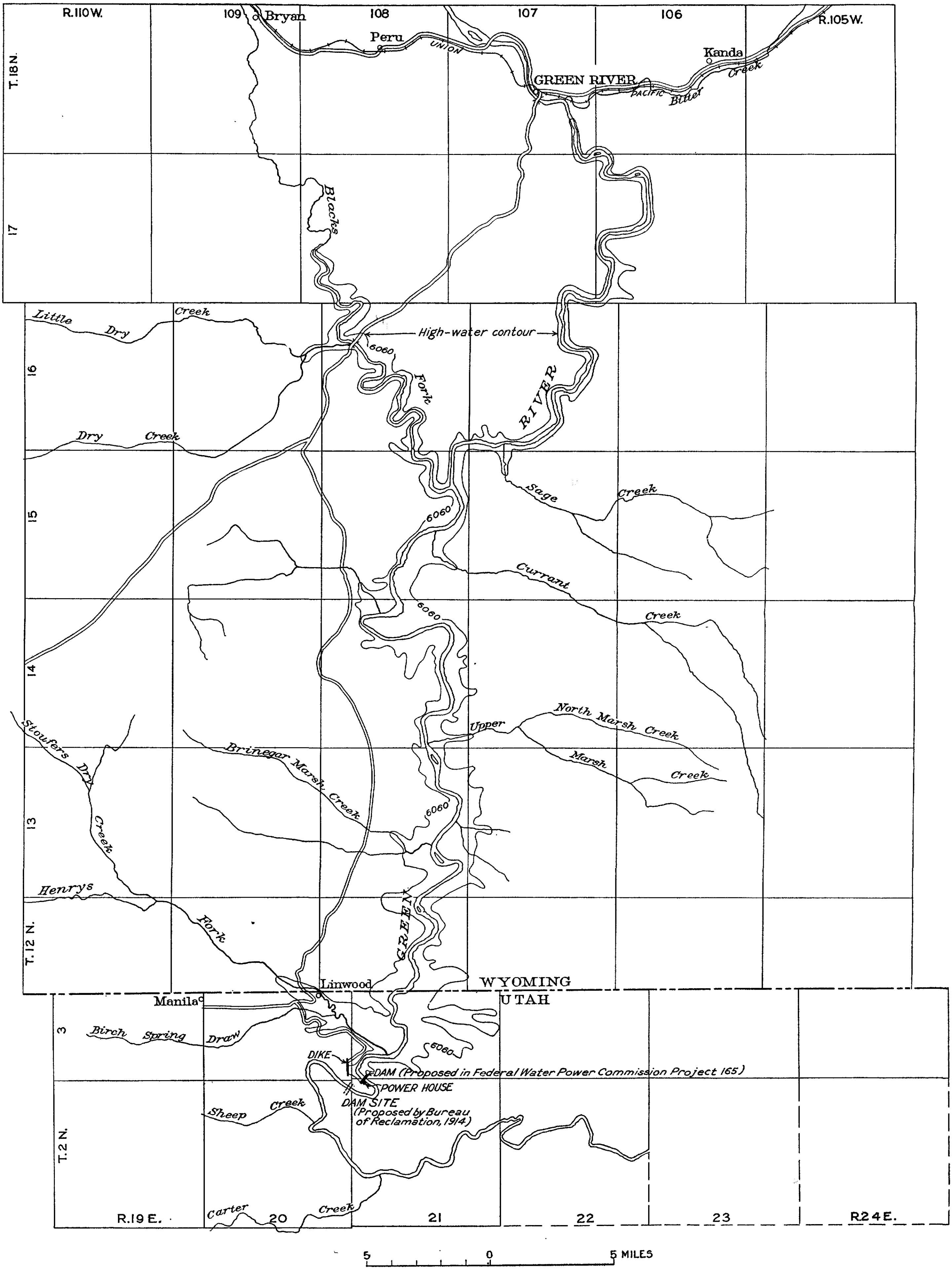
Location.—On Boulder Creek about 5½ miles north of Boulder settlement. The outlet is in sec. 14, T. 33 N., R. 108 W. (See fig. 14.)

Dam site.—A dam 90 to 100 feet high is suggested by the topography about 1,200 feet downstream from the lake outlet. The crest length of such a dam would be about 700 feet. The dam site is in glacial material, and the stream channel is filled with boulders. Foundation conditions are not known. (See pl. 3, *B*.)

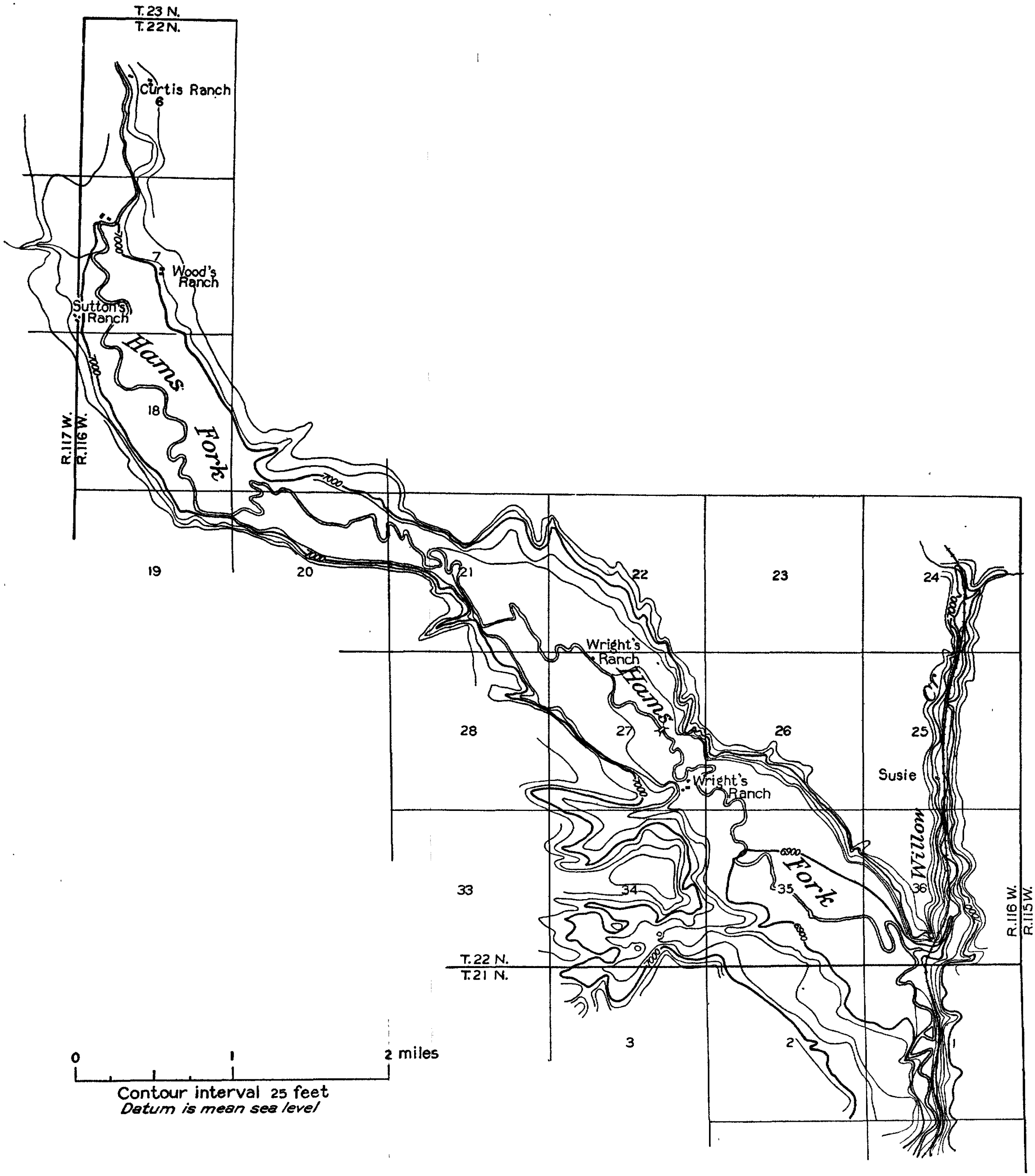
Basin.—A glacial lake with a surface area of about 1,230 acres. Its total ngth is a little less than 5 miles, and its maximum width is a little less than 1 le.



FLAMING GORGE DAM SITE



FLAMING GORGE RESERVOIR SITE



HAMS FORK RESERVOIR SITE

Capacity.—With a 100-foot dam the rise in the lake level would be such that the resulting area would be about 1,450 acres, and the estimated usable storage capacity is 130,000 acre-feet.

Drainage area.—About 94 square miles on the west slope of the Wind River Mountains, ranging in altitude from 7,267 to 11,000 feet above sea level. It is covered with timber, and numerous smaller glacial lakes are scattered over the headwater catchment area.

Water supply.—Some stream-flow records covering only parts of years are available for Boulder Creek. It is estimated that the mean annual run-off of the stream below Boulder Lake is 148,000 acre-feet.

Remarks.—This lake was filed on by the State Board of Land Commissioners of Wyoming in 1915, to be used as a storage reservoir in connection with the irrigation development of the basin. Some work is now in progress on a dam at this site to store water for use on lands around the settlement of Boulder.

HAMS FORK RESERVOIR SITE (9AG 1)

Location.—On Hams Fork about 2 miles north of Kemmerer. The proposed dam site is near the south line of sec. 1, T. 21 N., R. 116 W. (See pl. 4.)

Dam site.—A broad cross section with both sides rather steep to a height of 90 feet above the stream; thence the west side flattens to a slope of 25 feet in 1,500 feet. A branch railroad is located through the dam site and up Willow Creek. About 3½ miles of this location would be inundated by the proposed reservoir.

Basin.—A portion of Hams Fork Valley about 9 miles long with an average width of about 1 mile. Several ranches are located within it.

Capacity.—

Contour (feet above sea level)	Crest length of dam (feet)	Area (acres)	Capacity (acre-feet)	Contour (feet above sea level)	Crest length of dam (feet)	Area (acres)	Capacity (acre-feet)
6,860	0	0	0	6,950	900	2,018	69,925
6,875	250	60	450	6,975	2,400	2,788	130,000
6,900	650	558	8,175	7,000	3,175	4,050	215,475
6,925	800	1,182	29,925				

Drainage area.—About 380 square miles, partly in the Wyoming National Forest.

Water supply.—Stream-flow records at Diamondville, about 4 miles below the dam site, indicate that the annual run-off would be in excess of 130,000 acre-feet.

Remarks.—This site was surveyed in 1915 by the United States Bureau of Reclamation in cooperation with the State of Wyoming. Practically all land in the reservoir site is irrigated meadow and native hay land. The building of the reservoir would necessitate the relocating of several miles of a branch railroad, which traverses the dam site and part of the reservoir site and is necessary to the coal-mining operations in the vicinity.

BASIN RESERVOIR SITE (9AK 1)

Location.—Between Burnt Fork and Beaver Creek on the headwaters of Henrys Fork, in T. 3 N., R. 16 E., just south of the Wyoming-Utah line.

Dam site.—Basin could be filled to a maximum depth of nearly 120 feet without the construction of any dam. For a greater depth two low dams would be required at depressions on the north and west sides of the basin.

Basin.—A natural depression to which water could easily be supplied by comparatively short feeder canals from Henrys Fork into Beaver Creek and from tributaries of Beaver Creek and Burnt Fork into the basin. A tunnel about

1 mile long would be required to draw the water from the basin into Beaver Creek. A part of the basin is being dry farmed.

Capacity.—

Contour (feet above sea level)	Area (acres)	Capacity (acre-feet)	Contour (feet above sea level)	Area (acres)	Capacity (acre-feet)
8,085	0	0	8,175	1,026	43,480
8,100	93	705	8,200	1,294	72,480
8,125	443	7,405	8,225	1,521	107,680
8,150	708	21,805			

Drainage area.—The area that might be made tributary to this basin with 7 or 8 miles of canal is about 133 square miles. It includes the headwaters of Burnt Fork and the forks of Beaver Creek. The range in altitude is from 8,400 to 13,422 feet above sea level. The area lies on the north slopes of the Uinta Mountains, and many glacial lakes are scattered over it. With about 10 miles more canal the headwaters of Henrys Fork could also be made tributary to this basin, adding 36 square miles more of drainage area.

Water supply.—No data are available. Irrigation in lower valleys along these streams requires all normal summer flow.

Remarks.—This site was surveyed by the United States Bureau of Reclamation, and in a report concerning it, the opinion was expressed that it will not hold water.

FLAMING GORGE RESERVOIR SITE (9AK 2)

Location.—On the Green River. The proposed dam would be in Horseshoe Canyon, 3 or 4 miles south of the Wyoming-Utah line, and the reservoir would extend back up the river to Green River, Wyo., a distance of about 70 miles. (See pl. 5.)

Dam site.—Several dam sites have been suggested, and considerable investigation has been made of the foundation conditions at these sites. As early as 1904 a site was suggested by the United States Bureau of Reclamation about half a mile below the mouth of Henrys Fork. In 1914 a survey of the reservoir site was made by the same bureau, and during the winter of 1914–15 diamond core drilling was done at two sites in the lower part of Horseshoe Canyon, one of them about 4,000 feet above the mouth of the canyon and the other about 500 feet farther up. The saddle connecting the two ends of Horseshoe Canyon was also drilled. (See pl. 6.)

In 1923 a preliminary permit was issued by the Federal Power Commission to the Utah Power & Light Co. for the purpose of conducting investigations incident to the determination of the feasibility of building a dam in Horseshoe Canyon for power development and river control. Flaming Gorge and Horseshoe Canyon present a number of cross sections that might be considered as dam sites, and for this reason the Utah Power & Light Co. carried out a drilling program covering the entire length of Horseshoe Canyon. Holes were placed at intervals of 500 to 1,500 feet wherever a section appeared suitable for a dam, and a series of holes were drilled at one section in Flaming Gorge a little less than a mile below the mouth of Henrys Fork.

Bedrock lies at a depth of about 45 feet at the Flaming Gorge section, but the cross section of the dam site is broad. The holes through Horseshoe Canyon indicated that bedrock ranges in depth from 50 feet near the head of the canyon to about 73 feet at the dam site near the lower end. The narrowest cross section in the canyon is just below the sharp turn of the horseshoe, but this site is the most inaccessible. The lowest point in the saddle between the ends of the horseshoe is about 180 feet higher than the river at the head of Horseshoe Canyon. Accordingly, a rise of the water surface of the reservoir greater than that amount will necessitate a dike across the saddle.

Basin.—The reservoir site is a long, narrow strip of the Green River Valley extending from the dam site up the river to the city of Green River, up Blacks Fork for about 20 miles, and up Henrys Fork to the town of Linwood, about 6 miles. Only a small amount of agricultural land would be flooded, and this lies chiefly along Henrys Fork and the main stream at the Bridger Bottoms.

Capacity.—

Assumed contour (feet) [a]	Area (acres)	Capacity (acre-feet)	Assumed contour (feet)	Area (acres)	Capacity (acre-feet)
0	0	0	150	20,613	1,351,400
25	2,195	27,440	175	25,457	1,927,280
50	5,394	122,300	200	30,629	2,628,350
75	7,672	285,630	225	37,214	3,476,390
100	12,153	533,470	250	45,026	4,504,340
125	16,333	889,570			

[a] Contour 0 is about 5,837 feet above sea level. See Plan and profile of Green River from Green River Utah, to Green River, Wyo., sheet H, U. S. Geol. Survey, 1924.

Drainage area.—All of the upper Green River Basin, about 18,000 square miles, ranging from 5,837 to 14,000 feet above sea level.

Water supply.—The mean annual run-off of the Green River at Green River, Wyo., as determined from more than 20 years of stream-flow records, is about 1,500,000 acre-feet, and it is estimated that the mean annual run-off at the Flaming Gorge dam site is about 2,000,000 acre-feet. A 200-foot rise in the water surface at the Flaming Gorge dam site would create storage capacity large enough to regulate the flow of the river completely at this point.

Remarks.—This reservoir site is what might be called the key project in the complete development of the Green River. It is situated at the head of the canyons and is large enough to effect complete control of the river at this point, thus permitting the maximum power development in the canyons above the mouth of the Yampa River. It is a major factor in the regulation of the stream below the mouth of the Yampa and would affect to some extent the régime of the Colorado River below, but it would not be of material benefit in reducing the floods on the lower Colorado.

YAMPA AND WHITE RIVER BASINS

GENERAL CONDITIONS

According to the biennial reports of the State engineer of Colorado, the basins of the Yampa and White Rivers very seldom experience a water shortage for irrigation needs, except occasionally on some of the smaller streams, which get very low during a hot dry season. Accordingly no need has required the building of any large reservoirs, and all the reservoirs that have been built are adjuncts to small local irrigation enterprises, many of which are individual ranches.

During the period of general activity in irrigation development that swept over the arid Western States for a few years after 1905, these basins were completely scanned in search of reservoir sites and irrigable lands. As a result several hundred surveys were made, and these apparently covered everything that looked like a reservoir site.

When these projects finally received careful consideration with reference to cost of construction and probable returns from crops, it became apparent that most of them are economically infeasible and for that reason they have been abandoned. These surveys were made the basis of filings for water rights in the State engineer's office; and as they are a matter of public record, it is believed that some comment should be made concerning at least the more important ones in order that this report may show that these projects have not been overlooked.

A great many of the constructed reservoirs are shown on the general map of the Green River Basin (pl. 1), and those which have a capacity of 100 acre-feet or more, with the larger undeveloped sites that may possibly be used at some future time, are listed in the table on page 117, which is followed by a more detailed description of the undeveloped sites.

In the search for reservoir sites along the Yampa River above Steamboat Springs, a preliminary survey was made of Pleasant Valley in 1910, and a filing was made in the State engineer's office. This survey indicates that a dam 100 feet high would have a crest length of 550 feet, and the resulting reservoir would have a capacity of about 84,000 acre-feet. Practically all the lands that would be inundated by such a reservoir are patented and under cultivation. The dam site is not so good as the Upper Bear site, which is only a few miles upstream, and the run-off of the stream is not great enough to utilize both reservoir sites. The Upper Bear site apparently also has economic advantages over this one, and accordingly it is considered to be the better site.

On the upper part of Elkhead Creek is a rather large mountain basin known as California Park. This has been suggested at different times as a reservoir site, and in 1909 a preliminary survey was made of it for the Great Northern Irrigation & Power Co. This survey indicated that a dam 255 feet high would have a crest length of more than 2,100 feet. Data on water supply from the drainage area tributary to the proposed reservoir indicate that the capacity of the reservoir would be much greater than the run-off available. This condition and the high construction costs incident to building so long a dam make the project in no way attractive to capital.

On the lower reaches of Elkhead Creek the M. Q. Starr reservoir site was surveyed in 1910. It is in secs. 9, 10, and 16, T. 7 N., R. 89 W., and the dam site is about 5 miles above the mouth of the creek. The proposed dam at this place would be 30 feet high and 450 feet long, and the capacity of the resulting reservoir is estimated at 2,030 acre-feet. This reservoir was to be used for irrigation. A number of smaller reservoir sites on tributaries of Elkhead Creek have also been surveyed, but they are of minor importance.

On Fortification Creek preliminary surveys were made in 1909 of two rather large reservoir sites designated the Rampart and Fortification sites. The Rampart site is high on the creek on the north line of T. 9 N., R. 91 W., and has only a small drainage area tributary to it. The survey suggests a dam 210 feet high and a capacity of about 235,000 acre-feet. The Fortification site covers that part of the Fortification Creek Valley at and above the mouth of Little Bear Creek. The topography at the dam site, in sec. 23, T. 8 N., R. 90 W., indicates that a dam 75 feet high would have a crest length of about 2,100 feet, and the resulting reservoir would have a capacity of about 28,300 acre-feet. Much of the land that would be inundated in both of these sites is now irrigated. Partial stream-flow records near the mouth of the creek indicate a possible run-off of 46,000 acre-feet annually. No important tributaries enter between the Fortification reservoir site and the gaging station. Court decrees allot 111 second-feet of flow above the gaging station, and a conditional decree is issued for storage of 235,000 acre-feet. It was proposed to use these reservoir sites for irrigation, but lack of sufficient water supply and the high construction costs that would be entailed in flooding improved lands and building expensive structures have led to abandonment of the projects.

Along the south side of the Yampa River from Mount Harris westward for 6 miles beyond Craig is a stretch of mesa lands that were included in a Carey Act project designated the Hayden Mesa project. It was proposed to water this area with a canal taken out of the East Fork of the Williams River at the mouth of Bunker Creek and another taken out of Fish Creek near the north line of T. 4 N., R. 87 W. Two reservoir sites that could be used for this project were surveyed—the Bunker Basin site, in the northwest corner of T. 2 N., R. 87 W., and the Dunkley site, in the northern part of T. 4 N., R. 87 W. The Bunker Basin site was surveyed in 1908, and a storage capacity of about 8,400 acre-feet was proposed, with a dam 83 feet high. The Dunkley site was surveyed in 1904, and with a dam 60 feet high a capacity of about 3,300 acre-feet would be available. Practically all the lands that would be inundated by these reservoirs are now irrigated and improved, and the lands to be irrigated in the project are badly cut up by prominent drainage courses and isolated hills. They are from 6,300 to about 6,700 feet in altitude, and the slopes over most of the area are 250 feet or more to the mile. The application for this project was never approved, and it was finally rejected in 1919. The high cost of proposed structures for this project and the uncertainty of sufficient water supply make the project economically unsound. Accordingly these reservoir sites do not warrant any serious consideration.

Another rather elaborate irrigation project was proposed in 1909 to carry water from the White River through Yellow Jacket Pass to the head of Milk Creek and thence onto lands in Axial Basin. This project contemplated storage in Trappers and Marvine Lakes in the White River Basin and the use of the Pass Butte reservoir site on Milk Creek in T. 3 N., R. 92 W. These storage sites were all surveyed, and also the canal line and tunnel location through Yellow Jacket Pass. The survey of the Pass Butte site suggests a dam 185 feet high, having a crest length of 1,300 feet. The capacity of the reservoir with such a dam would be about 110,000 acre-feet. Much of the land that would be inundated by such a reservoir is now irrigated and in improved ranches. The lands that were to be irrigated by the project are hilly and cut by many drainage courses. Construction costs to build this project would be prohibitive. The project was included in a Carey Act segregation, which was approved in 1911 but restored again in 1912.

Another large project known as the Elk River project, was at one time located along the south side of the Little Snake River. Originally this enterprise involved more than 140,000 acres of land, more than 100 miles of main canal, and several reservoirs near the headwaters of the Little Snake River and tributaries. The Carey Act application covering this project was approved in 1910, was subsequently partly canceled, and is now pending as to about 75,000 acres. Storage was contemplated in the Big Red Park, Little Red Park, and Columbus Mountain reservoir sites, all of which are listed in the following table and described in some detail thereafter. Part of the water supply for this project was to be diverted from the headwaters of the Elk River through a tunnel into the Red Park reservoir site. The lands to be irrigated are badly cut up by erosion and will accordingly require an expensive distribution canal system. This fact, the expensive construction incident to the several reservoirs, long main canal, and collecting canals, and the questionable water supply for more than 50,000 acres of land make the project one of economic uncertainty.

Two reservoir sites have been surveyed on Savery Creek in connection with irrigation of lands on Dolan Mesa, on the north side of the Little Snake River near Dixon, Wyo. Detailed data on these sites are given on page 127.

In 1908 the Calvert Basin site, on Willow Creek in T. 11 N., R. 90 W., was surveyed for the Willow Creek Land & Livestock Co., of Dixon, Wyo. At this site a dam 90 feet high would have a crest length of 650 feet. The capacity would be more than 5,000 acre-feet. Lands that would be inundated are now under canal and are improved.

At two different times, in 1910 and 1915, a Carey Act project was proposed on Vermilion Creek near Ladore. Irish Lake was surveyed as a reservoir site, and also the Vermilion Creek reservoir site. Each time, however, the project was abandoned. Surveys were also made of sites on Wolf Creek in T. 5 N., R. 101 W., on Cottonwood Creek in T. 8 N., R. 101 W., on Lost Creek and Fawn Creek in T. 1 N., R. 90 W., and on many other small streams where topographic conditions suggested a reservoir site, but either the water supply is insufficient or there is no economic need for the development.

Preliminary surveys were made in 1910 also of two reservoir sites in the White River Basin in addition to those already mentioned and those described in detail further on in this report. One of these is on the White River just below the mouth of Beaver Creek, often mentioned as the Buford reservoir site, and the other is on the South Fork of the White River at what is known as Stillwater, and the site is thus designated. At the Buford site a dam 110 feet high would have a crest length of 2,000 feet. The area inundated, 2,638 acres, would include the settlement at Buford and much land that is now irrigated and in improved ranches. The estimated capacity of such a reservoir is 250,000 acre-feet. The proposed dam at the Stillwater site was to be 110 feet high, and its crest length would be 2,000 feet. The area inundated would be 1,697 acres, and the capacity of such a reservoir would be about 5,220 acre-feet. Here also much of the area is irrigated and in improved ranches. The development of these reservoir sites is hardly probable, because of the high costs incident to the purchase of the ranches that would be destroyed, the lang dams, and the small size of the areas on which the water might be used.

During the years 1907 to 1909 some drilling was done by the Bureau of Reclamation in the upper part of the Canyon of Lodore, on the Green River. A dam at this place would make a reservoir of Browns Park, but the results of the work were not encouraging. For further statement regarding these studies, see pages 240–241 of this report.

Reservoirs and reservoir sites in Yampa and White River Basins

Constructed reservoirs of 100 acre-feet or more capacity

Name	Index No.	Minor drainage basin	Source of supply	Location	Approximate height of dam (feet)	Approximate area (acres)	Capacity (acre-feet)	Remarks
YAMPA RIVER BASIN								
Crowner	9CA R1	Beaver Creek	Beaver Creek	Sec. 32, T. 2 N., R. 84 W	12		100	Used for private irrigation; supplies about 100 acres.
Gardner Park	9CA R2	Upper Yampa River	Snow and springs	Secs. 15 and 22, T. 1 N., R. 86 W	30	96	1,155	Supplies Stillwater ditch.
Hart Lake	9CA R3	Watson Creek	Watson Creek	Sec. 33, T. 2 N., R. 86 W	Dike.		275	Supplies ditches from Watson Creek.
Eckman Park No. 1	9CA R4	Trout Creek	Fidel Creek	Sec. 12, T. 4 N., R. 87 W			117	Used with two smaller reservoirs to supply irrigation water to about 800 acres.
J. M. Yoast	9CA R5	Fish Creek	Yoast Creek	Sec. 20, T. 4 N., R. 87 W	25	24	197	Small drainage area. Near headwaters of Fish Creek. See Mount Harris topographic map. Used to irrigate about 200 acres.
Trull Creek	9CA R6	Elk River	Trull Creek	Sec. 25, T. 7 N., R. 86 W	25	17	145	Used to irrigate about 240 acres.
Noftsger	9CA R7	Yampa River	Grass Creek	Secs. 4 and 9, T. 5 N., R. 87 W	25	19	342	Drainage area about 1.7 square miles. Stream flow intermittent. See Mount Harris topographic map.
Sage Creek	9CA R8	do	Sage Creek	Sec. 13, T. 5 N., R. 88 W	45	33	812	Earth dam. Crest length 300 feet, drainage area about 5.5 square miles. Shown on Mount Harris topographic map.
Emrick	9CA R9	do	Tributary of Temple Creek.	Sec. 32, T. 6 N., R. 88 W	29	32	421	Earth dam, crest length 631 feet, drainage area about 520 acres. Shown on Daton Peak topographic map. Used to irrigate about 155 acres.
J. C. Temple No. 1	9CA R10	do	do	Sec. 33, T. 6 N., R. 88 W	30	83	553	Dam, crest length about 900 feet. Drainage area about 15 square miles. Stream intermittent. Shown on Daton Peak topographic map. Used to irrigate about 300 acres.
Basin	9CA R11	do	Basin and Buchanan Gulches.	Sec. 17, T. 6 N., R. 89 W			289	See Daton Peak topographic map. Used to irrigate about 170 acres.

Bunkers Lake	9CB R1	Williams Fork	Bunker Creek	Sec. 5, T. 2 N., R. 87 W.			192	Supplies Bunker and Haley ditches.
Sellers Crowell	9CB R2	do	Willow Creek	Secs. 1 and 2, T. 3 N., R. 88 W.			106	Supplies Sellers and Crowell ditches.
Dunkley Debeau	9CB R3	do	do	Sec. 1, T. 3 N., R. 88 W.			113	Used to irrigate about 250 acres.
Miller	9CB R4	do	Miller Creek	Sec. 1, T. 3 N., R. 89 W.			155	Supplies Brush Creek.
Saddle	9CB R5	do	Butler Creek	Sec. 2, T. 3 N., R. 89 W.			141	Supplies Jones ditch.
Elk Lake	9CC R1	Little Snake	Willow Creek	Sec. 1, T. 10 N., R. 90 W.			398	Supplies Perkins & Fox.
WHITE RIVER BASIN								
Proctor	9BF R1	White River	Curtis Creek	Sec. 32, T. 2 N., R. 93 W.			120	Supplies Riley Proctor.
H. T. Wilson	9BF R2	Flag Creek	East Flag	Sec. 35, T. 1 S., R. 94 W.	27	10	104	See Grand Hoback topographic map. Stream intermittent. Supplies Nichols.
Keystone	9BH R1	White River	Deep Channel Creek	Sec. 36, T. 4 N., R. 96 W.	15		150	See White River topographic map. Drainage area about 18 square miles. Streams intermittent. Irrigates about 418 acres.

Reservoir sites

YAMPA RIVER BASIN								
Upper Bear	9CA 1	Yampa River	Yampa River	Sec. 29, T. 4 N., R. 84 W.	190	1,790	125,000	See p. 115.
Hinman Park	9CA 2	Elk River	Elk River	Sec. 18, T. 9 N., R. 84 W.	150	750	43,650	See p. 120.
Swamp Park	9CA 3	do	Mad Creek	Sec. 21, T. 8 N., R. 84 W.	25	309	2,470	See p. 121.
Kilpatrick	9CA 4	Elkhead Creek	Elkhead Creek	Sec. 3, T. 8 N., R. 88 W.	130	98	7,380	See p. 122.
Juniper	9CB 1	Yampa River	Yampa River	Sec. 18, T. 6 N., R. 94 W.	155	13,500	827,000	See p. 122.
Cross Mountain	9CB 2	do	do	Sec. 13, T. 6 N., R. 98 W.	100	12,300	481,000	See p. 123.
Lily Park	9CD 1	do	do	Sec. 20, T. 6 N., R. 99 W.	150	10,800	720,000	See p. 124.
Red Park	9CC 1	Little Snake River	Middle Fork of Little Snake River.	Sec. 14, T. 11 N., R. 85 W.	100	937	41,500	See p. 125.
Little Red Park	9CC 2	do	Little Red Park Creek.	Sec. 27, T. 11 N., R. 85 W.	50	489	12,090	See p. 126.
Columbus Mountain	9CC 3	do	South Fork of Little Snake River.	Sec. 5, T. 10 N., R. 87 W.	125	1,714	73,660	See p. 126.
Savery	9CC 4	do	Savery Creek	T. 15 N., R. 89 W.	90	1,056	45,760	See p. 127.
WHITE RIVER BASIN								
Trappers Lake	9BF 1	Upper White River	North Fork of White River.	Sec. 2, T. 1 S., R. 88 W.	50	474	20,380	See p. 128.
Marvine Lakes	9BF 2	White River	Marvine Creek	Sec. 12, T. 1 S., R. 89 W.	50	241	10,520	See p. 128.
Rangely	9BH 1	do	White River	Sec. 12, T. 1 N., R. 103 W.	180	10,000	650,000	See p. 129.

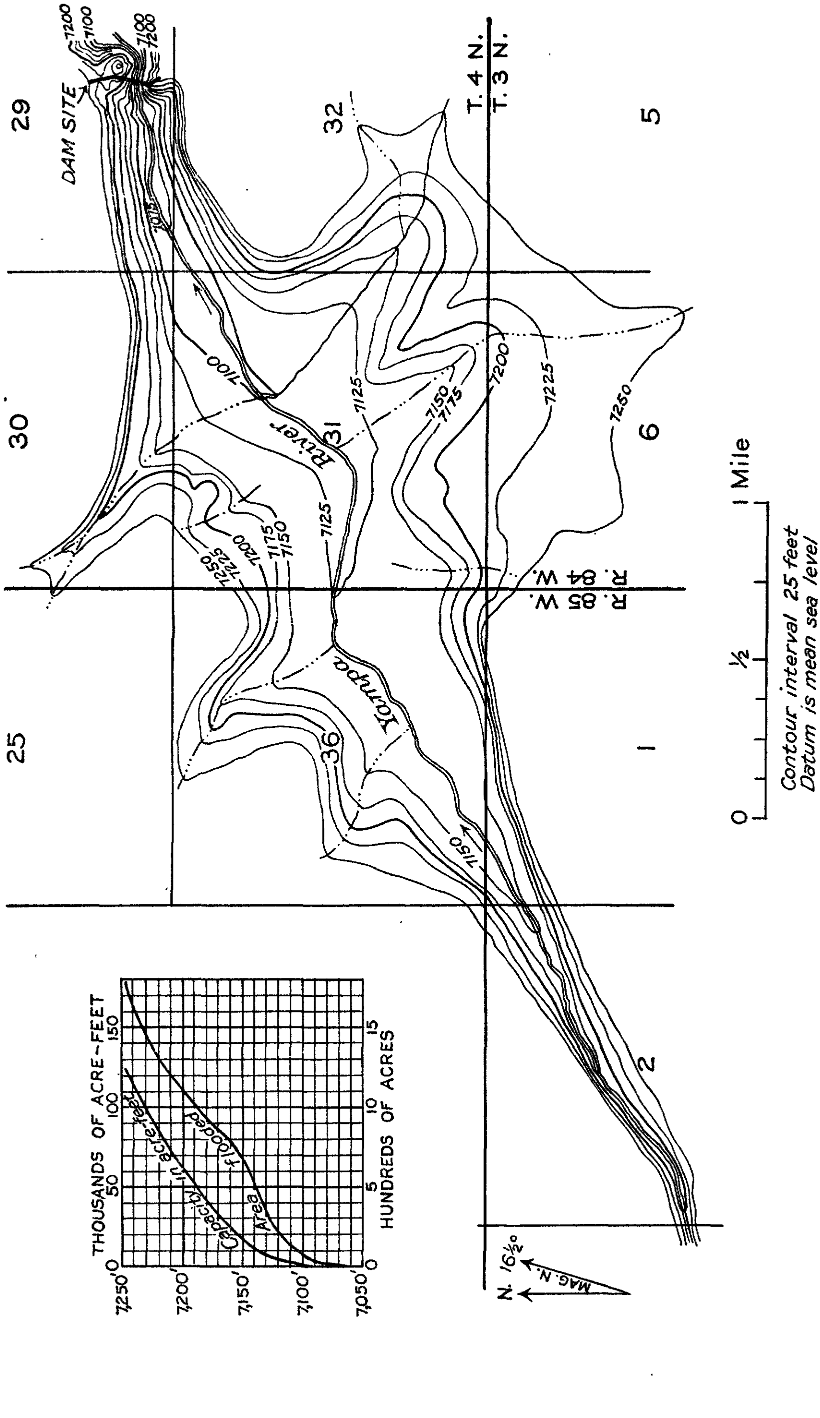


FIGURE 15.—Upper Bear reservoir site

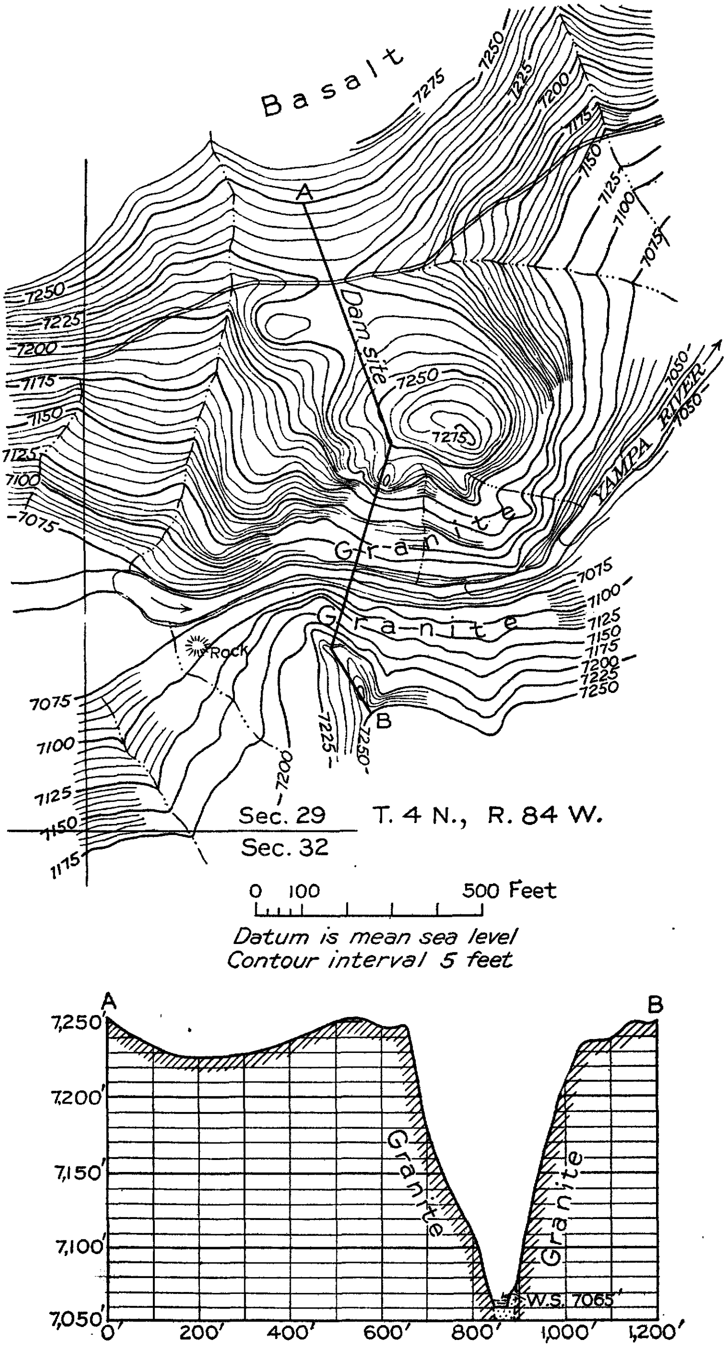


FIGURE 16.—Upper Bear dam site

UPPER BEAR RESERVOIR SITE (9CA 1)

Location.—On the Bear River or Yampa River about 14 miles south of Steamboat Springs, Colo.; dam site in sec. 29, T. 4 N., R. 84 W. (See fig. 15.)

Dam site.—In a V-shaped granite gorge. A dam 190 feet above the stream bed would have a crest length of 195 feet and would necessitate an auxiliary dike 150 feet long with a maximum height of 25 feet. (See pl. 7, *A*, and fig. 16.)

Basin.—A small valley roughly resembling an arrowhead in shape, with the tip pointing upstream. It is about 4 miles in length and a little over 2 miles in maximum width. (See pl. 7, *B*.)

Capacity.—

Contour (feet above sea level)	Area (acres)	Capacity (acre-feet)	Contour (feet above sea level)	Area (acres)	Capacity (acre-feet)
7,060	0	0	7,175	890	36,000
7,100	80	1,000	7,200	1,110	61,000
7,125	250	6,000	7,225	1,380	91,000
7,150	670	17,000	7,245	1,790	125,000

Drainage area.—About 200 square miles ranging from 7,050 to more than 12,000 feet above sea level. The headwater areas lie within the White River and Routt National Forests.

Water supply.—Stream-flow records have not been obtained at the reservoir site. Partial records are available for the stream at Yampa, about 12 miles upstream, and at Steamboat Springs, about 14 miles downstream. The drainage area above Yampa is about 50 square miles, and the estimated mean annual run-off at that place is 25,000 acre-feet. The drainage area above the station at Steamboat Springs is 500 square miles, and the records there indicate a mean annual run-off of about 389,000 acre-feet. It is estimated that the annual run-off at this reservoir site is about 115,000 acre-feet.

Remarks.—This reservoir site has been considered in connection with the Wessels irrigation project, which comprises about 12,000 acres of land; 9,000 acres of which centers around the town of Sidney and 3,000 acres lying west of Steamboat Springs. The site was surveyed in 1906 and 1909 by private engineers, and also in 1917 by the United States Bureau of Reclamation. The principal value would be for irrigation. Much of the area that would be inundated is in cultivated ranches.

HINMAN PARK RESERVOIR SITE (9CA 2)

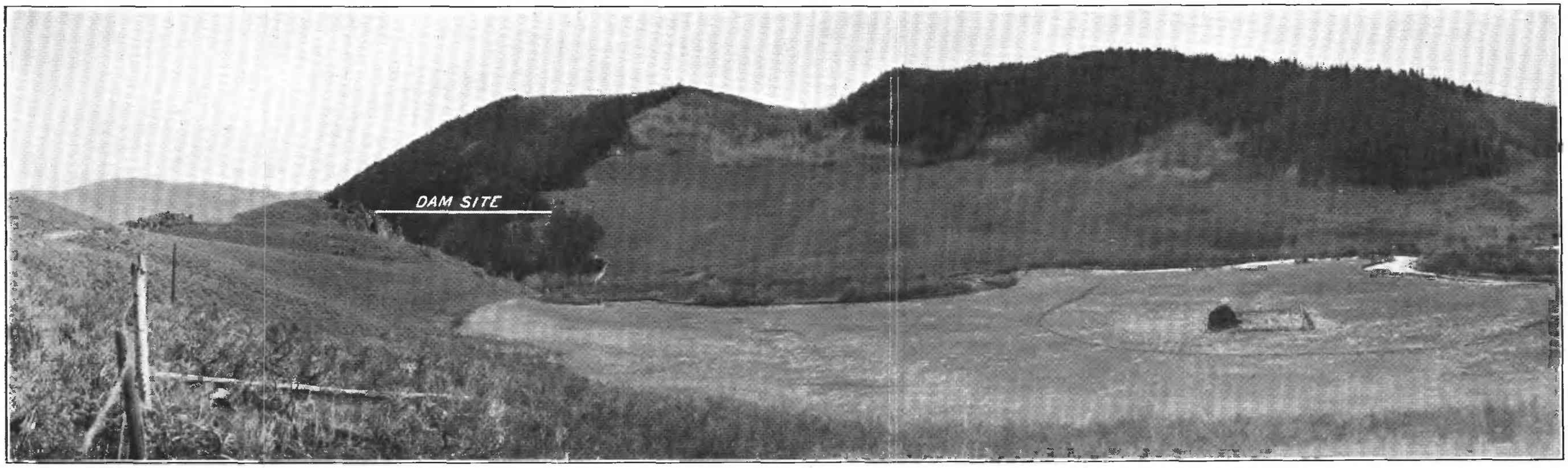
Location.—On the Elk River about 18 miles directly north of Steamboat Springs, Colo. The proposed dam site is in sec. 18, T. 9 N., R. 84 W. (See Hahns Peak topographic map.)

Dam site.—At outlet to Hinman Park. A dam 150 feet high would have a crest length of about 1,050 feet. Foundation conditions not known.

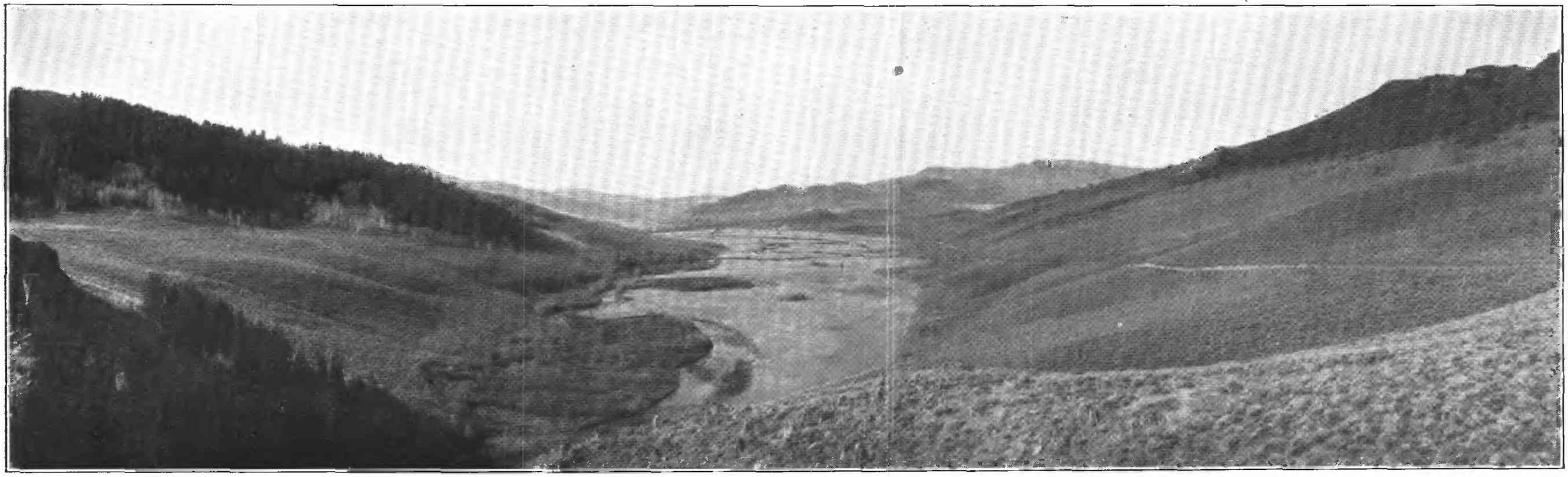
Basin.—A small mountain park with a maximum length and width of about 2 miles and 1 mile, respectively. Several summer houses located within it.

Capacity.—

Depth of water at dam (feet)	Area (acres)	Capacity (acre-feet)	Depth of water at dam (feet)	Area (acres)	Capacity (acre-feet)	Depth of water at dam (feet)	Area (acres)	Capacity (acre-feet)
10	40	200	60	190	5,950	110	430	20,050
20	70	750	70	220	8,000	120	510	24,750
30	100	1,600	80	250	10,350	130	590	30,250
40	130	2,750	90	280	13,000	140	670	36,550
50	160	4,200	100	350	16,150	150	750	43,650

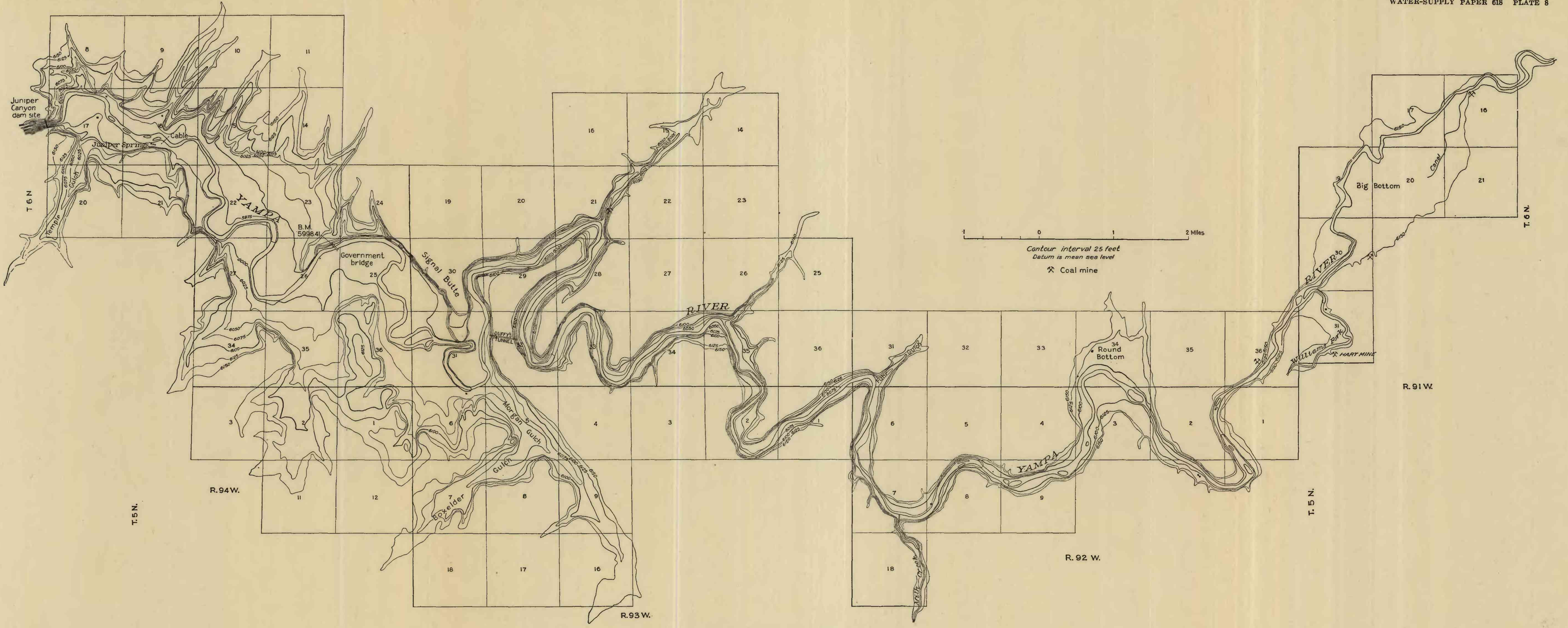


A. VIEW DOWNSTREAM TOWARD THE UPPER BEAR DAM SITE, ON THE YAMPA RIVER ABOUT 14 MILES SOUTH OF STEAMBOAT SPRINGS, COLO.

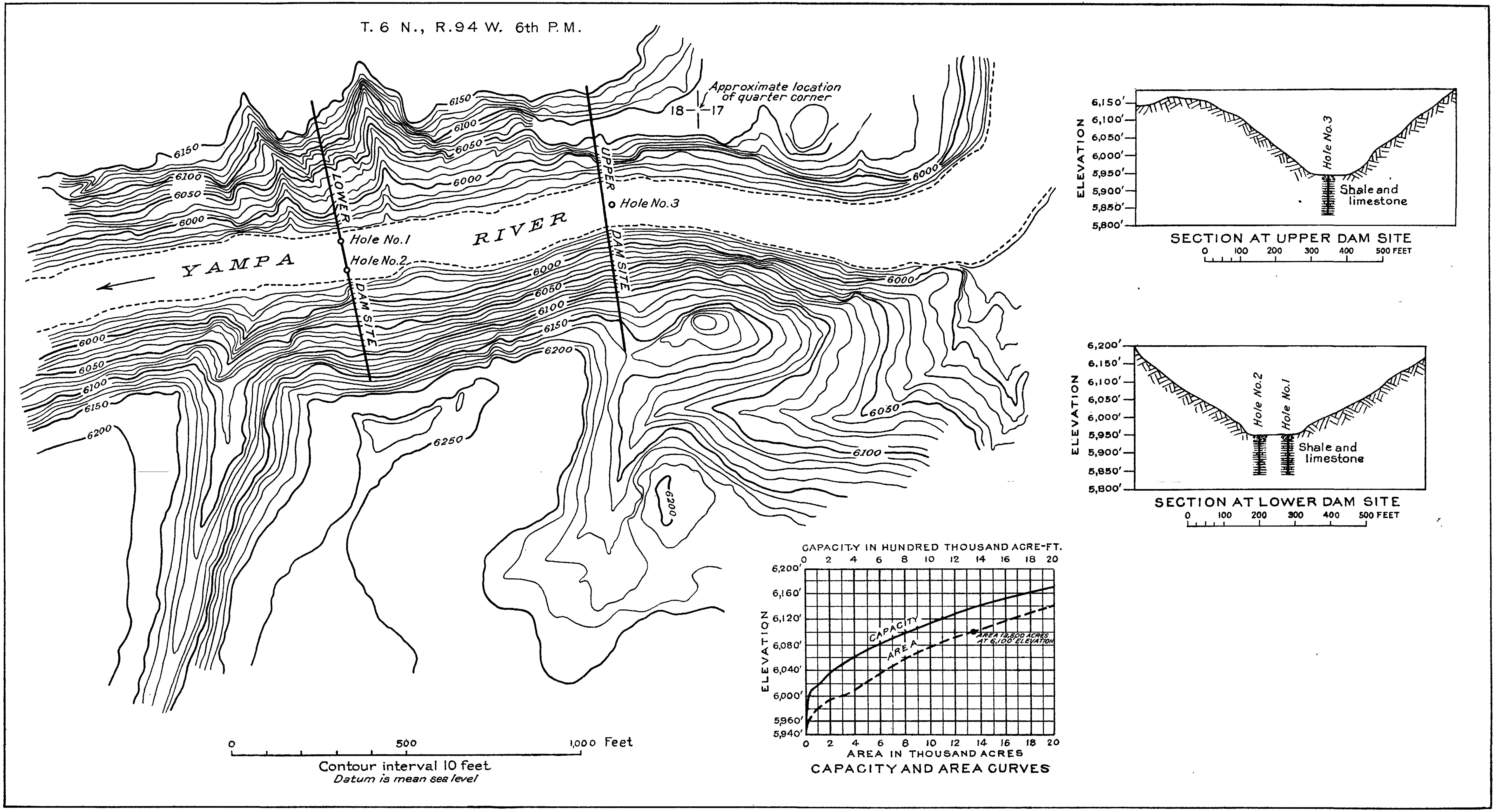


B. VIEW UPSTREAM FROM THE UPPER BEAR DAM SITE

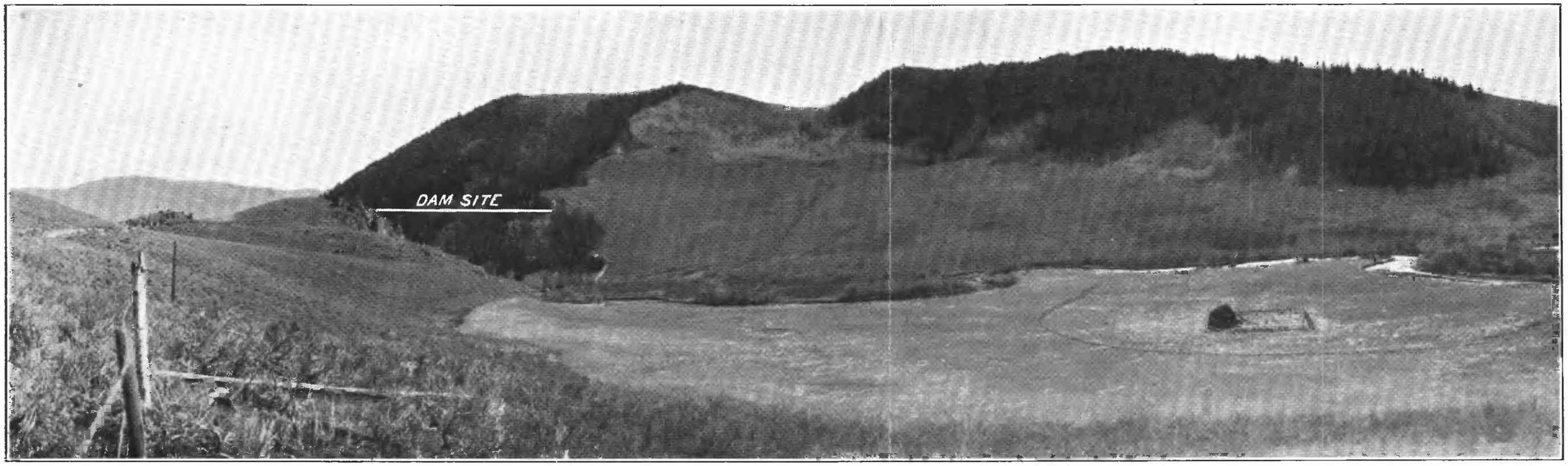
Showing the reservoir basin and improved lands that would be inundated by the reservoir.



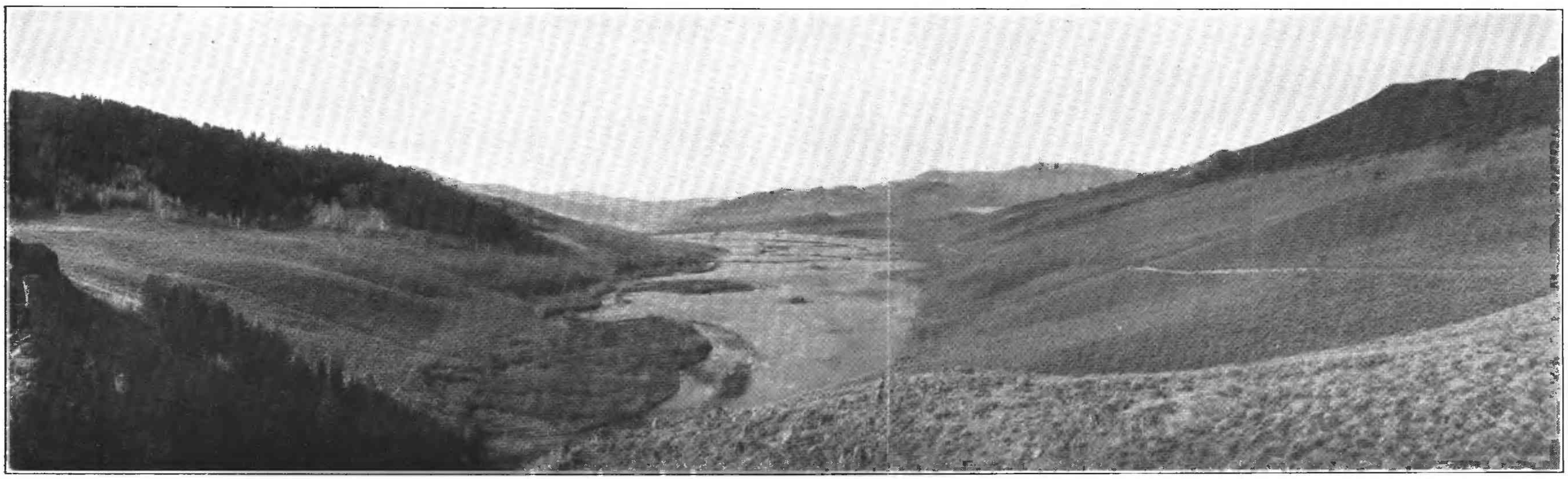
JUNIPER RESERVOIR SITE



JUNIPER DAM SITE



A. VIEW DOWNSTREAM TOWARD THE UPPER BEAR DAM SITE, ON THE YAMPA RIVER ABOUT 14 MILES SOUTH OF STEAMBOAT SPRINGS, COLO.



B. VIEW UPSTREAM FROM THE UPPER BEAR DAM SITE

Showing the reservoir basin and improved lands that would be inundated by the reservoir.

Drainage area.—About 140 square miles lying on the west slopes of the Park Range, which at this place forms a part of the Continental Divide. The area is from 7,600 to 12,220 feet above sea level. It lies within the Routt National Forest and is well wooded. The principal streamlets rise in a number of small lakes scattered over the catchment areas.

Water supply.—Partial stream-flow records near the dam site for 1912 to 1918 show a mean run-off of 134,500 acre-feet for the year exclusive of December, January, February, and March.

Remarks.—This site was surveyed at one time for the Farwell Mountain Copper Co. A smaller site, designated No. 1 reservoir site, a little more than a mile downstream from it, was also surveyed for the same company, but both of them were determined to be economically infeasible. A dam 100 feet high at this lower site would have a crest length of 560 feet, and the reservoir capacity would be about 6,380 acre-feet. The development of either site would be expensive, and there is no apparent need for either of them. Present irrigated areas find no shortage of water supply sufficient to justify the development, and there are no additional irrigable areas to which the stored water could be taken cheaply. In the discussion of undeveloped power in this report, a power project is suggested that would utilize the Hinman Park reservoir site.

SWAMP PARK RESERVOIR SITE (9CA 3)

Location.—On Mad Creek in unsurveyed T. 8 N., R. 84 W., apparently in sec. 21. (See Hahns Peak topographic map.)

Dam site.—A rather broad, flat cross section where the stream leaves the park. A dam 25 feet high would have a crest length of about 1,200 feet.

Basin.—A mountain park or meadow area of about 500 acres.

Capacity.—

Depth of water at dam (feet)	Area (acres)	Capacity (acre-feet)	Depth of water at dam (feet)	Area (acres)	Capacity (acre-eet)
5	3	5	20	147	1,030
10	19	60	25	309	2,470
15	55	270			

Drainage area.—About 12 square miles on the west slopes of the Park Range. Its altitude ranges from 9,000 to 11,940 feet above sea level. It lies within the Routt National Forest, is well wooded, and has a relatively high rainfall.

Water supply.—Fragmentary stream-flow records at the mouth of Mad Creek, about 6½ miles below the reservoir site, show a mean run-off of 86,800 acre-feet for the year exclusive of December, January, February, and March. The total drainage area above the gaging station is about 40 square miles. It is estimated that possibly 35,000 acre-feet would be the mean annual run-off at the reservoir site.

Remarks.—After Mad Creek leaves Swamp Park it falls rapidly for its entire length of about 7 miles. In this distance the total fall is 2,260 feet. It has a flashy regimen, but the estimated mean annual flow is about 120 second-feet.

In 1906 Swamp Park, Luna and Marguerite Lakes, at the head of Mad Creek, and the Three Rivers reservoir site, a little more than a mile downstream from Swamp Park, were surveyed as reservoir sites. A dam at Luna Lake 50 feet high and 365 feet long was proposed, and a tunnel 1,005 feet long to tap the lake about 10 feet below its normal surface. The storage capacity at this site was determined to be about 3,660 acre-feet. The drainage area tributary to the lake is about 4 square miles. At Lake Marguerite a dam 10 feet high and 464 feet long was proposed, and a tunnel 670 feet long to tap the lake 35 feet below the natural water surface. The determined storage capacity was about 300 acre-feet. The drainage area tributary to this lake is hardly 1 square mile. At the Three Rivers site a 60-foot dam with a crest length of about 325 feet was proposed, and the capacity was determined to be about 3,080 acre-feet. There is no apparent need for the development of any of these sites for irrigation, but in the discussion of undeveloped power in this report is suggested a plan of power development on Mad Creek that contemplates the use of some storage.

KILPATRICK RESERVOIR SITE (9CA 4)

Location.—On Elkhead Creek about 24 miles northeast of Craig, Colo. The proposed dam site is in sec. 3, T. 8 N., R. 88 W. (See Pilot Knob topographic map).

Dam site.—A dam 140 feet high would have a crest length of 524 feet.

Basin.—A broadened canyon section.

Capacity.—

Depth of water at dam (feet)	Area (acres)	Capacity (acre-feet)	Depth of water at dam (feet)	Area (acres)	Capacity (acre-feet)
10	9	40	70	62	2,050
20	18	180	80	71	2,650
30	25	380	90	79	3,620
40	36	710	100	90	4,740
50	44	1,110	110	98	5,910
60	53	1,530	130	----------	7,380

Drainage area.—About 56 square miles.

Water supply.—Partial stream-flow records obtained about 5 miles above the dam site indicate an annual run-off of possibly 60,000 to 65,000 acre-feet. The quantity available for storage is somewhat uncertain. The stream supplies a considerable area of irrigated lands below, and in an average year the natural stream flow after June 15 is apparently all appropriated. Court decrees allocate more than 650 second-feet and conditionally provide for reservoir diversions of 177,000 acre-feet from Elkhead Creek.

Remarks.—This site was surveyed in 1905. Its principal value as a reservoir would be for irrigation. The water could be used on lands included in the project known as Great Northern project No. 1, lying between Fortification and Elkhead Creeks. The Pilot Knob topographic map, made in 1923 by the Geological Survey, indicates that a dam about 250 feet high near the north line of sec. 3, T. 8 N., R. 88 W., would have a crest length of about 600 feet. Such a dam would create a reservoir with a water surface about 1½ miles long and 1,500 feet in maximum width, having an area of about 175 acres. The estimated capacity of such a reservoir is about 15,000 acre-feet.

JUNIPER RESERVOIR SITE (9CB 1)

Location.—On the Yampa River about 24 miles west of Craig, Colo. The proposed dam site is at the head of Juniper Canyon, in the eastern part of sec. 18, T. 6 N., R. 94 W. (See pls. 8 and 10, *A*.)

Dam site.—Two dam sites were surveyed in detail by the United States Bureau of Reclamation in 1915. The upper one is about 300 feet west of the east line of sec. 18, T. 6 N., R. 94 W., and the lower one is about 800 feet farther downstream. The crest lengths of dams 150 feet high at these two sites would be about 500 feet and 600 feet respectively. Some study of the foundation conditions was made at each site by drilling. One hole was sunk at the upper site near the middle of the stream, and rock was encountered at a depth of 24 feet. At the lower site two holes were sunk—one near each edge of the stream in the channel. In one of them rock was reached at a depth of 13 feet, and in the other at a depth of 17 feet. (See pl. 9.)

Basin.—The topography of the basin is shown on the Axial and Monument Butte topographic maps. For about 7 miles above the dam the reservoir would have an average width of more than a mile, but beyond that point it would be confined to a narrow strip along the river. The air-line length of the reservoir would be about 18 miles; the length by the river course is 38 miles. A few ranches lie within the reservoir site, but the greater part of the area that would be flooded is unimproved and barren, except for a scattered growth of sagebrush and juniper. The Juniper Hot Springs resort would be inundated and also a section of the Maybell-Meeker road.

Capacity.—

Contour (feet above sea level)	Area (acres)	Capacity (acre-feet)	Contour (feet above sea level)	Area (acres)	Capacity (acre-feet)
5,945	0	0	6,050	7,300	306,000
6,000	3,200	46,000	6,060	8,200	390,000
6,010	4,000	80,000	6,070	9,200	482,000
6,020	4,800	120,000	6,080	10,400	583,000
6,030	5,600	172,000	6,090	11,800	700,000
6,040	6,400	234,000	6,100	13,500	827,000

Drainage area.—About 3,410 square miles, ranging in altitude from 5,950 feet to more than 12,000 feet above sea level and comprising all the important drainage area tributary to the Yampa River except that of the Little Snake River.

Water supply.—Partial stream-flow records for a number of years have been obtained at a gaging station on the Yampa River about 5 miles downstream from the Juniper dam site. No winter records were obtained on account of ice conditions. The discharge at this station is virtually the amount that is available at the Juniper reservoir site, and this is estimated, from the records, to be about 1,346,000 acre-feet for the mean year.

Remarks.—During the period 1918 to 1924 a storage capacity of 700,000 acre-feet was sufficient to give the maximum equalized flow that could be obtained—about 1,550 second-feet. No large tracts of irrigable land lie in the Yampa River Valley below this site upon which the stored water could be applied. It has been proposed, however, to divert water at the Juniper dam, 115 feet above low-water level of the river, into a projected canal along the south side of the river, through Cross Mountain in a tunnel, thence through the divide south into Wolf Creek, a tributary of the White River, thence along the south slopes of the Blue Mountains to Deadmans Bench. This project was investigated in 1923 by the United States Bureau of Reclamation, which concluded that the project is not feasible, owing to the high cost of construction.

The chief value of this reservoir site is apparently for power. Like the Flaming Gorge site, on the Green River, it is a key site, located at the "top of the hill," so to speak, so that the advantage of the stream regulation would be available to all power sites or irrigation projects on the streams below. It has been mentioned at times as one of the headwater storage sites that might be used in a proposed flood-control program for the Imperial Valley, but when considered by itself its effect upon the flow of the lower Colorado River would be negligible.

CROSS MOUNTAIN RESERVOIR SITE (9CB 2)

Location.—On the Yampa River about 45 miles directly west of Craig, Colo. A dam site has been suggested in the NE. ¼ sec. 13, T. 6 N., R. 98 W., near the head of Cross Mountain Canyon, but other places in the canyon also offer good sites. The canyon is 3 miles long. (See pl. 10, *B*, also plan and profile of Yampa River, Colo., from Green River to Morgan Gulch, sheets B and E.)

Dam sites.—The dam site near the head of Cross Mountain Canyon was suggested during the early studies of storage possibilities in the Colorado River Basin for the regulation of the flow of the lower Colorado and for irrigation in the lower valleys. A dam at this place 100 feet high would have a crest length of about 300 feet. The walls of the canyon are sandstone, and bedrock is estimated to be about 25 feet below the stream bed.

Basin.—The reservoir area is known as Maybell Valley. A dam of 100 feet or more would inundate the town of Maybell as well as a considerable area of agricultural lands, with canal system, buildings, roads, and other improvements.

Capacity.—

Contour (feet above sea level)	Area (acres)	Capacity (acre-feet)	Contour (feet above sea level)	Area (acres)	Capacity (acre-feet)
5,815	0	0	5,905	10,300	365,000
5,865	4,200	86,000	5,915	12,300	481,000
5,875	5,500	136,000	[a] 5,925	14,400	615,000
5,885	6,900	198,000	[a] 5,935	16,700	772,000
5,895	8,500	273,000			

[a] Estimated.

Drainage area.—Slightly larger than that above the Juniper dam site.

Water supply.—About the same as that at the Juniper site—1,346,000 acre-feet for the mean annual run-off.

Remarks.—This reservoir site is below all possible irrigation projects in the Yampa River Valley and could be used for irrigation only along the Green and lower Colorado Rivers, where its effect upon the regimen of those streams would be of only slight consequence. It was investigated to some extent as a headwater storage site in connection with the flood-control problem of the lower Colorado. It might be considered as an alternate project with the Juniper site. Either one is large enough to control the Yampa River, and accordingly there is no need for the development of both of them. The Juniper site has several advantages. (1) It is located higher on the stream, and, though not feasible at this time, it is physically possible to take water from the reservoir in a gravity system to lands on Deadmans Bench. (2) Less improved agricultural land would be inundated by its development than by that of the Cross Mountain site. (3) No towns would be flooded, and less of other improvements, such as roads, canals, and ranch buildings, would be destroyed. Accordingly, the development of the Juniper site for storage seems to fit better into the most comprehensive development of the stream. Cross Mountain Canyon possesses attractive power possibilities in connection with the storage at the Juniper site, but these can be developed without material damage to any present or future agricultural development, as indicated in the discussion of this project as a power site under the heading "Undeveloped power sites."

LILY PARK RESERVOIR SITE (9CD 1)

Location.—On the Yampa River between Cross Mountain and Blue Mountain Canyons, where the Little Snake River joins the Yampa. (See plan and profile of Yampa River, sheet B, U. S. Geol. Survey, 1924.) The proposed dam site is in sec. 20, T. 6 N., R. 99 W.

Dam site.—A dam 60 feet high near the head of Blue Mountain Canyon would back water up the river 20 miles, to the mouth of Cross Mountain Canyon, and up the Little Snake River about 6 miles. No detailed investigations have been made of any definite location for a dam, but Blue Canyon is narrow, and there are many places where the physical conditions are apparently suitable.

Basin.—The basin comprises what is known as Lily Park, a valley area lying between Cross Mountain and Blue Mountain Canyons and extending several miles up the Little Snake River. A few ranches are situated within the proposed reservoir site, but they comprise a very small proportion of the total area and are not being used or worked to any extent.

Capacity.—

Contour (feet above sea level)	Area (acres)	Capacity (acre-feet)	Contour (feet above sea level)	Area (acres)	Capacity (acre-feet)
5,590	0	0	5,680	6,720	278,590
5,600	166	930	5,700	8,220	427,990
5,620	1,710	19,690	[a] 5,720	9,800	615,000
5,640	3,530	72,090	[a] 5,740	10,800	720,000
5,660	5,200	159,390			

[a] Estimated.

Drainage area.—More than 7,000 square miles, comprising all the principal water sources of the entire river basin.

Water supply.—The stream flow as the river leaves Lily Park is very little less than at the mouth of the river. The entrance to Blue Mountain Canyon is just 45 miles from the junction of the Yampa River with the Green River, and this entire stretch is a canyon with only a few wet-weather channels coming in. The mean annual run-off is estimated to be more than 1,500,000 acre-feet.

Remarks.—The principal value of this reservoir site is apparently for some stream regulation through the canyons below for the development of power. No irrigation projects on which stored water might be used exist in the Yampa River Basin below this site. The site is too small to be considered individually in connection with the control of floods on the lower Colorado River. Its utilization is further considered under the heading "Undeveloped power sites."

RED PARK RESERVOIR SITE (9CC 1)

Location.—On the Middle Fork of the Little Snake River. The proposed dam site is in sec. 14, T. 11 N., R. 85 W. (See Hahns Peak topographic map.)

Dam site.—A narrow section at the outlet of Red Park. A dam 100 feet high would have a creast length of about 175 feet.

Basin.—A mountain park area roughly about 2 miles long and 1 mile wide. A survey of the site in 1911 carried the dam to a height of 180 feet.

Capacity.—

Depth of water at dam (feet)	Area (acres)	Capacity (acre-feet)	Depth of water at dam (feet)	Area (acres)	Capacity (acre-feet)
0	0	0	60	489	13,740
10	41	360	70	576	19,060
20	134	1,230	80	680	25,340
30	233	3,020	90	807	32,780
40	312	5,690	100	937	41,500
50	404	9,270	110	1,082	51,590

Drainage area.—About 16 square miles, ranging from 8,600 to about 10,500 feet above sea level.

Water supply.—Incomplete stream-flow records on the Middle Fork of the Little Snake River near its mouth indicate a mean annual run-off of about 95,000 acre-feet. The drainage area above this station is about 120 square miles. The estimated mean annual run-off at the reservoir site is about 13,000 acre-feet.

Remarks.—This reservoir site was surveyed in 1911 in connection with the Elk River irrigation project, which embraced more than 100,000 acres of land along the south and east side of the Little Snake River. Some water was to be diverted from the headwater streams of the Elk River into the drainage basin above this reservoir site, in order to supplement the natural flow available at the site. In all, water was to be gathered from 18 different sources and collected into this and other reservoirs for use on the project.

LITTLE RED PARK RESERVOIR SITE (9CC 2)

Location.—Joins Red Park on the southwest by a low divide. It is on King Solomon Creek, which empties into Independence Creek, a tributary of the Middle Fork of the Little Snake River. The proposed dam site is on the north line of sec. 27, T. 11 N., R. 85 W. (See Hahns Peak topographic map.)

Dam site.—A rather broad cross section between gently sloping hills. A dam 60 feet high would have a crest length of 500 feet or more.

Basin.—A mountain-park area covering roughly about 1½ square miles.

Capacity.—

Depth of water at dam (feet)	Area (feet)	Capacity (acre-feet)	Depth of water at dam (feet)	Area (feet)	Capacity (acre-feet)
10	68	300	40	411	7,590
20	189	1,570	50	489	12,090
30	301	4,330			

Drainage area.—About 14 square miles, ranging in altitude from 8,500 to 10,850 feet above sea level.

Water supply.—No records of stream flow are available at the reservoir site, but incomplete records on the Middle Fork of the Little Snake River near its mouth indicate a mean annual run-off at that place of about 95,000 acre-feet. The water flowing through Little Red Park is included in the records of this station, and by comparison of the relative size of drainage areas above the gaging station and the proposed dam site and consideration of other factors, it is estimated that the annual run-off at the reservoir site is about 11,000 acre-feet.

Remarks.—This reservoir site was surveyed in 1912 and is one of the sites that was to be used for storage in connection with the proposed Elk River irrigation project. The principal value of the site is apparently for irrigation, but at this time there seems to be no economic need for it or the other sites proposed for this project.

COLUMBUS MOUNTAIN RESERVOIR SITE (9CC 3)

Location.—On Slater Creek, a tributary of the Little Snake River. The proposed dam site is in sec. 5, T. 10 N., R. 87 W.

Dam site.—A broad, shallow cross section. A dam 140 feet high would have a crest length of 1,468 feet.

Basin.—A small valley about 3 miles long and 1 mile in average width.

Capacity.—

Depth of water at dam (feet)	Area (acres)	Capacity (acre-feet)	Depth of water at dam (feet)	Area (acres)	Capacity (acre-feet)
10	25	130	80	700	19,510
20	65	570	90	922	27,620
30	129	1,520	100	1,143	37,950
40	200	3,170	110	1,371	50,520
50	271	5,520	120	1,600	65,380
60	399	8,870	125	1,714	73,660
70	526	13,490			

Drainage area.—About 32 square miles.

Water supply.—No stream-flow records are available at the reservoir site. A few years of incomplete records, however, have been obtained at a gaging station about 13 miles downstream from the site, and these indicate that the average annual run-off of the creek at that place is about 60,000 acre-feet, and it is estimated that about 40 to 50 per cent of this passes the reservoir site.

Remarks.—This site was surveyed for the Elk River Irrigation & Construction Co. in 1908 and was to be use in conjunction with the Red Park and Little Red Park sites. Supplemental water supply was to be brought into the reservoir from the headwaters of the Elk River and also from the two Red Park reservoir sites. Construction costs of the project works will be high, because of the elaborate system of collecting canals and reservoirs. The project is now inactive.

A few miles downstream from the Columbus Mountain reservoir site is another reservoir site that has been proposed to store water for irrigation. The dam site is in sec. 3, T. 10 N., R. 88 W., and the survey indicates that a dam 100 feet high would have a crest length of 500 feet. With a depth of water of 88 feet at the dam the storage capacity of the site is 22,730 acre-feet, and the surface area of such a reservoir is 855 acres. This site is known as the Slater Park or Farmer's reservoir site. It apparently has a better dam site than the Columbus Mountain site and sufficient capacity for any development contemplating the use of only water from Slater Creek. There is no apparent need that would require the development of both of these sites.

SAVERY RESERVOIR SITE (9CC 4)

Location.—On Savery Creek about 18 miles northeast of Baggs, Wyo., in T. 15 N. on the line between Rs. 88 and 89 W.

Dam site.—In sec. 1, T. 14 N., R. 89 W. A dam at this place would be 20 feet long at the creek level and 320 feet long at a height of 80 feet. The west wall of the canyon is rather steep; the east wall is formed by a bench about 100 feet above the creek. Sandstone in the east wall of the canyon and conglomerate in the west wall both dip away from the canyon, suggesting that the canyon is on a fault. Some years ago test pits were dug at this site by the Routt County Development Co., but no data are available showing the results of this work.

Basin.—A small valley in a broadened section of Savery Creek Canyon, about 7,500 feet above sea level.

Capacity.—The estimated capacity of the reservoir with a dam 80 feet high is about 40,000 acre-feet.

Drainage area.—About 160 square miles.

Water supply.—No stream-flow records are available on Savery Creek except some incomplete ones at a gaging station a few miles above the mouth of the creek, about 13 miles downstream from the reservoir site. These records indicate an average annual run-off from Savery Creek of 85,000 to 90,000 acre-feet, from a drainage area of about 354 square miles.

Remarks.—This reservoir site has been surveyed and the cost estimated in detail in connection with the irrigation of lands on what is known as Dolan Mesa. The estimated cost of the dam is about $375,000. The main canal as suggested by the project would divert from the creek about 8 miles below the reservoir and cover about 8,000 acres of land north and east of Dixon, Wyo., and about 10,000 acres north and west of Baggs, Wyo., besides supplying supplemental water to two small ditches diverting from Little Snake River.

Another reservoir site on Savery Creek, at the place where Little Sandstone and Sandstone Creeks enter, is designated the Sandstone reservoir site. It has a capacity of about 13,000 acre-feet. This site has received only secondary attention because it is not required in connection with the irrigation projects that have been seriously considered. In connection with the project to use Savery Creek for further irrigation, it has been proposed to divert the waters of Battle Creek into Little Sandstone Creek near Copperton. This can be done at comparatively small cost, and as Battle Creek drains an area along the west side of the Continental Divide, from about 8,000 to 10,000 feet in altitude, it has a relatively high run-off per square mile of drainage area. This run-off also lags behind that of Savery Creek and would thus help to sustain a better flow in that creek during the summer.

TRAPPERS LAKE RESERVOIR SITE (9BF 1)

Location.—At the headwaters of the North Fork of the White River. Dam site is at the outlet of Trappers Lake, about in unsurveyed sec. 2, T. 1 S., R. 88 W. (See Glenwood Springs topographic map.)

Dam site.—A broad, shallow cross section between gentle hill slopes. A dam 60 feet high would have a crest length of 1,200 feet.

Basin.—A mountain lake about 1¼ miles long and about 2,000 feet wide. Its altitude is 9,604 feet above sea level.

Capacity.—

Contour (feet above sea level)	Area of lake surface (acres)	Capacity (acre-feet)	Contour (feet above sea level)	Area of lake surface (acres)	Capacity (acre-feet)
9,604	340	1,650	9,629	428	11,320
9,609	360	3,390	9,634	442	13,490
9,614	379	4,240	9,644	455	15,730
9,619	398	7,180	9,649	465	18,030
9,624	413	9,210	9,654	474	20,380

Drainage area.—About 12 square miles, ranging in altitude from 9,604 to 11,990 feet above sea level.

Water supply.—No stream-flow records are available on the White River above the station at Buford, where some incomplete records have been obtained. This station is about 22 miles downstream from the lake, and the drainage area tributary to it is about 240 square miles. The estimated mean annual run-off of the stream at this place is about 240,000 acre-feet.

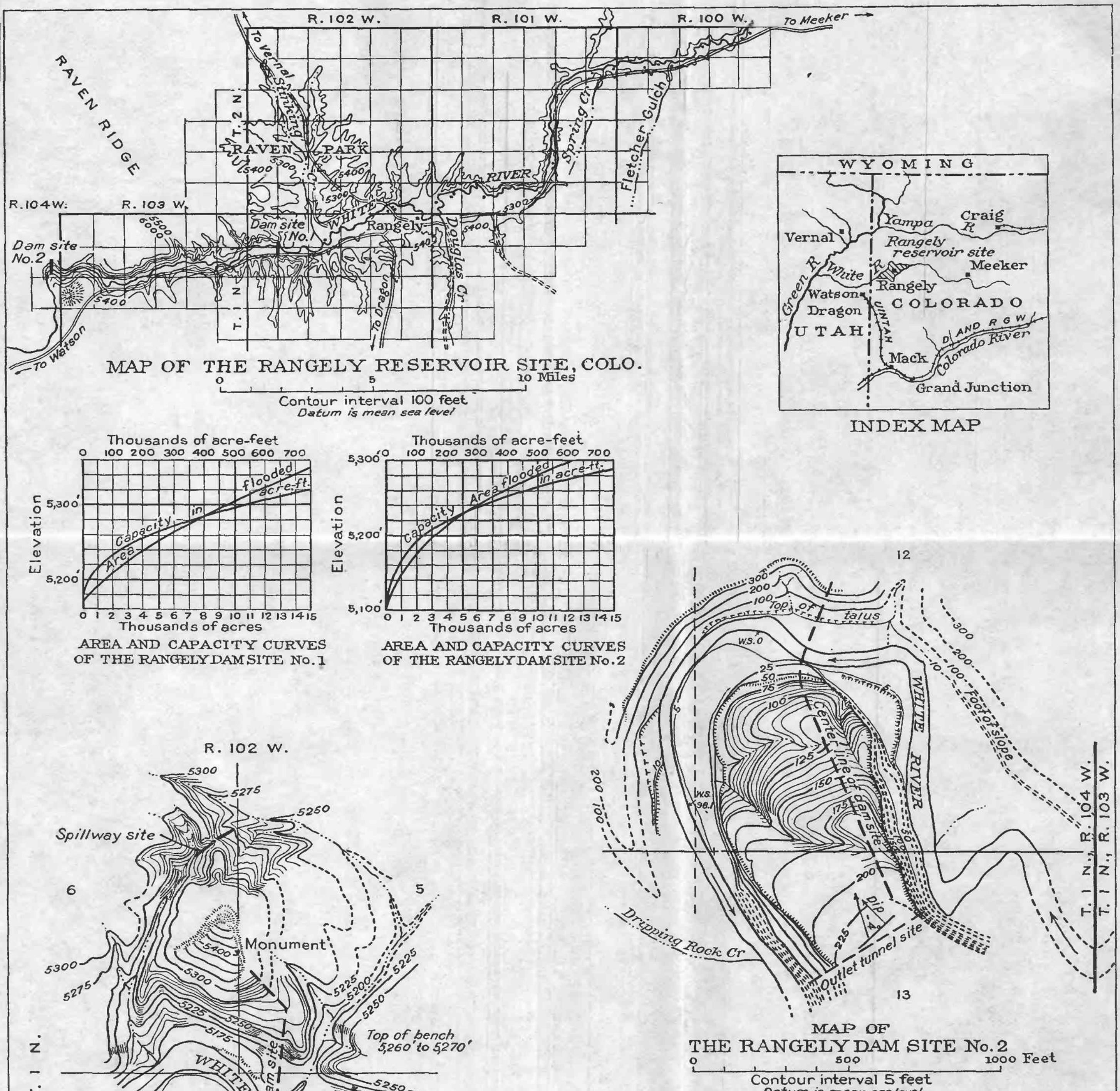
Remarks.—This lake has been proposed as a reservoir site in connection with irrigation of lands in the Yellow Jacket project, in Axial Basin, and also in connection with proposed irrigation of lands in the lower White River Valley and on the area known as Deadmans Bench. The site was surveyed as early as 1909. Storage here is principally valuable for irrigation. At present there is no economic need for development of this site.

MARVINE LAKES RESERVOIR SITE (9BF 2)

Location.—At the headwaters of Marvine Creek, a tributary of the White River. The dam site is at the outlet of the lower lake, approximately in unsurveyed sec. 28, T. 1 S., R. 89 W. (See Glenwood Springs topographic map.)

Dam site.—A broad U cross section, where a dam 60 feet high would have a crest length of 520 feet.

Basin.—Two small mountain lakes in chain. Total length about 7,000 feet and maximum width about 1,000 feet. Altitude 9,325 feet above sea level.



RANGELY RESERVOIR SITE AND DAM SITES

Capacity.—

Contour (feet above sea level)	Area (acres)	Capacity (acre-feet)	Contour (feet above sea level)	Area (acres)	Capacity (acre-feet)
9,325	(a)	----------	9,355	222	5,890
9,330	174	870	9,360	227	7,010
9,335	184	1,770	9,365	232	8,160
9,340	197	2,720	9,370	236	9,330
9,345	210	3,730	9,375	241	10,520
9,350	216	4,800			

[a] Lake surface.

Drainage area.—About 10 square miles, ranging in altitude from 9,325 to 11,875 feet above sea level.

Water supply.—Incomplete stream-flow records on Marvine Creek near its mouth, about 8 miles below this lake, indicate that the mean annual run-off of the creek is about 86,000 acre-feet. The drainage area above the gaging station is about 30 square miles.

Remarks.—These lakes were surveyed as a possible reservoir site in 1909. Storage has been suggested at this place in connection with the Yellow Jacket irrigation project, in Axial Basin, as well as other irrigation projects in the lower White River Valley. Storage here would be principally valuable for irrigation, and at present there is no economic need for its development.

RANGELY RESERVOIR SITE (9BH 1)

Location.—On the White River. The town of Rangely lies within the reservoir site. The proposed dam site is about 12 miles west of Rangely, in sec. 12, T. 1 N., R. 104 W. (See pl. 11.)

Dam sites.—Two dam sites were investigated to some extent by the United States Bureau of Reclamation in 1916. Cross sections of these are shown in Plate 11. Site No. 2 is the lower one on the stream and is considered the better of the two.

Basin.—A narrow valley along the White River. The side slopes are rugged and cut by numerous cross gullies. Total length of proposed reservoir about 25 miles.

Capacity.—The following figures relate to site No. 2:

Contour (feet above sea level)	Area (acres)	Capacity (acre-feet)	Contour (feet above sea level)	Area (acres)	Capacity (acre-feet)
5,100	0	0	5,200	3,100	130,000
5,120	550	10,000	5,220	4,200	210,000
5,140	1,000	20,000	5,240	6,000	315,000
5,160	1,500	42,000	5,260	7,800	460,000
5,180	2,200	75,000	5,280	10,000	650,000

Drainage area.—About 3,270 square miles.

Water supply.—A stream-gaging station was established about 1 mile west of Rangely in April, 1904, but it was not maintained after 1905, and the records obtained are fragmentary. Accordingly, the nearest gaging station to the Rangely reservoir site is the one near Meeker, and the records at this station show a mean annual run-off of about 484,000 acre-feet. No important tributaries come in between this station and the dam site, but there are several streams that drain considerable areas of barren plateaus and have a high wet-weather run-off.

Remarks.—The Rangely reservoir site is below all important irrigable areas along the White River. It is too small to play any important part in the flood control of the lower Colorado River. It may be used for power at some future time but not until after the more favorably located power sites in the region have been developed. Further discussion of this power possibility is given under "Undeveloped power sites." (See p. 213.)

UINTA BASIN IN UTAH

GENERAL CONDITIONS

Without considering the Strawberry Reservoir, because of the fact that it is used for lands in the Great Salt Lake Basin, the amount of developed storage in the Uinta Basin is surprisingly small. Several of the small headwater lakes have been converted into reservoirs—one at the head of Lake Fork Creek, known as Brown Duck Lake (9BC 2) (see pl. 14, *B*), and five on Ashley Creek, including the Ashley Twin Lakes (9BA 12). The combined storage capacity is 4,945 acre-feet. Plans, have been projected for the development of several more of these lakes, and in a few places some construction work has been done. The fact has been recognized for several years that storage is absolutely necessary before the irritated area in the basin can be extended to any appreciable amount beyond its present limits; furthermore, it is equally important that the flow of the streams should be regulated more or less to increase their power value. Accordingly one investigation after another has been made of the principal streams in search for feasible storage sites. Surveys have been made of more than 60 of the small glacial lakes on the headwaters of the streams and of at least 15 different sites on the lower reaches.

On the Green River itself the Bureau of Reclamation [50] made a survey of what is called the Ouray reservoir site, which would be developed by a dam in the upper end of Desolation Canyon. Borings were made at several sections in the canyon, but results were not encouraging. A storage capacity of 16,000,000 acre-feet would result from a 210-foot depth of water at the suggested dam site, and considerable agricultural land would be inundated. The site is also traversed by the proposed location of the Denver & Salt Lake Railroad, and this would add to the complications of development. Accordingly it is considered of doubtful availability and would apparently be too costly for the benefits to be derived. A partial use of the site is suggested on page 245 of this report in connection with a proposed alternate plan of power development.

In addition to these surveys a plan and profile of the upper Duchesne River and the principal tributaries of that stream was made by the United States Geological Survey in 1923–24. These maps are on a scale of 2 inches to the mile, and the topography is shown by contours with an interval of 20 feet on the land and water surface. The verti-

[50] Sixteenth Ann. Rept., p. 351, 1917.

cal scale of the profiles is 1 inch to 160 feet. The maps are printed in three colors, like the standard topographic maps of the Geological Survey, and in addition to the topography of the canyons and the location of the streams, they show all land lines, power, dwelling houses, roads, and other artifical features.

The salient facts obtained by these investigations are given in the following table, and a more detailed description of the largest and most valuable sites is given in the text.

Reservoirs and reservoir sites in Uinta Basin in Utah

Constructed reservoirs [a]

Name	Index No.	Minor drainage basin	Source of supply	Location [b]	Approximate height of dam (feet)	Approximate area (acres)	Capacity (acre-feet)	Remarks
Brown Duck Lake	9BC R2	Lake Fork	Headwater Lake	At corner common to Tps. 2 and 3 N., Rs. 6 and 7 W.	Dam 15, cut 10	202	3,725	Dam rock fill, crest length 700 feet, drainage area 3.1 square miles, annual precipitation about 20 inches.
Ashley Twin Lakes	9BA R12	Ashley Creek	do	Unsurveyed	Dam 18	52	420	Dam timber crib and earth, crest length 260 feet, drainage area about 1.5 square miles. Run-off ample.
Four small lakes		do	do	do	No data	No data.	800	Owned and operated by combined irrigation companies.

Reservoir sites [c]

Name	Index No.	Minor drainage basin	Source of supply	Location [b]	Approximate height of dam (feet)	Approximate area (acres)	Capacity (acre-feet)	Remarks
Hades	9BB 1	Duchesne River.	North Fork	Sec. 26, T. 2 N., R. 9 W.	140	495	33,770	See p. 136.
Tabiona	9BB 2	do	Duchesne River	Secs. 13 and 14, T. 1 S., R. 8 W.	150	1,250	62,500	See p. 136.
Upper Cliff Lake	9BB 1	Rock Creek	Headwater Lake	Sec. 20, T. 3 N., R. 8 W.	Dam 3, cut 5.5	96	686	Dam site broad and flat, crest length 320 feet, drainage area about 1,000 acres. Site remote, difficult of access.
Lower Cliff Lake	9BB 2	do	do	Secs. 21 and 28, T. 3 N., R. 8 W.	Dam 6, cut 4.5	35	287	Dam site broad and flat, crest length 190 feet, drainage area about 1,000 acres.
Upper Fish Lake	9BB 3	do	do	Secs. 8, 16, and 17, T. 3 N., R. 8 W.	Dam 7, cut 3	48	395	Dam site broad and flat, crest length 300 feet, drainage area about 500 acres.
Middle Fish Lake	9BB 4	do	do	Sec. 16, T. 3 N., R. 8 W.	Dam 8.5, cut 7	43	394	Dam site broad **U**, glacial drift, crest length 194 feet, drainage area about 1,000 acres.
Lower Fish Lake	9BB 5	do	do	Sec. 21, T. 3 N., R. 8 W.	Dam 9.5, cut 5	31	287	Dam site broad **V**, glacial drift and marsh, crest length 247 feet, drainage area about 3,000 acres.
Lower Brown Lake	9BB 6	do	do	Secs. 27 and 28, T. 3 N., R. 8 W.	Dam 7.5, cut 5	33	343	Dam site broad **U**, glacial deposit, crest length 217 feet, drainage area about 300 acres.
Lost Lake	9BB 7	do	do	Sec. 29, T. 3 N., R. 8 W.	Dam 2, cut 6.5	43	204	Dam site irregular, crest length 120 feet, drainage area about 300 acres.
Blue Lake	9BB 8	do	do	Secs. 28 and 33, T. 3 N., R. 8 W.	Dam 23, cut 8	12	257	Dam site deep **V**, crest length 170 feet, estimated development cost high.
Twin Glacier Lakes	9BB 9	do	do	Secs. 2, 10, and 11, T. 3 N., R. 8 W.	Dam 6.5, cut 6	58	547	Dam site broad **U**, crest length 143 feet, drainage area about 300 acres.
Glacier Lake No. 3	9BB 10	do	do	Sec. 11, T. 3 N., R. 8 W.	No dam, cut 3.5	15	52	Flat meadow not suitable for dam. Drainage area about 600 acres.
Glacier Lake No. 2	9BB 11	do	do	Sec. 11, T. 3 N., R. 8 W.	Dam 10, cut 4	28	291	Dam site broad and shallow, crest length 475 feet, drainage area about 600 acres.
High High Lake	9BB 12	do	do	Secs. 31 and 32, T. 3 N., R. 8 W.	Dam 6, cut 10	56	625	Dam site broad **V**, crest length 140 feet. drainage area about 1,000 acres.

Low High Lake	9BB 13	do	do	Sec. 32, T. 3 N., R. 8 W.	Dam 6, cut 20	43	598	Dam site narrow V, crest length 60 feet, drainage area about 1,500 acres.
Grandaddy Lake	9BB 14	do	do	Secs. 32 and 33, T. 3 N., R. 8 W.; secs. 4, 5, T. 2 N., R. 8 W.	Dams 8, 5, 4—Tunnels.	195	4,803	See p. 137.
Grandaddy Fish Lake	9BB 15	do	do	Sec. 33, T. 3 N., R. 8 W.	Dam 8, cut 10	35	383	Dam site broad and flat, crest length 200 feet, drainage area about 1,200 acres.
Spoonbill Lake	9BB 16	do	do	Sec. 34, T. 3 N., R. 8 W.	Dam 8	15	126	Dam site broad and flat, crest length 210 feet, drainage area about 600 acres.
Slide Rock Lake	9BB 17	do	do	Sec. 10, T. 3 N., R. 7 W.	Dam 25, cut 6	11	68	Dam site broad and flat, crest length 173 feet, drainage area about 150 acres.
Pothole Lake	9BB 18	do	do	Sec. 15, T. 3 N., R. 7 W.	Dam 6, cut 7	23	153	Dam site broad and flat, crest length 267 feet, drainage area about 150 acres.
Lower Pothole Lake	9BB 19	do	do	Sec. 15, T. 3 N., R. 7 W.	Dam 5, cut 4.5	11	74	Dam site broad V, crest length 180 feet, drainage area about 200 acres.
Meadow Lake	9BB 20	do	do	Secs. 14 and 15, T. 3 N., R. 7 W.	Dam 6, cut 6	29	204	Two dam sites—main broad and flat, auxiliary V section.
Duck Lake	9BB 21	do	do	Sec. 35, T. 3 N., R. 7 W.	Dam 11, cut 5.5	39	374	Dam site broad flat U, crest length 325 feet, drainage area about 500 acres.
East Fork	9BB 3	do	East Fork	Secs. 21 and 28, T. 3 N., R. 7 W.	Dams 29, 24	35	556	See p 137.
Stillwater	9BB 4	do	Rock Creek	Secs. 4, 5, 7, 8, and 9, T. 1 N., R. 6 W. and secs. 31 and 32, T. 2 N., R. 6 W.	150	805	67,000	See p. 137.
Upper Currant Creek	9BB 5	Strawberry River.	Currant Creek	Sec. 8, T. 2 S., R. 10 W.	100	1,490	50,000	See p. 138.
Lower Currant Creek	9BB 6	do	do	Sec. 3, T. 3 S., R. 8 W.	100	470	20,000	See p. 138.
Three Forks	9BB 7	do	Strawberry River	Sec. 17, T. 4 S., R. 7 W.	130	510	32,000	See p. 139.
Starvation	9BB 8	do	do	Secs. 28 and 29, T. 3 S., R. 5 W.	125	2,420	148,000	See p. 140.
Hidden Lake	9BC 1	Lake Fork	Headwater Lake	Sec. 24, T. 4 N., R. 7 W.	Dam 5, cut 20	28	690	Drainage area less than 1 square mile. Ample water supply uncertain.
Brown Duck Lake	9BC 3	do	do	Secs. 5 and 6, T. 2 N., R. 6 W.	Dam 15, cut 7	69	944	Dam site broad V, crest length 320 feet, drainage area about 3.5 square miles. Being developed as reservoir.
Brown Duck Lake	9BC 4	do	do	Secs. 5 and 6, T. 2 N., R. 6 W.	Cut 9	37	563	Dam site broad V, crest length 381 feet drainage area about 3.8 square miles. Being developed as reservoir.
Moon Lake	9BC 5	do	Lake Fork	Sec. 18, T. 2 N., R. 5 W.; secs. 12 and 13, T. 2 N., R. 6 W.	80	935	77,550	See p. 141.
Superior Lake	9BC 6	do	Headwater Lake	Sec. 20, T. 4 N., R. 5 W.	Dam 13, cut 5	50	500	See p. 142.
Five Point Lake	9BC 7	do	do	Sec. 29, T. 4 N., R. 5 W.	Dam 14, cut 5	100	1,170	See p. 142.
Lake No. 8	9BC 8	do	do	Sec. 29, T. 4 N., R. 5 W.	Dam 9, cut 3		150	Dam site narrow V, crest length about 150 feet, no instrumental surveys.
Lake No. 9	9BC 9	do	do	Sec. 8 T. 3, N., R. 5 W.	Dam 5, cut 3		300	Chain of three small lakes in meadow Basin. Dam at lowest lake; outlets of other two lowered.

[a] Complete survey data not available for several additional small lakes now used as reservoirs. Construction work done without such data.
[b] All locations referred to Uinta base and meridian, except the two marked otherwise.
[c] Lakes which might be developed as reservoirs are shown in Plate 1 in solid blue. Other reservoir sites are shown on Plate 1 in blue hachure.

Reservoirs and reservoir sites in Uinta Basin in Utah—Continued

Reservoir sites—Continued

Name	Index No.	Minor drainage basin	Source of supply	Location	Approximate height of dam (feet)	Approximate area (acres)	Capacity (acre-feet)	Remarks
Lake No. 10	9BC 10	Lake Forp	Headwater Lake	Sec. 29, T. 4 N., R. 4 W.	Dam 5, cut 5	30	200	Crest length of dam 350 feet. Filing made in State engineer's office to develop.
Lake No. 11	9BC 11	do	do	Sec. 29, T. 4 N., R. 4 W.				Too small to be considered individually. Included in plan to develop 9BC 10.
Lake No. 12	9BC 12	do	do	Sec. 29, T. 4 N., R. 4 W.	7.5	15	150	Crest length of dam 300 feet. Filing made in State engineer's office to develop.
Farmers Lake	9BC 13	do	do	Sec. 31, T. 4 N., R. 4 W.	10	54	200	Dam site low saddle below lake, crest length 1,400 feet. Adequate water supply questionable.
Water Lily Lake	9BC 14	do	do	Sec. 34, T. 3 N., R. 4 W.	15	48	300	Available water supply estimated about 300 acre-feet. Capacity of lake much greater.
Crystal Ranch	9BC 1	do	East Fork	Sec. 4, T. 1 N., R. 4 W.; secs. 33 and 34, T. 2 N., R. 4 W.	100	310	12,000	See p. 144.
Ouray Valley	9BD 1	Uinta River	Whiterocks and Uinta Rivers.	Secs. 20, 21, 28, and 29, T. 7 S., R. 20 E., Salt Lake base and meridian.		1,300	20,000	This site is a natural depression in Colorado Park. At present used to a small extent. Available water supply somewhat uncertain. Estimated to be 12,000 to 15,000 acre-feet. No survey data on proposed dam.
Lake No. 1	9BE 1	Dry Gulch	East Fork	Sec. 4, T. 2 N., R. 3 W.	10	23	190	Dam at one time constructed. Failed during high water, 1917.
Atwood Lake	9BE 2	Uinta River	Headwater Lake	Secs. 14 and 15, T. 4 N., R. 4 W.	14	220	2,000	See p. 144.
Lake No. 3	9BE 3	do	do	Secs. 29 and 30, T. 4 N., R. 3 W.	Dam 2, cut 5	30	250	Filing in State engineer's office.
Lake No. 4	9BE 4	do	do	Secs. 29 and 32, T. 4 N., R. 3 W.	Dam 3, cut 5	20	80	Outflow September, 1919, from 6 to 8 second-feet. Dam site in loose rock. Filing in State engineer's office.
Lake No. 5	9BE 5	do	do	Sec. 32, T. 4 N., R. 3 W.	Cut 5	40	300	Basin lake, broad outlet 300 feet wide. Outflow September 7, 1919, 10 to 12 second-feet. Accessible with difficulty.
Lakes Nos. 6 and 7	9BE 6-7	do	do	Sec. 28, T. 5 N., R. 3 W.	do	35	250	Two lakes separated by low ridge. Shallow, broad, rocky outlet.
Fox Lake	9BE 8	do	do	Sec. 31, T. 5 N., R. 2 W.	Dam 10, cut 5	49	200	Dam site narrow, crest length 150 feet, drainage area about 4.1 square miles. Filing in State engineers' office.
Crescent Lake	9BE 9	do	do	Sec. 31, T. 5 N., R. 2 W.	Cut 5	35	400	Rock basin lake. Small drainage area. Water supply questionable.
Sumner	9BE 1	do	Uinta River	Sec. 20, T. 2 N., R. 2 W.	40	149	2,750	See p. 145.
Uinta Canyon	9BE 2	do	do	Secs. 15, 22, and 23, T. 2 N., R. 2 W.	130	304	12,480	See p. 145.

Montes Hollow	9BE 3	do	do	Sec. 36, T. 1 S., R. 1 W.	35	82	1,000	See p. 147.
Bottle Hollow	9BE 4	do	do	Secs. 21 and 28, T. 2 S., R. 1 E.	Dam 53, 73	441	12,590	See p. 147.
Lake No. 10	9BE 10	Whiterocks River	Headwater Lake	Sec. 30, T. 5 N., R. 1 W.	Dam 6, cut 6	26	315	Drainage area small. Water supply questionable.
Antler Lake	9BE 11	do	do	Sec. 8, T. 4 N., R. 2 W.	15	46	460	Dam site broad and shallow. Crest length 1,000 feet. Covered by filing in State engineer's office.
Queant Lake	9BE 12	do	do	Secs. 3 and 10, T. 4 N., R. 2 W.	21	83	1,300	Dam site narrow, crest length 750 feet. Covered by filing in State engineer's office.
Chepeta Lake	9BE 13	do	do	Sec. 32, T. 5 N., R. 1 W.	35	151	2,710	See p. 148.
Whiterocks Lake	9BE 14	do	do	Sec. 1, T. 4 N., R. 1 W.	15	71	851	See p. 148.
Cliff Lake	9BE 15	do	do	Sec. 22, T. 4 N., R. 1 W.	Dam 5, cut 10	41	550	Crest length of dam 400 feet, drainage area about 2 square miles, mostly bare ridges.
Paradise Park	9BE 5	do	Mountain meadow	Sec. 7, T. 3 N., R. 1 E.	25	132	2,330	See p. 148.
Twin Lakes	9BA 1	Ashley Creek	Headwater Lake	Unsurveyed	20	61	730	Crest length of dam about 100 feet, drainage area about 6.5 square miles.
Dry Fork Fish Lake	9BA 2	do	do	do	12	20	180	No surveys; data estimated.
Chimney Rock Lake	9BA 3	do	do	do	15	20	250	Do.
Metcalf Lake	9BA 4	do	do	do	15	25	100	Dam site broad and flat, crest length 980 feet, drainage area 1.3 square miles.
Timber Line Lake	9BA 5	do	do	do	15	10	80	No survey; data estimated.
Lake Shore Lake	9BA 6	do	do	do	18	20	175	Dam site broad, crest length 440 feet, drain age area about 1.7 square miles.
Upper Bench Lake	9BA 7	do	do	do	18	12	100	Dam site broad, crest length 200 feet, drainage area less than 1 square mile. Precipitation about 20 inches annually.
Lower Bench Lake	9BA 8	do	do	do	15	16	130	Dam site broad, crest length 530 feet, drainage area less than 1 square mile. Precipitation about 20 inches annually.
Ashley Fish Lake	9BA 9	do	do	do	10	20	80	Dam site broad, crest length 140 feet, drainage area about 5.5 square miles by use of short collecting canal.
Goose Lake Feeder Lake.	9BA 10	do	do	do	18	10	105	Dam site broad, crest length 430 feet, drainage area less than 1 square mile. Precipitation about 20 inches annually.
Minor Lake	9BA 11	do	do	do	20	13	150	Dam site broad, crest length 280 feet, drainage area less than 1 square mile. Precipitation about 20 inches annually.
Upper Goose Lake	9BA 13	do	do	do	15	34	270	Dam site broad, crest length 215 feet. Being developed.
Lower Goose Lake	9BA 14	do	do	do	15	17	130	Dam site broad, crest length 170 feet. Being developed.
Leidy Peak Lake	9BA 15	do	do	do	18	30	250	Dam site broad, crest length 200 feet. Drainage area less than 1 square mile.
Ridge Lake	9BA 16	do	do	do	15		450	No survey; data estimated.
French Park	9BA 1	do	Mountain meadow	do	42	37	520	Dam site broad and flat, crest length 410 feet, drainage area about 2.1 square miles. Average annual precipitation 15 to 20 inches.
Stanaker Draw	9BA 2	do	Ashley Creek	Secs. 26, 34, and 35, T. 3 S., R. 21 E., Salt base and meridian.	82		15,600	See p. 149.

HADES RESERVOIR SITE (9BB 1)

Location.—On the North Fork of the Duchesne River about 5½ miles above the mouth of the West Fork. Dam site in SE. ¼ sec. 26, T. 2 N., R. 9 W., Uinta special base and meridian, at mouth of Hades Canyon. (See pl. 12.)

Dam site.—Formed by heavy alluvial fan at mouth of Hades Canyon, probably composed of wash from the end of a Hades Canyon glacier as well as postglacial wash from that tributary.[51] Proposed dam, earth fill. Maximum height 140 feet. Crest length about 1,750 feet. Foundation conditions not determined.

Basin.—A broad U-shaped trough with a maximum width of 3,200 feet at altitude of proposed high-water stage in reservoir. With a 140-foot dam back water would extend about 2 miles upstream from the dam.

Capacity.—

Contour (feet above sea level)	Depth of water at dam (feet)	Area (acres)	Capacity (acre-feet)	Contour (feet above sea level)	Depth of water at dam (feet)	Area (acres)	Capacity (acre-feet)
7,370	0	0	0	7,440	70	300	10,320
7,380	10	8	40	7,460	90	365	16,970
7,400	30	130	1,420	7,480	110	410	24,720
7,420	50	230	5,020	7,500	130	495	33,770

Drainage area.—78 square miles, ranging in altitude from 7,400 to nearly 12,000 feet above sea level.

Water supply.—A gaging station was established at the dam site in August, 1921, and discontinued September 30, 1923. It is estimated from a study of the records at this station and those of the Duchesne at Myton and at Tabiona, that the annual run-off from the North Fork at the Hades dam site was 116,000 acre-feet in 1922 and 99,000 acre-feet in 1923.

Remarks.—A survey of this site was made in 1918, for a dam to the height of 110 feet, by the Great Basin Power Co. It is also included in the plan and profile survey of the Duchesne River and tributaries made by the United States Geological Survey in 1923–24.

TABIONA RESERVOIR SITE (9BB 2)

Location.—On the Duchesne River at the mouth of Farm Creek, about 2½ miles up the river from Tabiona. Dam site is in secs. 13 and 14, T. 1 S., R. 8 W., Uinta special base and meridian. (See pl. 13.)

Dam site.—Broad, flat U section with steep side slopes. Crest length of dam 150 feet high would be 3,000 feet. Foundation conditions not determined.

Basin.—A V-shaped canyon broadened somewhat at the lower end on the north and east sides by the valley of Farm Creek. The maximum width with a depth of water of 150 feet at the dam site is about 7,500 feet. Backwater at this same water stage would extend 3 miles upstream from the dam.

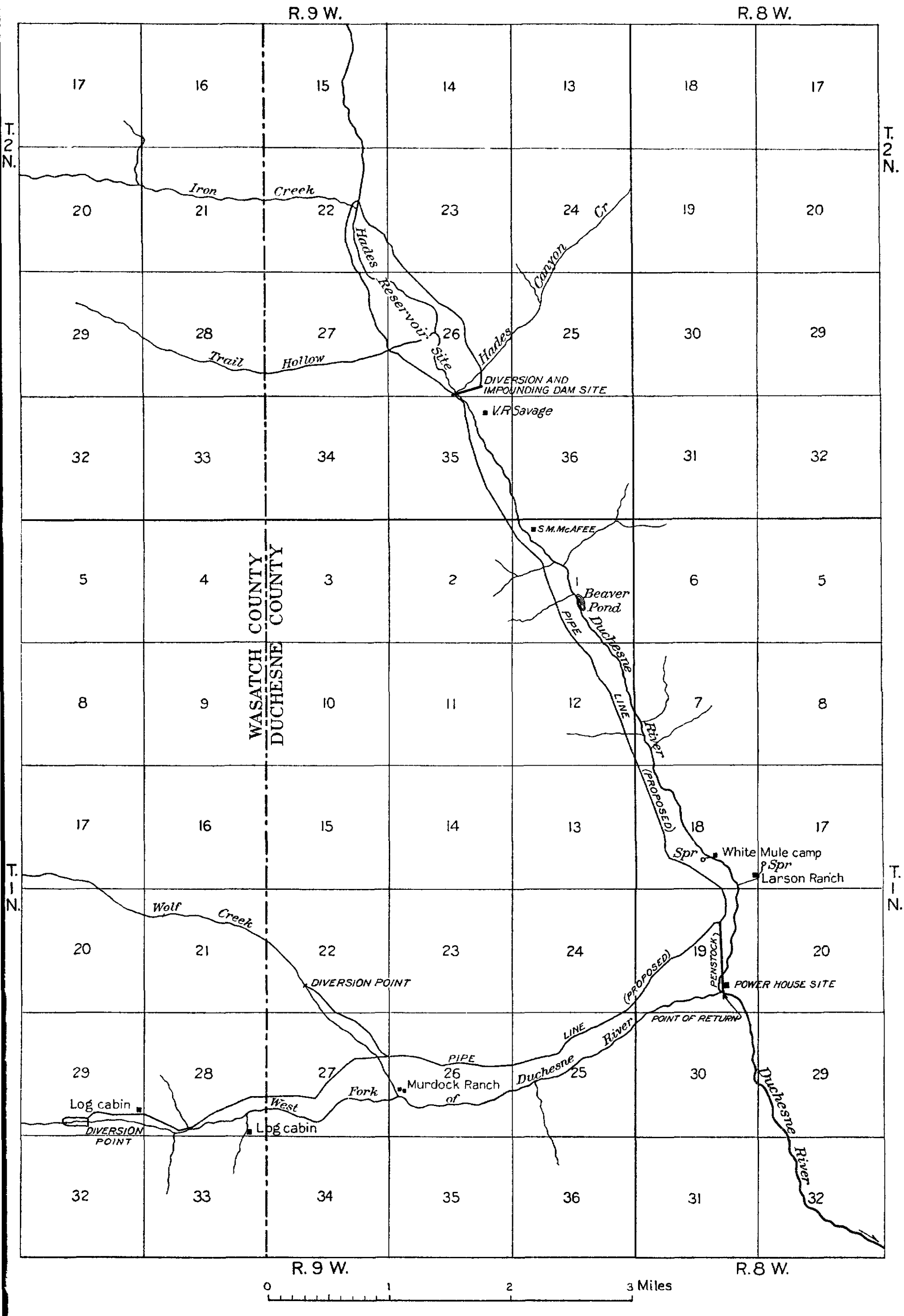
Capacity.—An analysis of the incomplete data available on this site indicates that with a dam to raise the water surface 100 feet the area of the reservoir would be about 630 acres and the capacity about 45,000 acre-feet. With the water surface raised 150 feet the area would be about 1,200 acres and the capacity about 62,500 acre-feet.

Drainage area.—About 352 square miles, ranging in altitude from 6,850 feet to nearly 12,000 feet above sea level. Upper part forest covered.

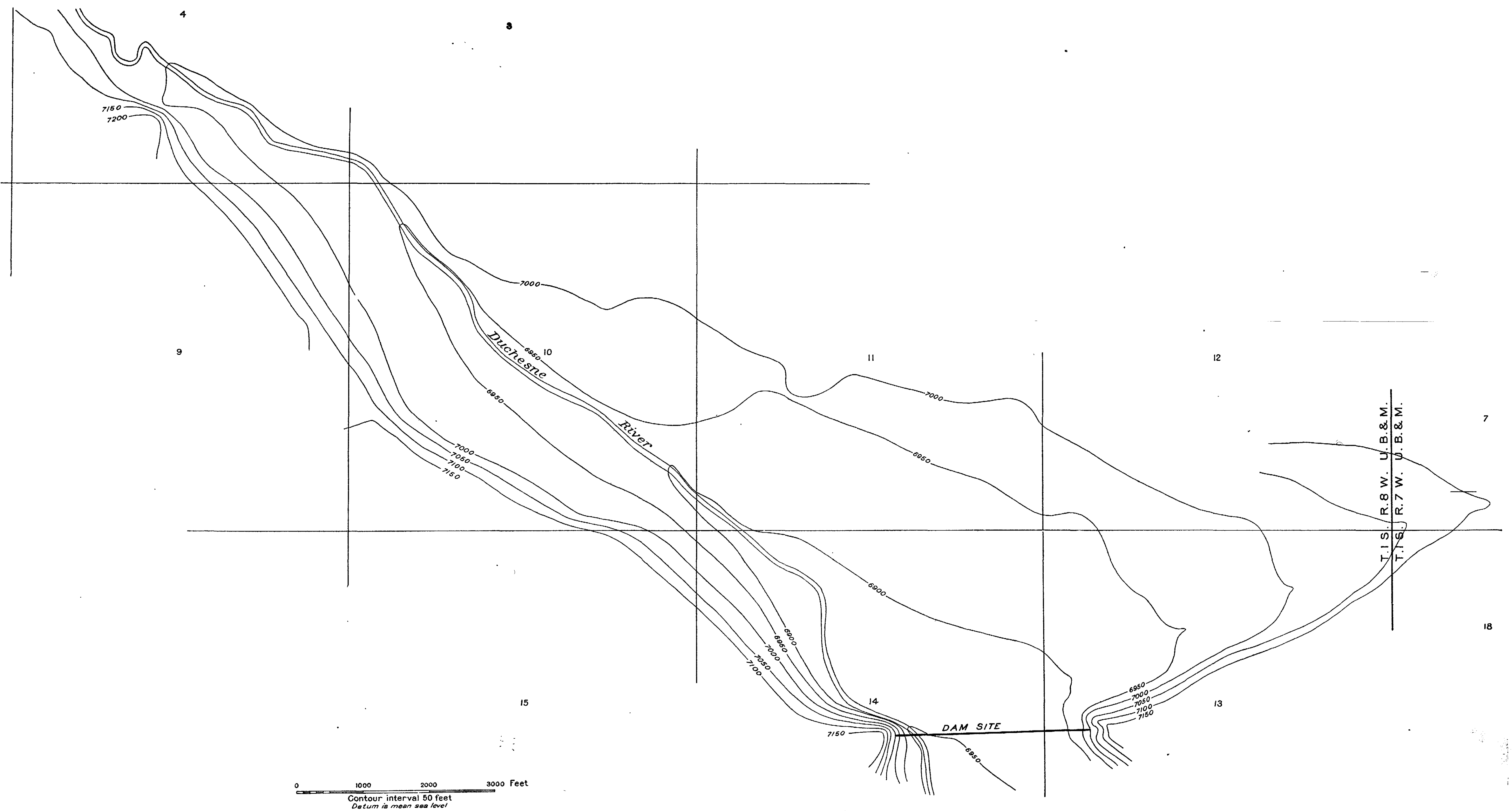
Water supply.—A gaging station was established a short distance below Tabiona in 1919, and the records of flow indicate an annual mean flow of 184,700 acre-feet virtually all of which passes the dam site.

Remarks.—Survey of site made by Unites States Bureau of Reclamation.

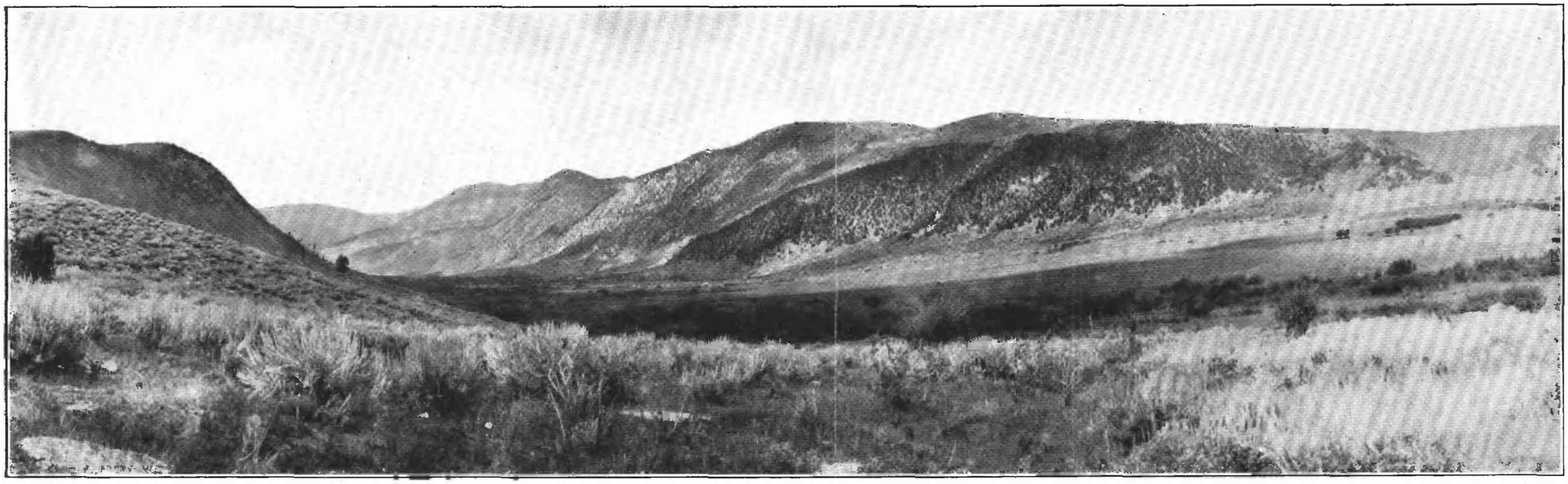
[51] Atwood, W. W., Glaciation of the Uinta and Wasatch Mountains: U S. Geol. Survey Prof. Paper 61, p. 57, 1909.



HADES RESERVOIR SITE

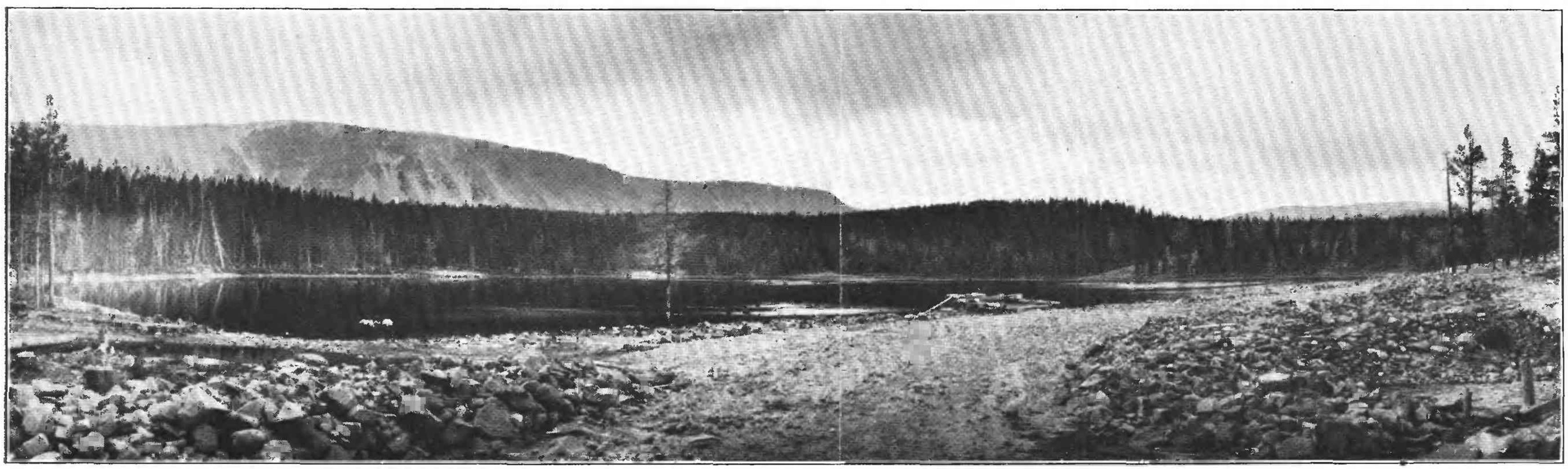


TABIONA RESERVOIR SITE



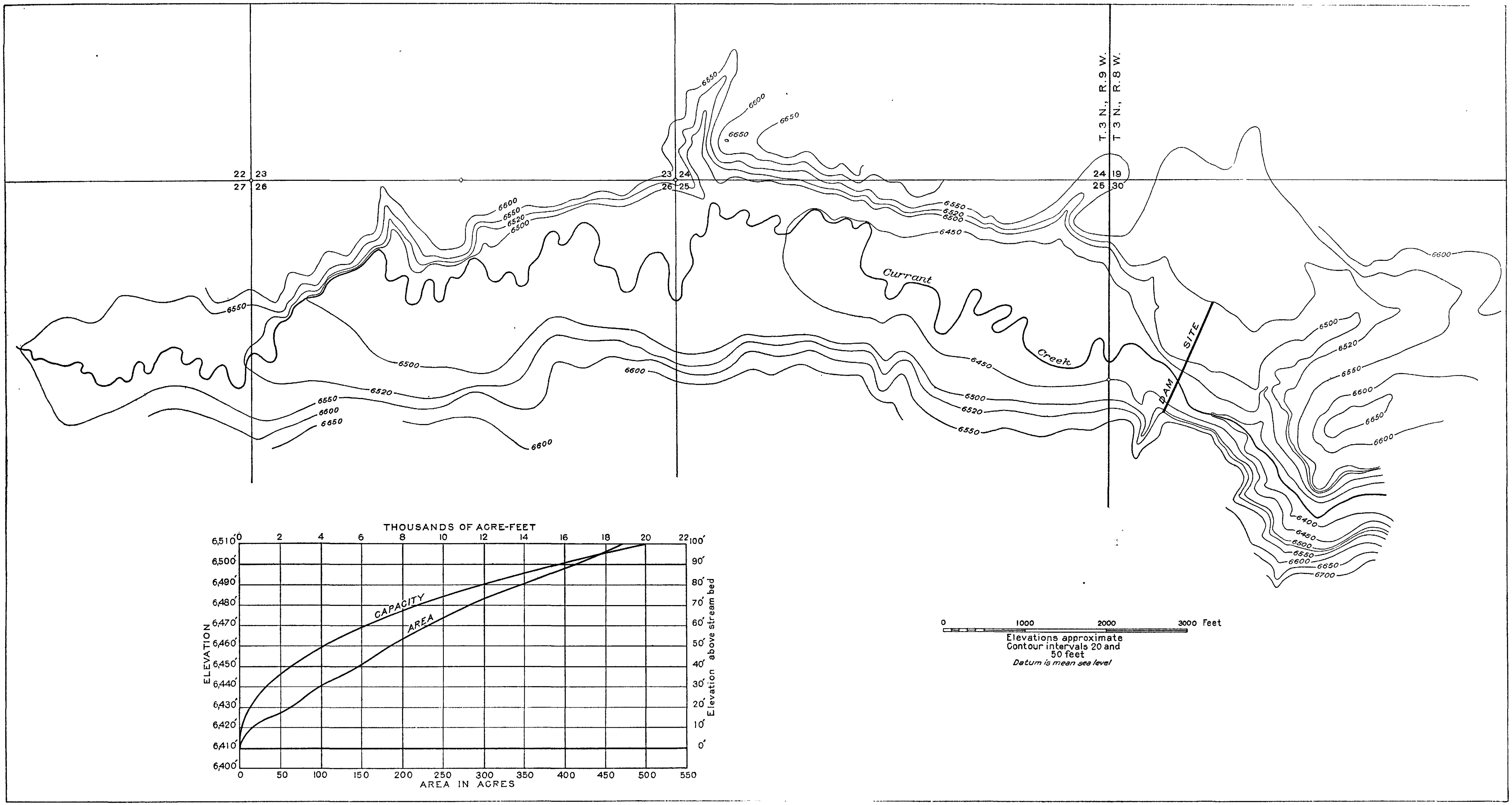
A. ROCK CREEK CANYON AND STILLWATER RESERVOIR SITE

Looking upstream from proposed dam site.

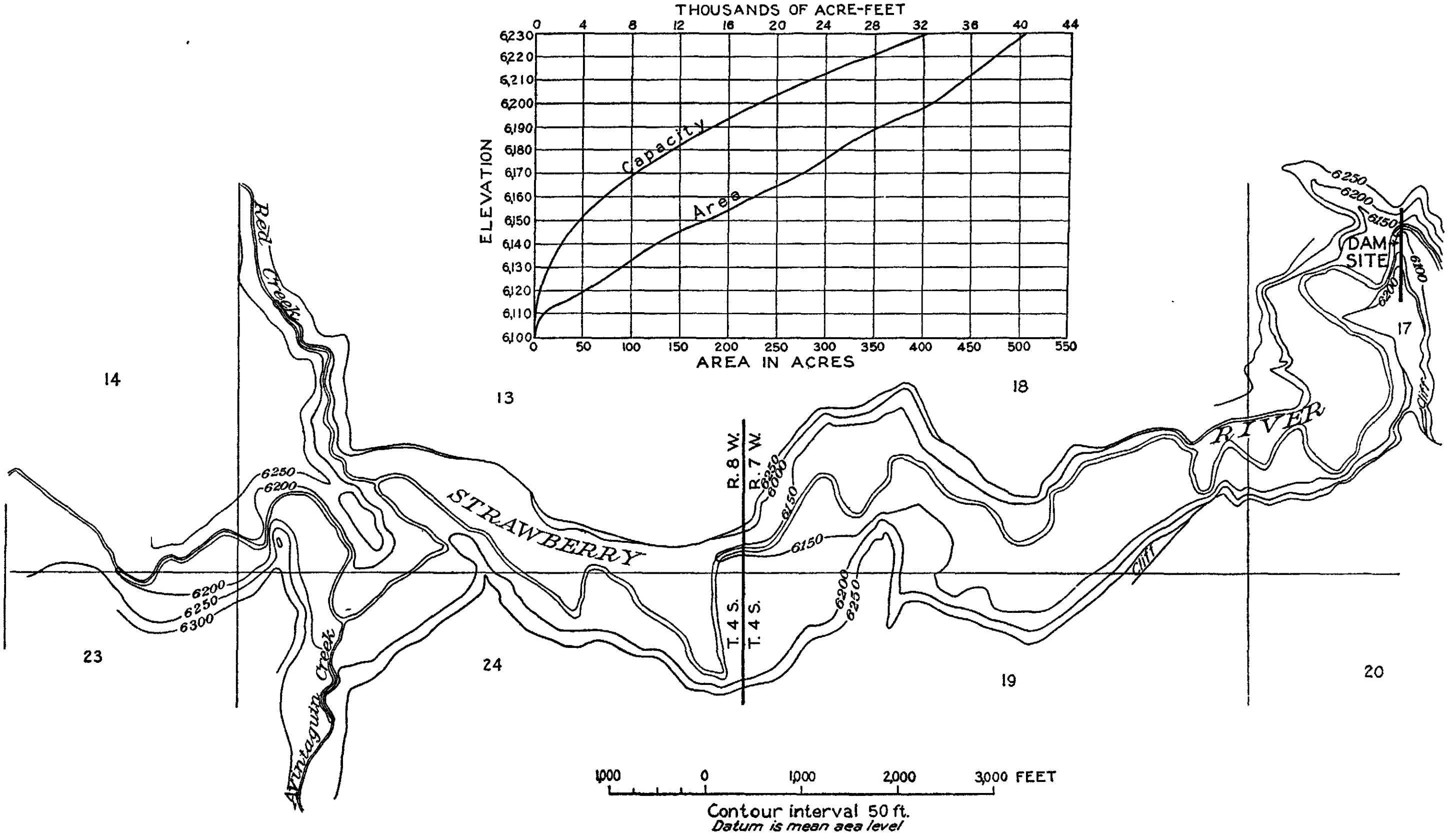


B. BROWN DUCK LAKE, IN UINTA BASIN, UTAH

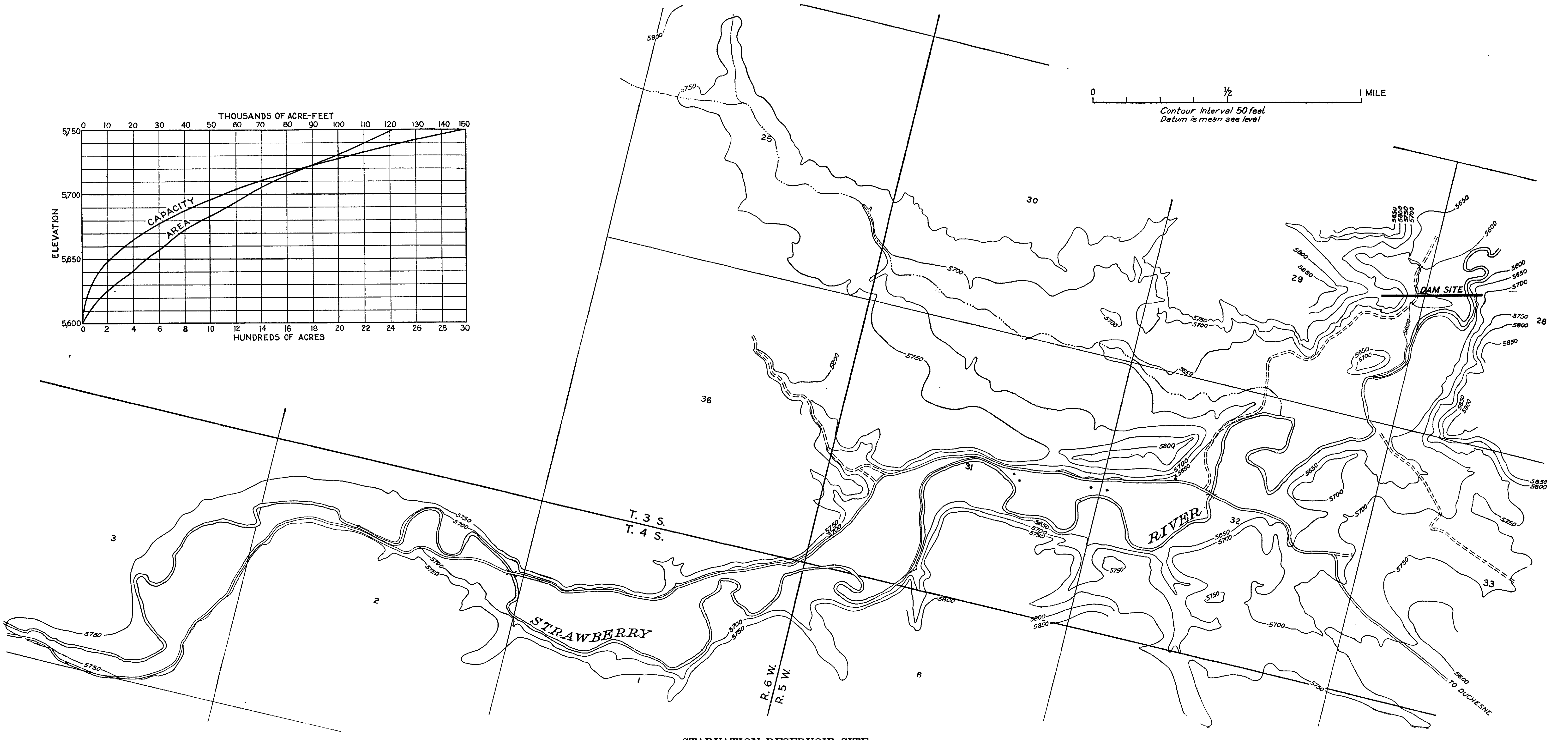
Used as a reservoir for irrigation.



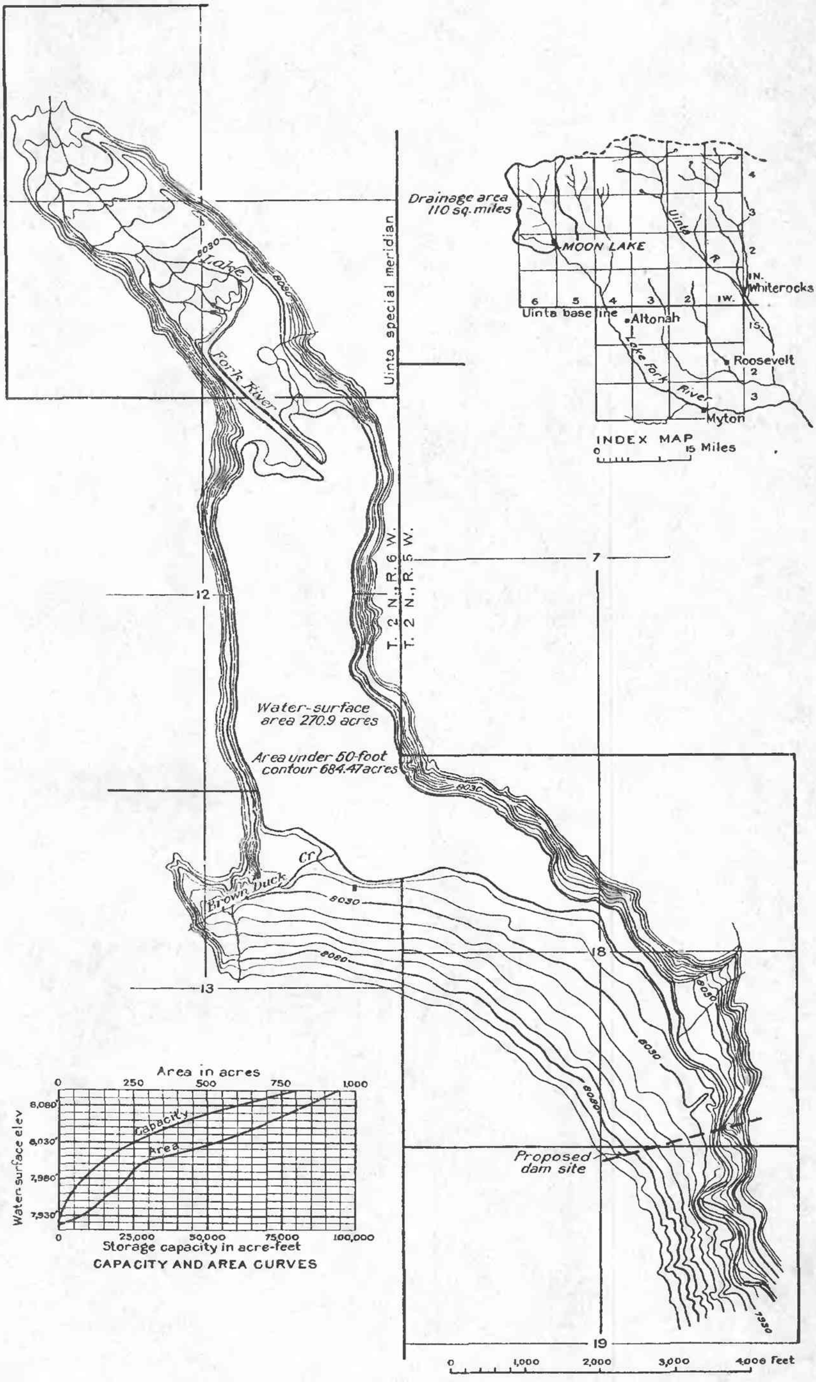
LOWER CURRANT CREEK RESERVOIR SITE



THREE FORKS RESERVOIR SITE



STARVATION RESERVOIR SITE



MOON LAKE RESERVOIR SITE

GRANDADDY LAKE (9BB 14)

Location.—In secs. 32 and 33, T. 3 N., R. 8 W., and secs. 4 and 5, T. 2 N., R. 8 W., Uinta special base and meridian.

Dam sites.—Three. Cross section at outlet is narrow U, where dam 8 feet high would have a crest length of 125 feet. Auxiliary dam site No. 1, about 500 feet northward along the lake shore from main outlet; cross section a flat-bottomed, narrow U, where dam 5 feet high would have a crest length of 138 feet. Auxiliary dam site No. 2, on north shore of lake, a broad, flat section, where a dam 4 feet high would have a crest length of 350 feet.

Basin.—Glacial lake, one of the largest on the Uinta Range. Water surface, 170 acres. A 7-foot rise in the surface would increase the area to 195 acres.

Capacity.—With the dams above indicated, 1,278 acre-feet. Additional capacity available by draining lake down 30 feet, through a tunnel 750 feet long, 3,525 acre-feet. Total capacity, 4,803 acre-feet.

Drainage area.—About 1,000 acres, comprising a glacial cirque with moraines and barren ridges.

Water supply.—Precipitation. Estimated annual amount averages 20 inches over the drainage basin.

Remarks.—Ditch line was surveyed from Low High Lake to Grandaddy Lake, to drain it down to 5 feet. Ditch line on slight grade for distance of 1,621 feet, and thence drops down the hillside to Grandaddy Lake. As an alternate plan, a ditch may terminate at point about 1,200 feet from Low High Lake, and water dropped into a small lake north of Grandaddy Lake. This lake, known as Elwife Lake, is 3.4 feet higher than Grandaddy Lake and is separated from it by an embankment about 127 feet wide and 7.4 feet higher than the water surface of Grandaddy Lake. The two lakes could be joined by an open cut.

EAST FORK RESERVOIR SITE (9BB 3)

Location.—On the East Fork of Rock Creek, about 2 miles above its confluence with Middle Fork, in secs. 21 and 28, T. 3 N., R. 7 W., Uinta special base and meridian.

Dam sites.—Two, with narrow V cross sections, separated by a knoll. At north site dam 24 feet high would have a crest length of 240 feet. At south site dam 29 feet high would have a crest length of 200 feet. A widened section of the East Fork Canyon where a tributary enters. Area when full, 34.5 acres. Area 10 feet below high-water line 25.8 acres. Area 20 feet below high-water line 15.6 acres.

Capacity.—With dams above indicated, 556 acre-feet. Outlet through south dam site.

Drainage area.—About 5,000 acres of small glacial basins.

Water supply.—Precipitation. Estimated annual amount 20 inches over drainage area.

Remarks.—Site surveyed by Knight Investment Co., 1918.

STILLWATER RESERVOIR SITE (9BB 4)

Location.—On Rock Creek at south boundary of Uinta National Forest. Dam site is in the western part of sec. 9, T. 1 N., R. 6 W., Uinta special base and meridian.

Dam site.—A broad, flat section where the alluvial side wash has partly choked the valley. A dam 150 feet high would have a crest length of 2,800 feet.

Basin.—A widened section of the canyon as it leaves the margin of the Uinta Range. Area with water surface 150 feet above the creek bed at the dam site, 805 acres. Maximum width at this altitude, 3,500 feet. Length of proposed reservoir 3 miles. (See pl. 14, *A*.)

Capacity.—

Contour (feet above sea level)	Depth of water at dam site (feet)	Area (acres)	Capacity (acre-feet)	Contour (feet above sea level)	Depth of water at dam site (feet)	Area (acres)	Capacity (acre-feet)
7,250	0	0	0	7,340	90	525	27,620
7,260	10	67	200	7,360	110	600	38,860
7,280	30	234	3,200	7,380	130	705	51,900
7,300	50	382	9,360	7,400	150	805	67,000
7,320	70	460	17,780				

Drainage area.—About 183 square miles of rugged mountain country, ranging in altitude from 7,300 to more than 12,000 feet above sea level.

Water supply.—No stream-flow records. A gaging station was built near the dam site, but it was never put into use. The characteristics of the stream are very similar to those of Lake Fork and the Uinta River. The run-off at the dam site is believed to be about the same as that of Uinta River below Pole Creek, the drainage areas being virtually equal.

Remarks.—Water stored at this site would be available for lands on the Blue Bench, northeast of Duchesne, and for lands along the lower reaches of the Duchesne River. Such storage would be valuable principally for irrigation, as the reservoir site is situated below the principal power sites.[52]

UPPER CURRANT CREEK RESERVOIR SITE (9BB 5)

Location.—Near the headwaters of Currant Creek, a tributary of the Strawberry River. Dam site in NW. ¼ sec. 8, T. 2 S., R. 10 W., Uinta special base and meridian.

Dam site.—At what is locally known as Currant Creek Narrows, where heavy deposits of sand, clay, and rock have been brought from the adjoining mountains. Foundation conditions not determined but according to surface indications apparently suitable for earth-fill dam. Abundant earth for construction near at hand. Dam 100 feet high would have a crest length of about 1,200 feet.

Basin.—A broad U-shaped trough extending about 3½ miles upstream from the dam site.

Capacity.—

Contour (feet)	Area (acres)	Capacity (acre-feet)	Contour (feet)	Area (acres)	Capacity (acre-feet)
0	0	0	50	160	4,240
10	8	40	100	310	15,990

Drainage area.—About 50 square miles, ranging in altitude from 7,500 feet to 10,580 feet above sea level.

Water supply.—Undetermined.

Remarks.—Survey of site made in 1917 by United States Bureau of Reclamation. Topography shown on Strawberry topographic map of the United States Geological Survey.

LOWER CURRANT CREEK RESERVOIR SITE (9BB 6)

Location.—On Currant Creek about 3 miles above the mouth of Red Creek. Dam site in NW. ¼ sec. 30, T. 3 N., R. 8 W., Uinta special base and meridian. (See pl. 15).

Dam site.—A V section at the head of a narrows, where a dam 110 feet high would have a crest length of 1,450 feet.

Basin.—A small park formed by the widening of the canyon. Length about 3 miles; maximum width about 2,300 feet. Grade about 40 feet to the mile.

52 See Plan and profile of Duchesne River and tributaries, sheet A.

Capacity.—

Contour (feet above sea level)	Area (acres)	Capacity (acre-feet)	Contour (feet above sea level)	Area (acres)	Capacity (acre-feet)
6,410	0	0	6,470	230	6,300
6,420	15	110	6,480	280	8,800
6,430	62	510	6,490	345	12,000
6,440	90	1,300	6,500	410	15,500
6,450	145	2,550	6,510	470	20,000
6,460	185	4,200			

Drainage area.—About 50 square miles, ranging in altitude from 7,600 to 10,580 feet above sea level.

Water supply.—No stream-flow records available at this site. Records of the Strawberry River at Duchesne indicate that the water supply is sufficient for a reservoir having a capacity of 20,000 acre-feet.

Remarks.—A survey was made of this site by the United States Bureau of Reclamation in its investigation of the Castle Peak project, southeast of Myton, on the lower part of the Duchesne River.

THREE FORKS RESERVOIR SITE (9BB 7)

Location.—On the Strawberry River at its junction with Avintaquin and Red Creeks. The dam site is in the NW. ¼ sec. 17, T. 4 S., R. 7 W., Uinta special base and meridian. (See pl. 16.)

Dam site.—Formed by projecting cliff extending across the canyon to a point within 250 feet of the opposite wall. A dam 130 feet high would have a crest length of 950 feet.

Basin.—A rather flat broadened section of the canyon with steep side walls. Maximum width about 1,500 feet. Backwater would extend about 3 miles upstream from the dam with a rise of 130 feet in the water surface at the dam.

Capacity.—

Contour (feet above sea level)	Area (acres)	Capacity (acre-feet)	Contour (feet above sea level)	Area (acres)	Capacity (acre-feet)
6,100	0	0	6,170	280	8,300
6,110	10	30	6,180	315	11,200
6,120	55	400	6,190	355	14,800
6,130	90	1,200	6,200	415	18,300
6,140	125	2,200	6,210	445	22,800
6,150	180	3,500	6,220	475	27,300
6,160	225	5,500	6,230	510	32,000

Drainage area.—About 710 square miles, of which 175 square miles is tributary to Strawberry Reservoir, and the run-off therefrom is used on the Strawberry project. Altitude 6,100 to 10,580 feet above sea level.

Water supply.—No stream-flow records available at this site. However, a gage is maintained on the Strawberry River at Duchesne, about 15 miles downstream, and no important tributaries enter the river between the gage and this site. The records of flow at this gage show considerable water in excess of the capacity of the reservoir site.

Remarks.—Complete survey of the site was made by the United States Bureau of Reclamation. The projected line of the Denver & Salt Lake Railroad is located along the river through the site.

STARVATION RESERVOIR SITE (9BB 8)

Location.—On the Strawberry River about 4 miles upstream from Duchesne. Dam site at quarter corner between secs. 28 and 29, T. 3 S., R. 5 W., Uinta special base and meridian. (See pl. 17.)

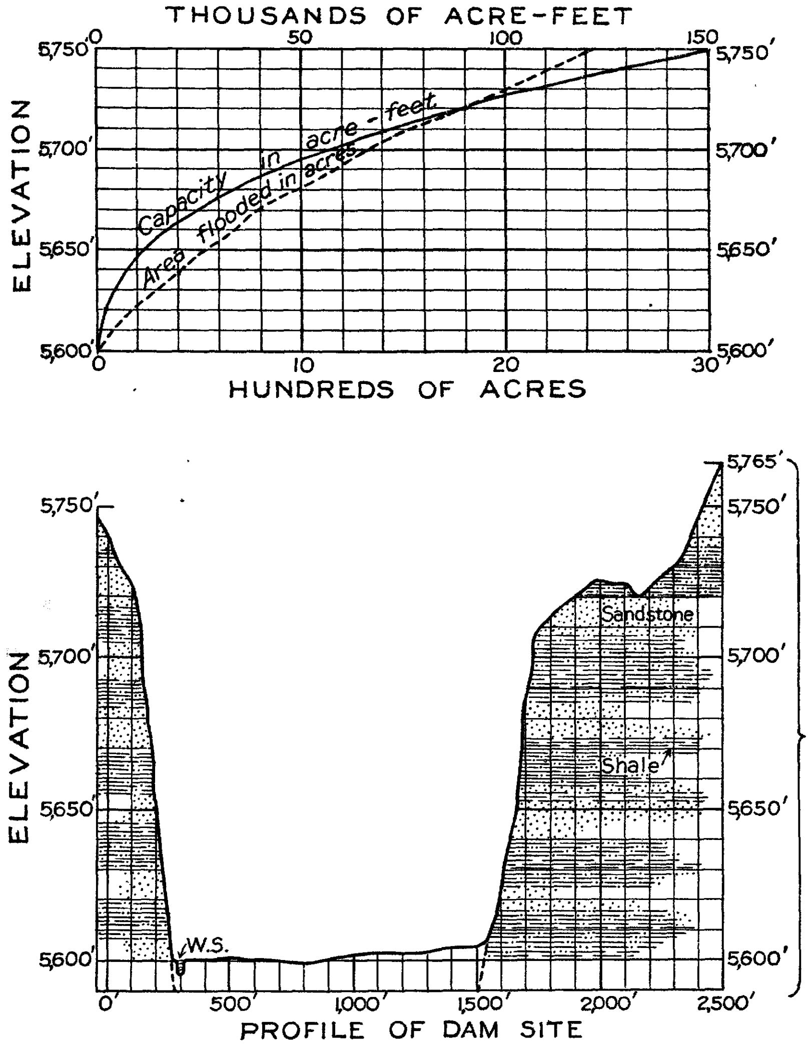


FIGURE 17.—Starvation dam site

Dam site.—Rather broad U section with steep walls. A dam 125 feet high would have a crest length of 1,950 feet. (See fig. 17.)

Basin.—Flat broadened section of the canyon about 5½ miles long. Steep side walls, except at the lower end where the backwater would extend about 2 miles up a tributary canyon with gentle side slopes.

Capacity.—

Contour (feet above sea level)	Area (acres)	Capacity (acre-feet)	Contour (feet above sea level)	Area (acres)	Capacity (acre-feet)
5,600	0	0	5,680	950	32,000
5,610	75	1,000	5,690	1,150	43,000
5,620	150	2,000	5,700	1,300	55,000
5,630	250	4,000	5,710	1,500	70,000
5,640	400	7,500	5,720	1,750	87,000
5,650	500	12,000	5,730	1,980	105,000
5,660	650	17,500	5,740	2,210	125,000
5,670	760	24,000	5,750	2,420	148,000

Drainage area.—About 1,040 square miles. Of this area 175 square miles supplies water to the Strawberry Reservoir, which is the source of water supply for the Strawberry reclamation project. Altitude 5,600 to 10,580 feet above sea level. Mostly forested.

Water supply.—A gaging station is maintained on the Strawberry River at Duchesne, about 3 miles downstream from the reservoir site. Records at this station since 1915 show a maximum run-off of 292,000 acre-feet, for the year ending September 30, 1922, and a minimum run-off of 96,200 acre-feet for the year ending September 30, 1915.

Remarks.—A survey of this site was made by the United States Bureau of Reclamation. The Pikes Peak Highway and the projected line of the Denver & Salt Lake Railroad are located through the site.

MOON LAKE (9BC 5)

Location.—On Lake Fork, about 17 miles upstream from Altonah, in secs. 12 and 13, T. 2 N., R. 6 W., and sec. 18, T. 2 N., R. 5 W., Uinta special base and meridian. (See pl. 18.)

Dam site.—About half a mile below the lake. East abutment glacial drift; west abutment low, sloping hill of glacial outwash. Glacial outwash foundation. Soundings 18 feet deep indicate 2 to 3 feet of compact gravel underlain by quicksand. Proposed dam hydraulic fill 70 feet high, 1,500 feet in crest length.

Basin.—Lake held in main canyon by glacial moraines, which form a massive barrier across the canyon to a point within a short distance of the eastern border.

Capacity.—Water surface of lake 272 acres. Altitude of lake surface, September, 1923, 8,004 feet above sea level.

Contour (feet above sea level)	Area (acres)	Capacity (acre-feet)	Contour (feet above sea level)	Area (acres)	Capacity (acre-feet)
[a]7,987	-------	----------	8,080	343	16,420
7,990	33	49	8,090	451	20,390
8,000	79	608	8,100	526	25,280
8,010	111	1,560	8,110	598	30,900
8,020	140	2,820	8,120	665	37,210
8,030	172	4,380	8,130	729	44,180
8,040	204	6,260	8,140	783	51,730
8,050	231	8,430	8,150	837	59,830
8,060	250	10,830	8,160	887	68,450
8,070	267	13,410	8,170	935	77,550
[b]8,075	296	14,820			

[a] Bottom of lake.
[b] Lake surface.

Drainage area.—110 square miles. Catchment basin is broad, open, and flat-bottomed, with many marginal cirques. Altitude from 8,000 to 13,230 feet above sea level.

Water supply.—Stream-flow records indicate ample water supply.

Remarks.—This is the largest reservoir site in the Uinta Basin. Plans are now under way for its development.[53]

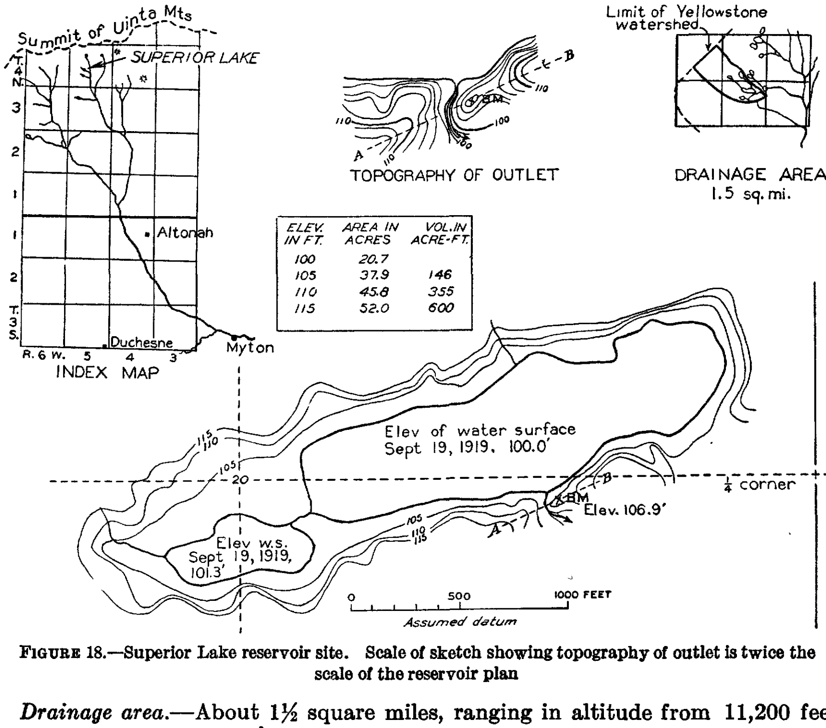
SUPERIOR LAKE RESERVOIR SITE (9BC 6)

Location.—On West Fork of Yellowstone Fork in sec. 20, T. 4 N., R. 5. W., Uinta special base and meridian. (See fig. 18.)

Dam site.—Narrow V-shaped cross section in glacial moraine. Boulder-drift abutments and rock foundation. Proposed dam 13 feet high, 350 feet in crest length.

Basin.—Glacial lake bounded on upper side by bare rock hills and on lower side by glacial moraine. Meadow and small pond at upper end. Scattered scrub underbrush, no timber. Area of lake about 21 acres.

Capacity.—See Figure 18. About 75 acre-feet available below lake surface with a 5-foot lowering of the surface.



ELEV. IN FT.	AREA IN ACRES	VOL. IN ACRE-FT.
100	20.7	
105	37.9	146
110	45.8	355
115	52.0	600

FIGURE 18.—Superior Lake reservoir site. Scale of sketch showing topography of outlet is twice the scale of the reservoir plan

Drainage area.—About 1½ square miles, ranging in altitude from 11,200 feet to 12,400 feet above sea level. Principally bare glaciated rock ridges. Some scattered drift and underbrush. No timber. Numerous small basins and ponds scoured out of the rock floor.

Water supply.—80 acre-feet per inch of run-off; 6 inches required. Estimated annual precipitation about 20 inches.

Remarks.—No timber within half a mile of dam site. Earth also scarce. Site surveyed by United States Indian Service.

FIVE POINT LAKE RESERVOIR SITE (9BC 7)

Location.—On West Fork of Yellowstone Fork in sec. 29, T. 4 N., R. 5 W., Uinta special base and meridian, about 29 miles from Altonah. (See fig. 19.)

[53] See plan and profile of Duchesne River and tributaries, sheet B, for topographic survey data.

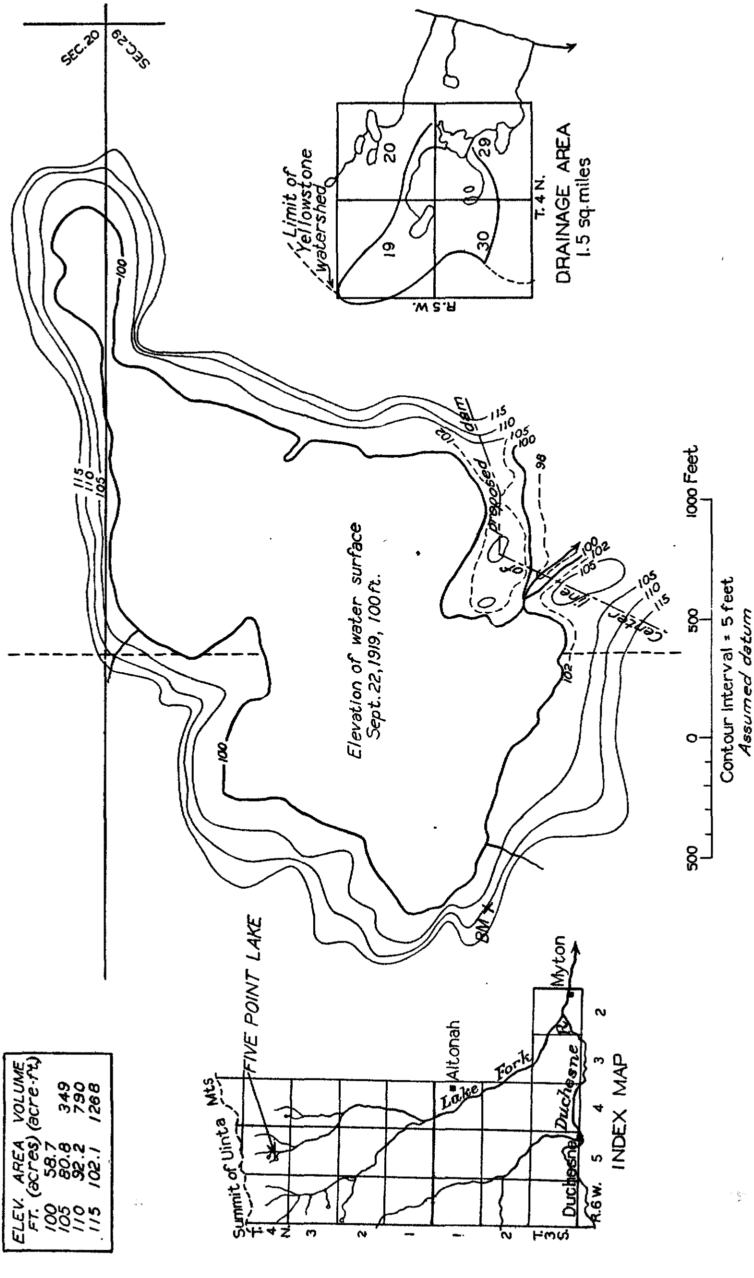


FIGURE 19.—Five Point Lake reservoir site

Dam site.—Broad cross section. Glacial drift abutments and foundation. Some clearing necessary. Proposed development; dam 14 feet high.

Basin.—Glacial Lake inclosed by drift-covered rock hills on upper side and moraine on lower side. Bare Rock outcrops and glacial drift cover. Partly timbered.

Capacity.—See Figure 19. Estimated additional capacity of 200 acre-feet by lowering lake level 5 feet.

Drainage area.—About 1½ square miles, ranging in altitude from 11,000 to 12,400 feet above sea level. Greater part of basin bare glaciated ridges and hills.

Water supply.—Dependent upon precipitation, which probably is seldom less than 10 inches annually.

Remarks.—Timber for construction within a few hundred feet of dam site. Earth not plentiful. Site surveyed by United States Indian Service. Application filed in State engineer's office for development by private irrigation company.

CRYSTAL RANCH RESERVOIR SITE (9BC 1)

Location.—On lower part of East or Yellowstone Fork of Lake Fork. Dam site near center of sec. 4, T. 1 N., R. 4 W., Uinta special base and meridian.

Dam site.—Formed by morainic ridge which partly crosses the valley. Stream has cut a narrow valley through the glacial terrace adjacent to the moraine. Foundation and abutments in glacial deposits. Dam 100 feet high would have a crest length of about 500 feet.

Basin.—Broad and open valley with side slopes deeply eroded and floor mantled with alluvial deposits, which form a plain sloping from the valley sides to the stream channel.

Capacity.—

Contour (feet above sea level)	Area (acres)	Capacity (acre-feet)	Contour (feet above sea level)	Area (acres)	Capacity (acre-feet)
7,420	0	0	7,480	127	3,620
7,440	24	240	7,500	205	6,940
7,460	94	1,420	7,520	310	12,080

Drainage area.—About 135 square miles, ranging from 7,400 to 13,498 feet above sea level.

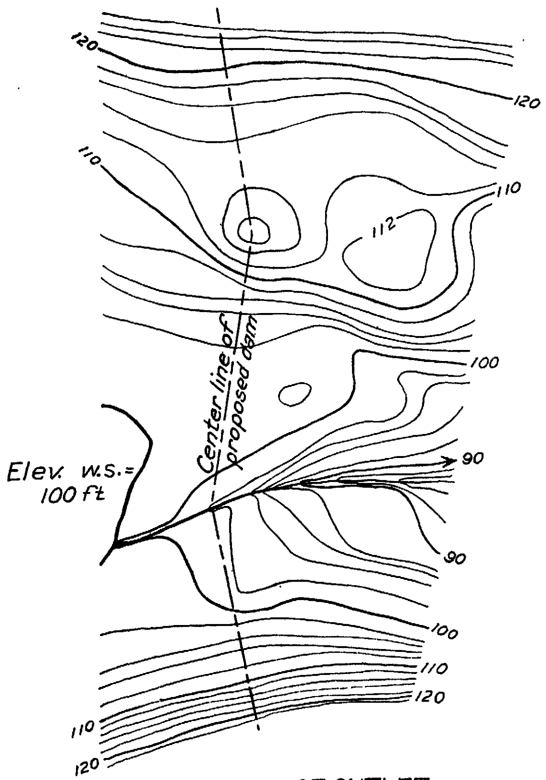
Water supply.—Three years of stream-flow records (1908–1910) on Lake Fork a short distance below the mouth of Yellowstone Fork, prior to any material diversions above this point, show a mean annual run-off of 366,600 acre-feet. The drainage area above the station is about 300 square miles, of which 145 square miles drains into Yellowstone Fork. Conditions over the entire drainage area would seem to justify the assumption that the annual run-off from Yellowstone Fork is about 160,000 to 170,000 acre-feet.

Remarks.—Water stored at this reservoir site [54] could be used to good advantage for irrigation in the lower valley during the later part of the season, when the natural stream flow is too small to meet all the demands.

LAKE ATWOOD RESERVOIR SITE (9BE 2)

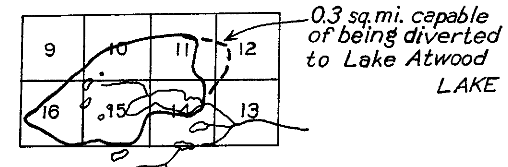
Location.—About 2 miles north of Mount Emmons and 28 miles northwest of Whiterocks, in secs. 14 and 15, T. 4 N., R. 4 W., Uinta special base and meridian. (See pl. 19.)

[54] See op. cit., sheet B, for topographic survey.

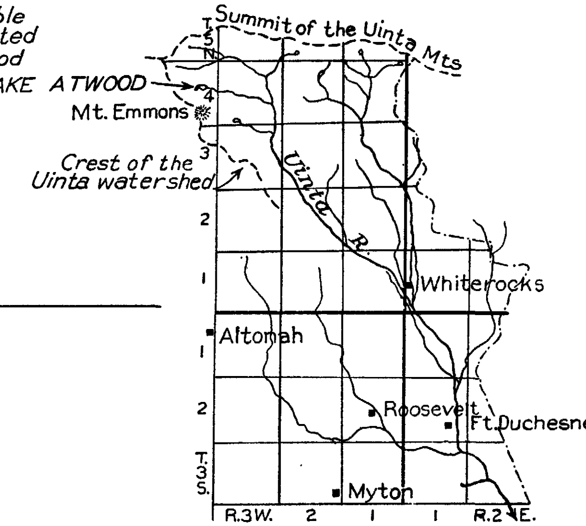


TOPOGRAPHY OF OUTLET

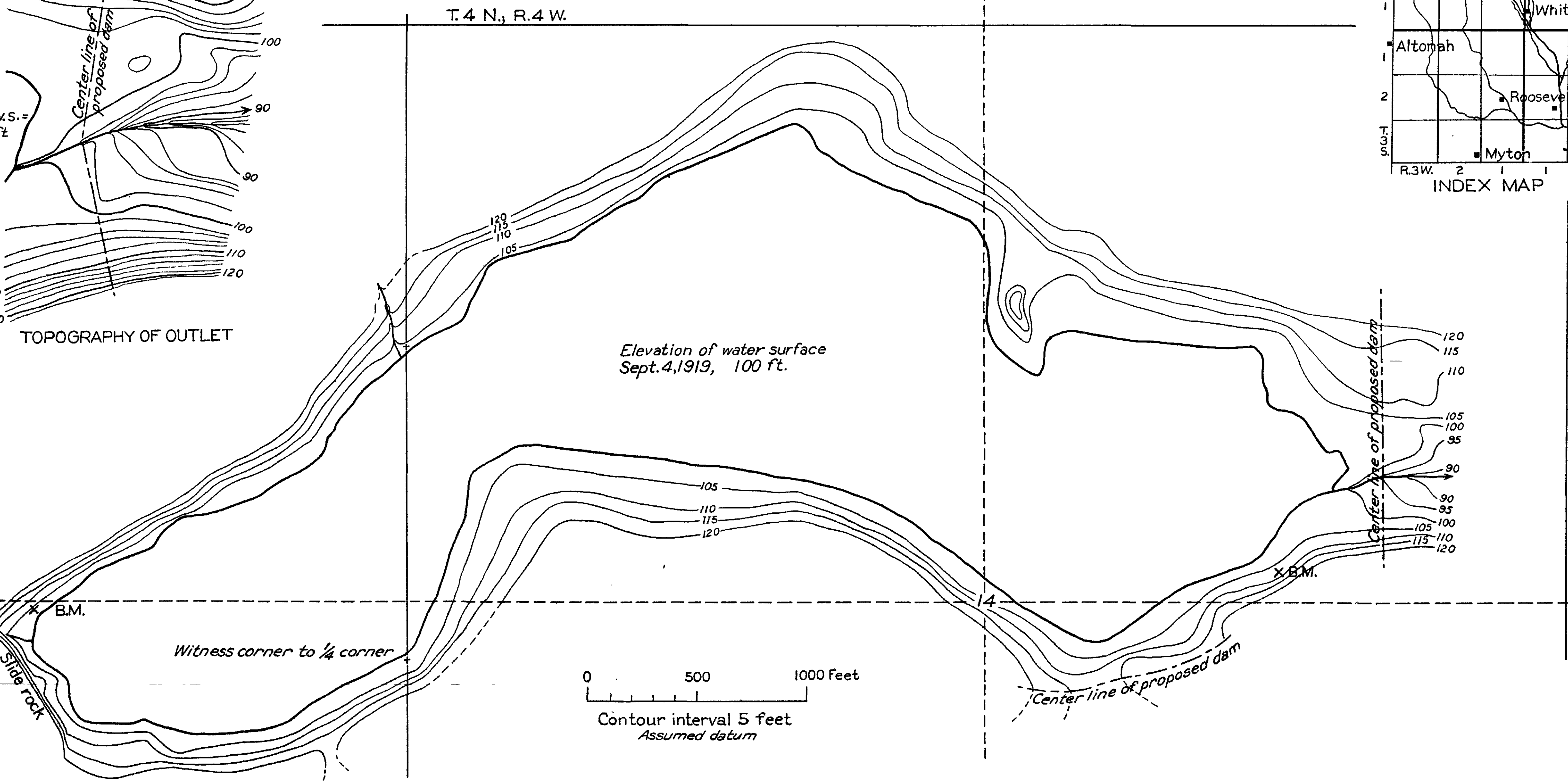
ELEV. IN FT.	AREA IN ACRES	VOL. IN ACRE-FT.
100	153	
105	185	845
110	208	1827
115	225	2909
120	242	4077



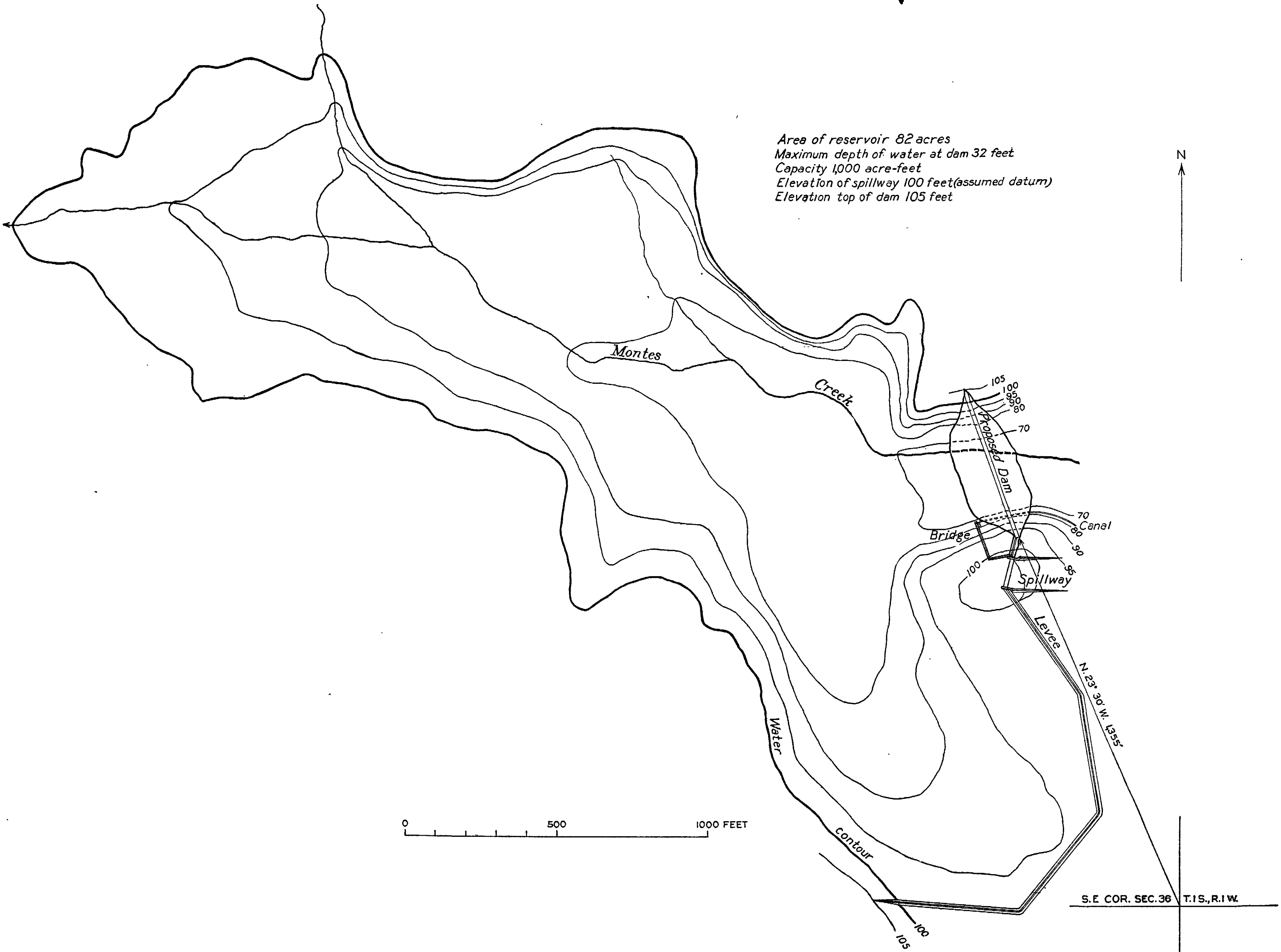
DRAINAGE AREA
2.9 sq.mi.



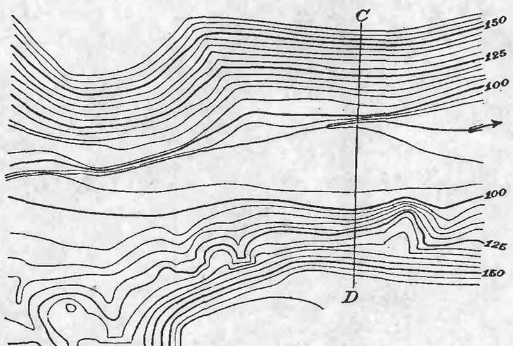
INDEX MAP



LAKE ATWOOD RESERVOIR SITE



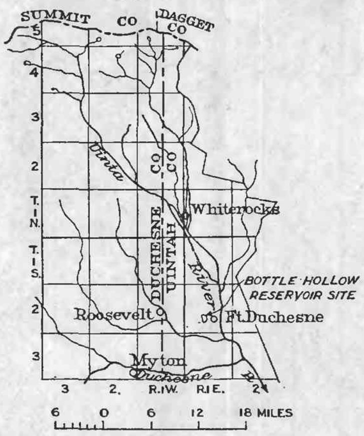
MONTES HOLLOW RESERVOIR SITE



TOPOGRAPHY OF LOWER OUTLET

100 0 200 400 Feet

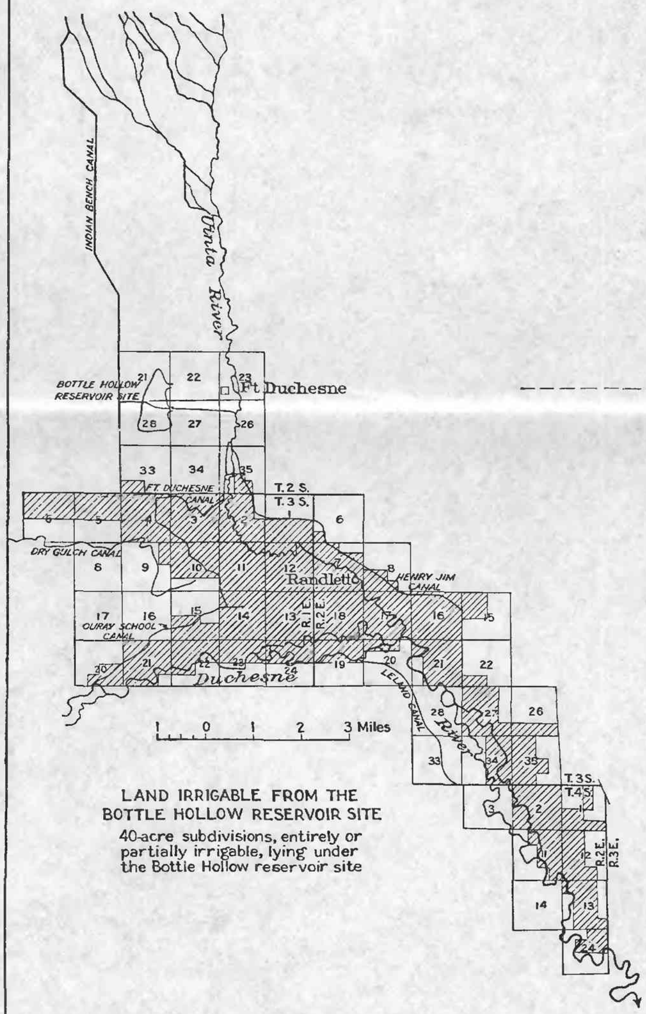
Contour interval 5 feet
Assumed datum



INDEX MAP

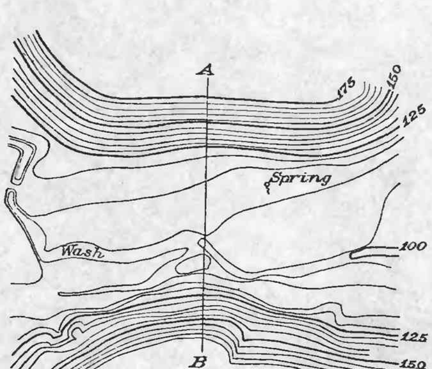
CAPACITY

ELEV. IN FEET	LOWER BASIN AREA IN ACRES	LOWER BASIN VOLUME IN ACRE-FT.	UPPER BASIN AREA IN ACRES	UPPER BASIN VOLUME IN ACRE-FT.	TOTAL AREA IN ACRES	TOTAL VOLUME IN ACRE-FT.
100	0.8				0.8	
105	6.9	19			7	19
110	24.8	98			26	98
115	46.7	277	3.1	10	50	287
120	70.5	570	35.7	107	106	677
125	97.0	989	60.1	347	157	1,336
130	122.7	1,538	94.5	733	217	2,271
135	148.5	2,216	120.9	1,271	269	3,487
140	173.4	3,020	149.3	1,932	317	4,952
145	191.8	3,933	159.8	2,690	352	6,623
150	206.5	4,929	177.2	3,533	384	8,462
155	220.0	5,996	193.2	4,460	413	10,456
160	232.5	7,127	208.6	5,463	441	12,590



LAND IRRIGABLE FROM THE BOTTLE HOLLOW RESERVOIR SITE

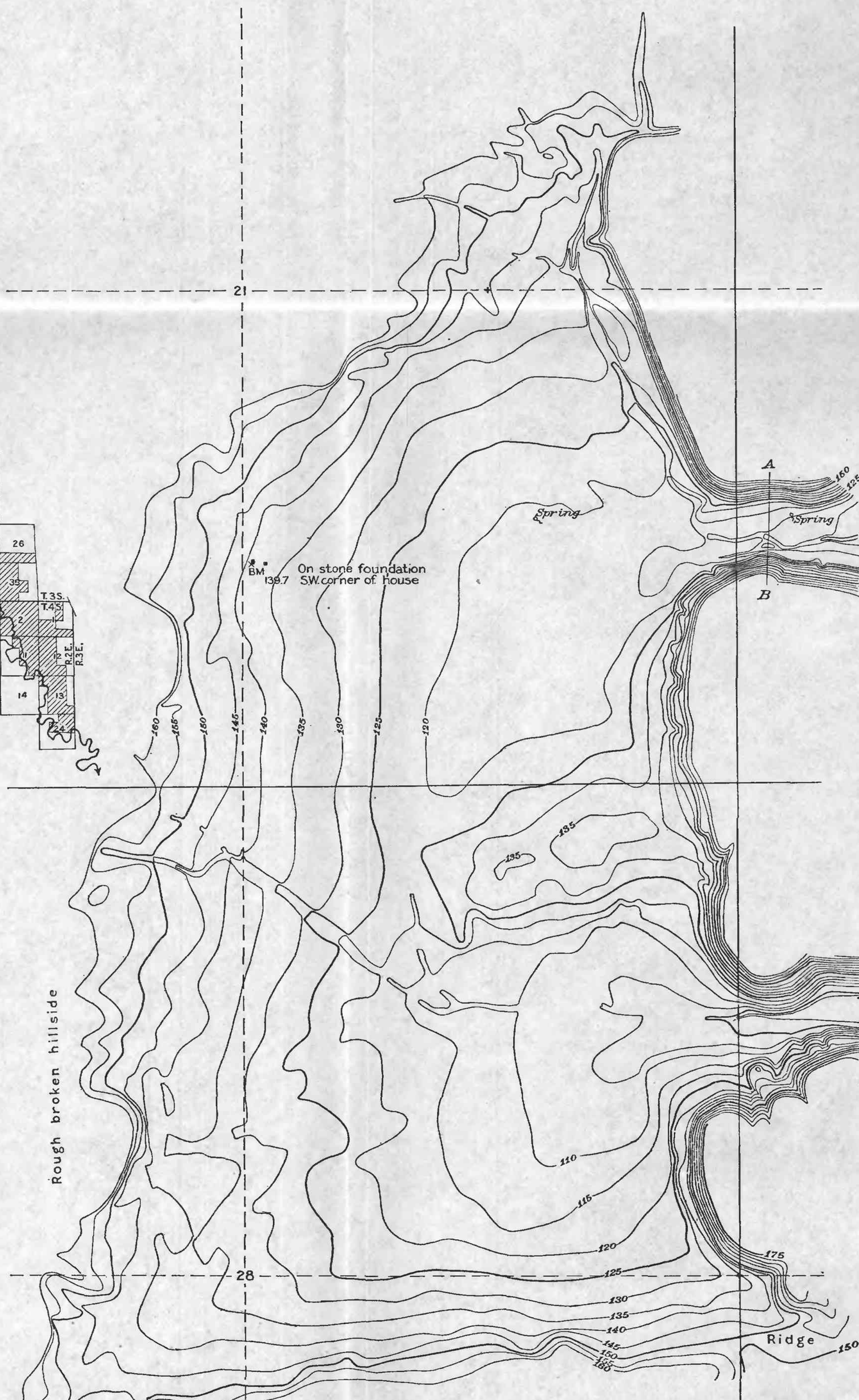
40-acre subdivisions, entirely or partially irrigable, lying under the Bottle Hollow reservoir site



TOPOGRAPHY OF UPPER OUTLET

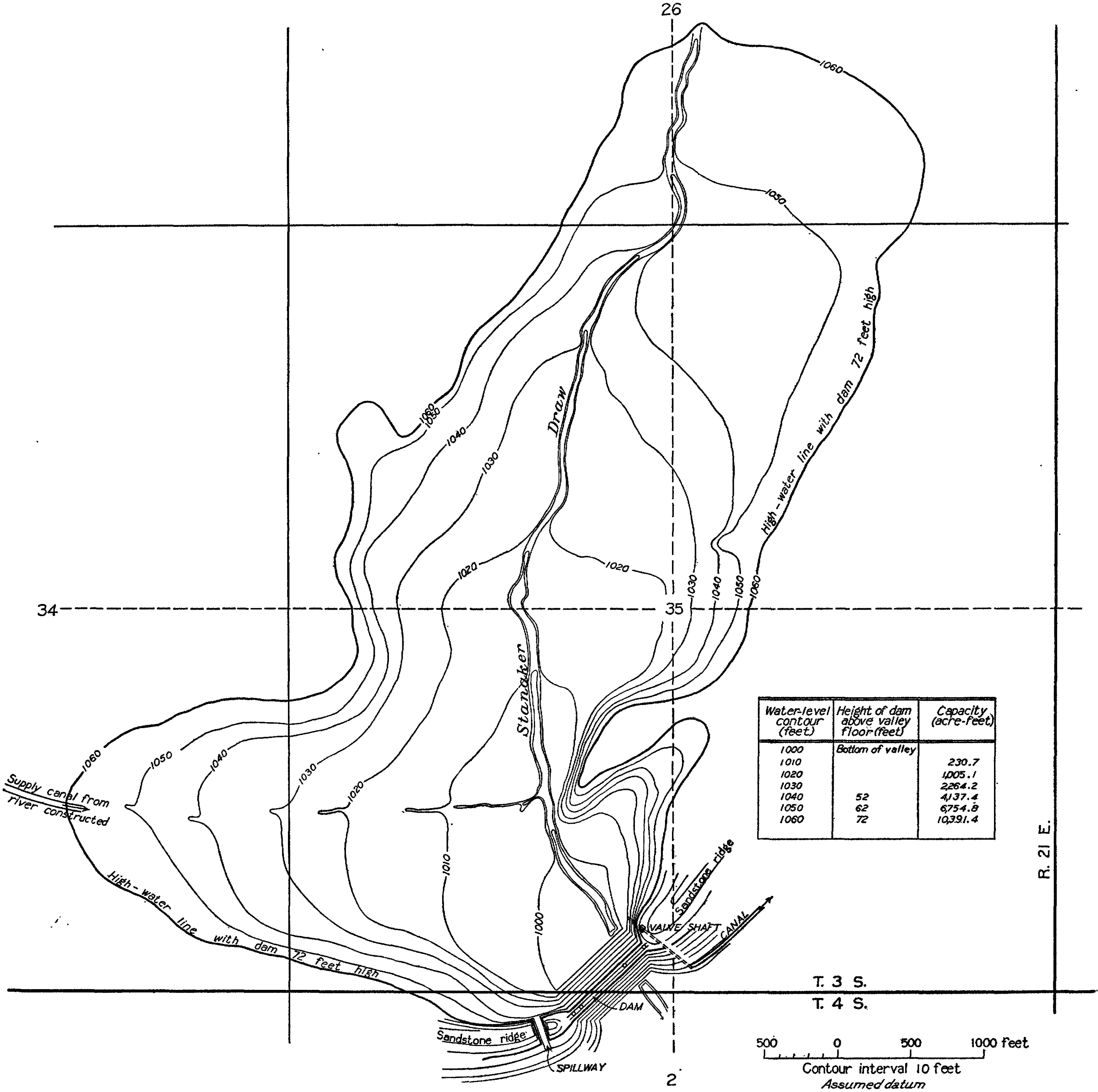
100 0 200 400 Feet

Contour interval 5 feet
Assumed datum



Contour interval 5 feet. Assumed datum

BOTTLE HOLLOW RESERVOIR SITE



Water-level contour (feet)	Height of dam above valley floor (feet)	Capacity (acre-feet)
1000	Bottom of valley	
1010		230.7
1020		1,005.1
1030		2,264.2
1040	52	4,137.4
1050	62	6,754.8
1060	72	10,391.4

STANAKER DRAW RESERVOIR SITE

Dam site.—Broad, flat cross section; meadow formed of outwash drift, seepy in places, sloping rapidly away from lake. South abutment, steep, coarse moraine material; north abutment low moraine drift. Dam 14 feet high would have a crest length of 2,020 feet.

Basin.—Glacial basin bounded by talus-clad divides. Abundance of drift and numerous lakes. Lake Atwood is among the largest in the Uinta Mountains, about 1¼ miles long and a quarter of a mile wide. Water surface 153 acres.

Capacity.—See Plate 19. An additional 700 acre-feet may be made available by lowering lake surface 5 feet. It is believed that available capacity exceeds available water supply.

Drainage area.—2.9 square miles, altitude 11,000 to 13,200 feet above sea level. Inclosed by steep, barren ridges; about two-thirds of area untimbered rock slopes, remainder timbered. About one-third of area mantled with coarse, shallow drift. Several small lakes intercept part of run-off and reduce effective area. Run-off from additional 0.3 square mile may be diverted into this drain age area.

Water supply.—This area is believed to be one of the greatest in amount of annual precipitation in the Uinta Range. Ten inches of run-off from a net area of 2 square miles will yield 1,100 acre-feet, and this is probably the minimum. From 1,500 to 2,500 acre-feet is the estimated annual supply available for storage at this site.

Remarks.—One of the largest storage sites on the Uinta River. Accessible with difficulty. Covered by filings in State engineer's office for permission to develop as storage reservoir.

SUMNER RESERVOIR SITE (9BE 1)

Location.—On East Fork of Dry Gulch, north of John Star Flat, in sec. 20, T. 2 N., R. 1 W., Uinta special base and meridian. (See fig. 20.)

Dam site.—Outlet between two moraines. Cross section narrow. Dam 40 feet high would have a crest length of 465 feet. Abutments and foundation, glacial depostis. No timber at hand.

Basin.—A depression in a mass of glacial drift comprising part of the terminal moraine of the Uinta Glacier, area 6 acres. At 35.5-foot contour area would be 149 acres.

Capacity.—About 2,750 acre-feet at 35.5-foot contour.

Drainage area.—4.8 square miles above point of diversion of supply canal, plus about 0.2 square mile direct drainage. Altitude 8,200 to 10,400 feet above sea level. Steep slopes covered with glacial drift and rock waste.

Water supply.—No records. Stream intermittent. Run-off of 6 inches probably as much as can be depended upon. This would furnish about 1,600 acre-feet.

Remarks.—Supply canal 3,600 feet long from the East Fork of Cottonwood Creek. Another canal possible to the Uinta River, about 3 miles long. Seepage losses likely to be large, because of morainic material to be traversed.

UINTA CANYON RESERVOIR SITE (9BE 2)

Location.—On the Uinta River about 3 miles upstream from mouth of Pole Creek. Dam site is in sec. 23, T. 2 N., R. 2 W., Uinta special base and meridian.

Dam site.—A gorge cut through glacial outwash. Foundation and abutments in glacial deposits. Dam 130 feet high would have a crest length of about 800 feet.

Basin.—A broadened section of the canyon. Maximum width about 2,000 feet, and length 1½ miles with water surface 130 feet above stream bed at dam site.

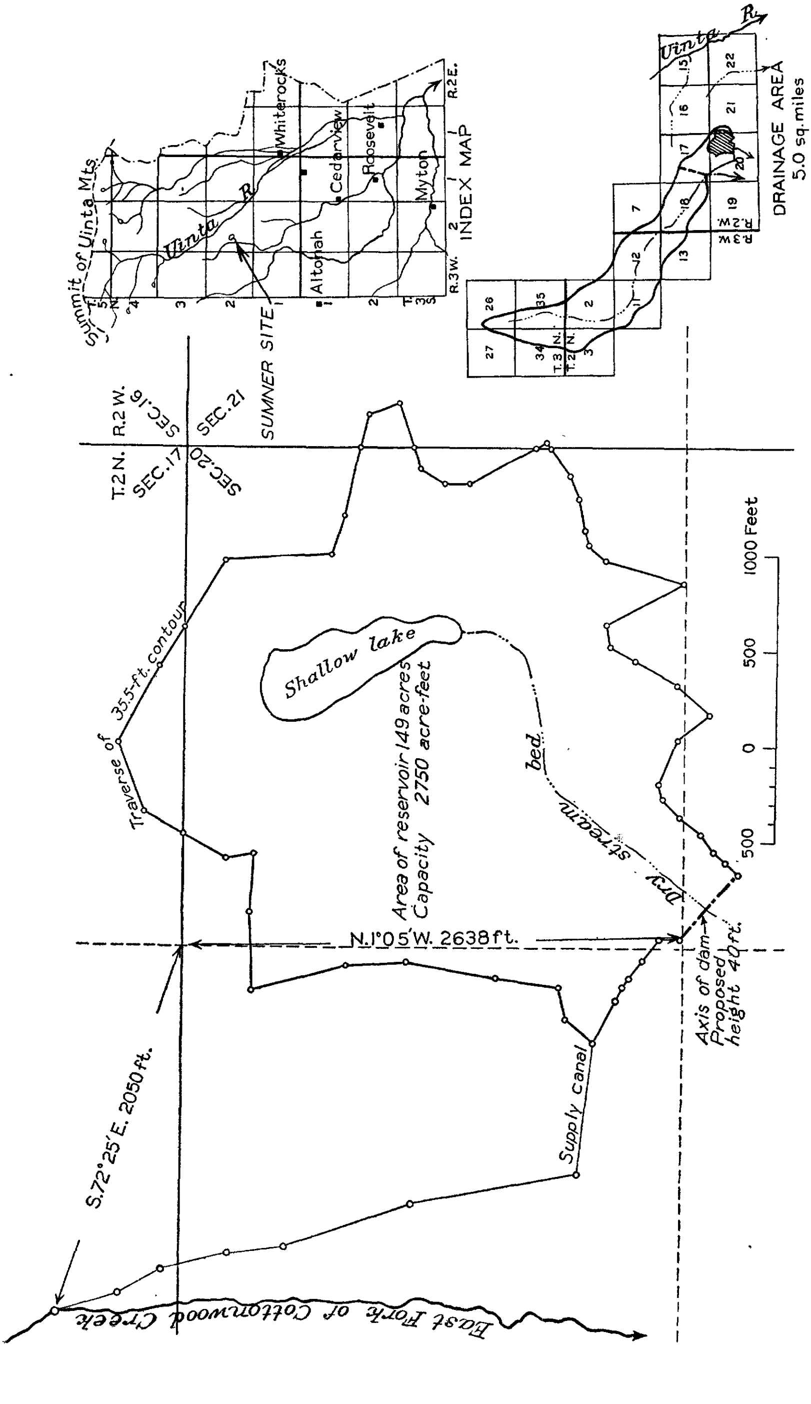


FIGURE 20.—Sumner reservoir site

Capacity.—

Contour (feet above sea level)	Area (acres)	Capacity (acre-feet)	Contour (feet above sea level)	Area (acres)	Capacity (acre-feet)
7,070	0	0	7,160	127	3,580
7,100	15	240	7,180	230	7,140
7,120	31	700	7,200	304	12,480
7,140	65	1,660			

Drainage area.—About 180 square miles, ranging in altitude from 7,100 to 13,498 feet above sea level. Main catchment basin is broad, open region. Several headwater streams wander from lake to lake or meadow to meadow, eventually finding their way to the main canyon.

Water supply.—A gaging station is located on the river about 3 miles below this reservoir site. Records indicate a mean annual run-off of about 185,000 acre-feet, nearly all of which passes through the reservoir site.

Remarks.—Water stored at this reservoir site could be used for both power and irrigation.[55]

MONTES HOLLOW RESERVOIR SITE (9BE 3)

Location.—About 1 mile southwest of Bennett, in sec. 36, T. 1 S., R. 1 W., Uinta special base and meridian. (See pl. 20.)

Dam site.—Flat U cross section with steep walls. Foundation, compact clay overlain by about 15 feet of gravel. North abutment in sandstone and shale; south abutment in earth and gravel. Proposed dam 35 feet high above stream bed, crest length about 600 feet. Auxiliary embankment of 1,700 feet required, extending from south abutment in the form of a J, average height 8 feet.

Basin.—A broad section of the canyon of Montes Creek. Water surface at full stage about 2,000 feet long and 500 feet wide. Area, 82 acres.

Capacity.—With dam 35 feet high, 1,000 acre-feet. Maximum depth of water, 32 feet.

Water supply.—To be taken from the Uinta River through a feeder canal, also run-off from Montes Creek.

Remarks.—Filings in State engineer's office propose the development of this site.

BOTTLE HOLLOW RESERVOIR SITE (9BE 4)

Location.—About 1 mile west of Fort Duchesne, in secs. 21 and 28, T. 2 S., R. 1 E., Uinta special base and meridian. (See pl. 21.)

Dam sites.—Two openings through east bench land. Upper site, steep walls, flat bottom, 500 feet across top, 250 feet across bottom; sandstone ledges exposed on side slopes, no rock exposed in bottom; erosion shows 5 to 6 feet of soil in bottom. Lower site, steep walls; sandstone ledges crop out in walls and bottom; cross section 600 feet on top, 175 feet on bottom. Proposed dams, earth or rock fill. Upper dam 53 feet high, lower dam 73 feet high.

Basin.—441 acres under 60-foot contour. Depression in sandstone formation. Inclosed on east and west sides by sandstone mesas, on south by low transverse ridge. Basin divided into two parts by low, sandy ridge across center of it. Soil ranges from gravelly sand to fine sandy loam, as shown by washes cutting through it. In some places bare rock exposed. Part of land under cultivation.

Capacity.—See Plate 21.

Water supply.—To be taken from the Uinta River below mouth of the Whiterocks River, through the Bench Canal. Water supply ample. Reservoir could be filled during nonirrigating season.

[55] Sheet C of the Duchesne River survey shows topography.

Remarks.—Basin consists of two depressions, each served by separate outlet. To drain upper basin into lower one requires cut 500 to 800 feet long; otherwise two sets of outlet gates are necessary. Storage at this site could be used on lands under lower Dry Gulch and lower Ouray irrigation systems.

CHEPETA LAKE RESERVOIR SITE (9BE 13)

Location.—At head of the Center Fork of the Whiterocks River, about 27 miles north of Whiterocks, in sec. 32, T. 5 N., R. 1 W., Uinta special base and meridian.

Dam site.—Broad cross section. Foundation and abutments glacial drift. Test pits 5 to 6 feet deep show boulders with earth. Proposed dam 35 feet high with crest length 1,600 feet. Greater part of dam, however, is relatively low embankment.

Basin.—Two glacial lakes. Upper one has about 50 acres of water surface, and lower one about 5 acres. Inclosed by timbered moraines and drift-covered ridges. Upper lake level 3.4 feet higher than lower one.

Capacity.—Area of reservoir with 30-foot rise in water surface would be 151 acres, and the corresponding capacity would be 2,710 acre-feet. Upper lake level by cut could be lowered to same altitude as lower lake and yield about 200 acre-feet additional capacity.

Drainage area.—4.7 square miles, altitude 10,600 to 12,000 feet above sea level. About one-third of area timbered drift deposits, rest bare ridges. Steep slopes.

Water supply.—Annual run-off of 12 inches required to furnish 3,000 acre-feet. Annual precipitation probably averages more than this amount.

Remarks.—Filings made in State engineer's office for development of this site.

WHITEROCKS LAKE RESERVOIR SITE (9BE 14)

Location.—Near head of the East Fork of the Whiterocks River, in sec. 1, T. 4 N., R. 1 W., Uinta special base and meridian. (See fig. 21.)

Dam site.—Broad cross section. Shallow with gently sloping walls. Surface indications are favorable for finding bedrock close to surface. Timber, rock, and earth at hand. Proposed dam 10 feet high, crest length 1,090 feet.

Basin.—Glacial lake. Area of water surface 31 acres. Inclosed by timbered hills. Maximum depth about 15 feet. Large part of lake about 8 feet deep.

Capacity.—See Figure 21.

Drainage area.—3.2 square miles. About two-thirds of it bare rock ridges, rest timbered hills. Altitude 10,500 to 12,000 feet above sea level.

Water supply.—Maximum capacity of reservoir site would require about 5 inches of annual precipitation on the catchment area. Precipitation data indicate a possible annual average of 20 inches.

Remarks.—Filings in State engineer's office contemplate development of this site.

PARADISE PARK RESERVOIR SITE (9BE 5)

Location.—On Paradise Creek, 15 miles north of Whiterocks, in sec. 7, T. 3 N., R. 1 E., Uinta special base and meridian. (See fig. 22.)

Dam site.—Broad, shallow cross section. Gently sloping sides. Test pits 6 feet deep show consolidated drift material. Proposed dam 35 to 40 feet high. Crest length 1,300 feet.

Basin.—Meadow about 120 acres, bordered by timbered hills. Bottom consists of sandy, mucky soil, containing many springs and seeps. Side slopes of solid rock. Surface features indicate shallow rock basin formed by rock ridge across outlet.

Capacity.—See Figure 22.

Drainage area.—3.9 square miles, altitude 10,000 to 11,000 feet above sea level. Timbered, largely rock and soil, covered with pine litter. Some grass-covered patches. Relatively steep slopes.

Water supply.—Reliable water supply each year for full capacity of site not certain.

Remarks.—Timber at site. Portable sawmill one-fourth mile away. Earth scarce. Covered by filings in State engineer's office. Being developed by Whiterocks Irrigation Co. Dam about one half completed (1927). Developed capacity, 1,000 acre-feet.

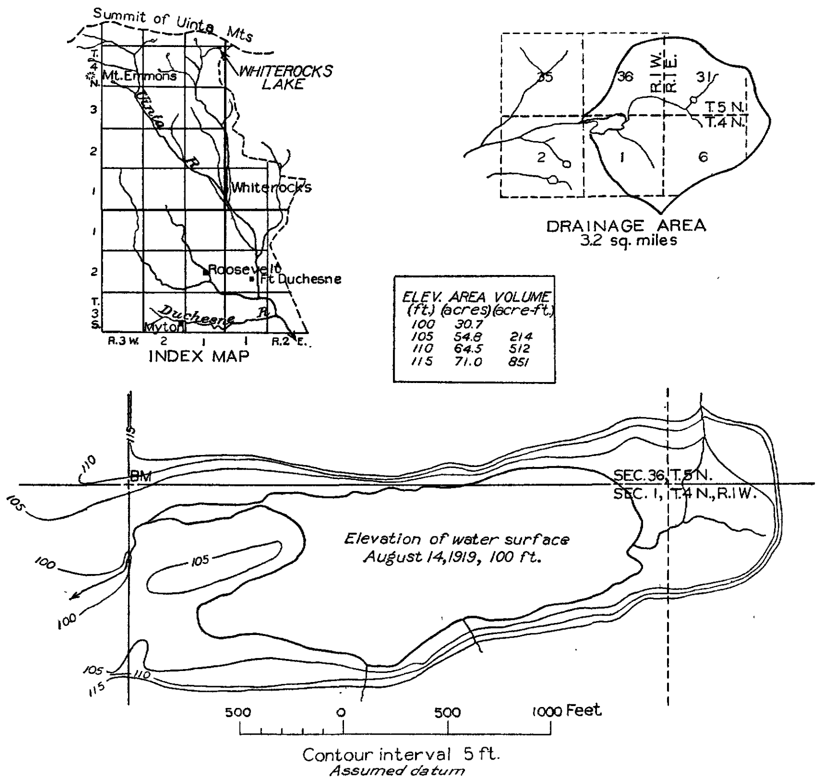


FIGURE 21.—Whiterocks Lake reservoir site

STANAKER DRAW RESERVOIR SITE (9BA 2)

Location.—In secs. 26, 34, and 35, T. 3 S., R. 21 E., and sec. 2, T. 4 S., R. 21 E., Salt Lake base and meridian, about 4 miles north of Vernal. (See pl. 22.)

Dam site.—At the extreme south end of Stanaker Draw, where erosion has cut a gap through uptilted layers of sandstone and shale. These strata form a reef dipping away from the reservoir toward the southeast. The top of this reef at the dam site is from 80 to 100 feet above the level of the valley floor. The gap is 530 feet wide in the bottom and 735 feet wide at a point 75 feet above the bottom. Abutments sandstone and shale in places. Proposed dam earth and rock fill. Topography suggests maximum height of dam about 95 feet.

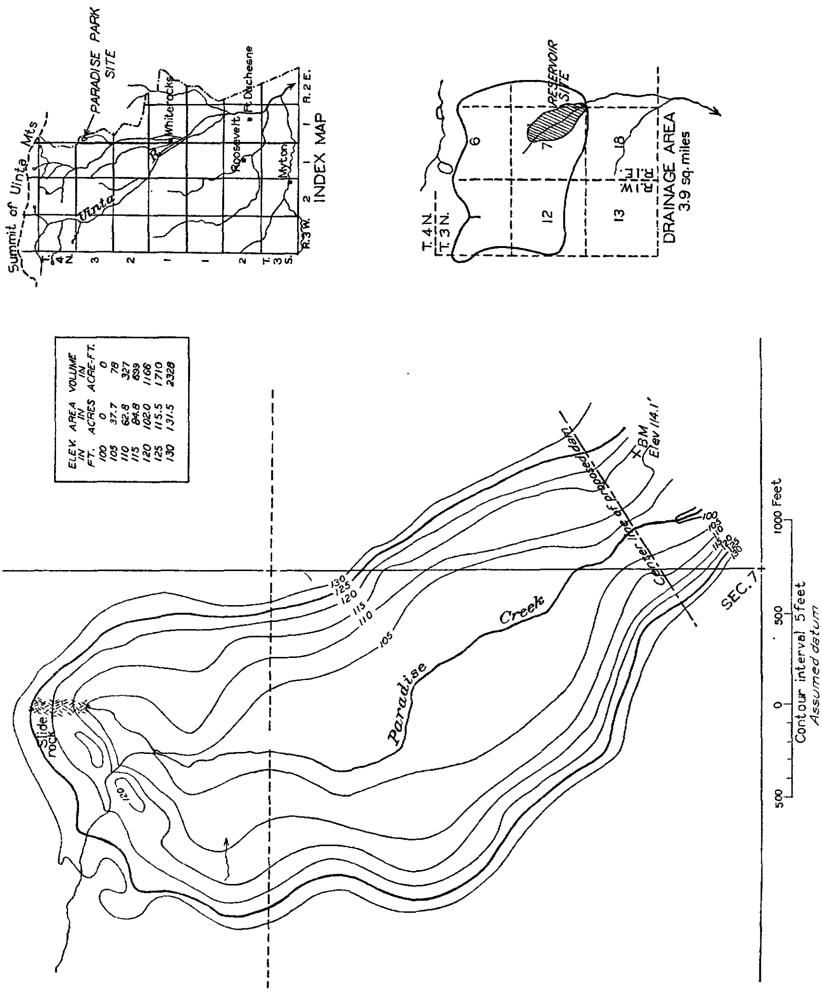
Basin.—Flat-bottomed valley, with a gradient to the south of about 50 feet to the mile. Arroyo about 100 feet wide, 15 to 20 feet deep, traverses the basin.

Red loamy soil comprises basin floor. About two-thirds of the basin at south end is under cultivation.

Capacity.—See Plate 22.

Water supply.—To be taken from Ashley Creek through a supply canal about 2 miles long. Project involves storage of flood waters only, and the recovery of waters which apparently are lost in "sinks" on Dry Fork of Ashley Creek.

Remarks.—Filings have been made in the State engineer's office for water rights, but because of protests filed by other users on the creek, favorable action



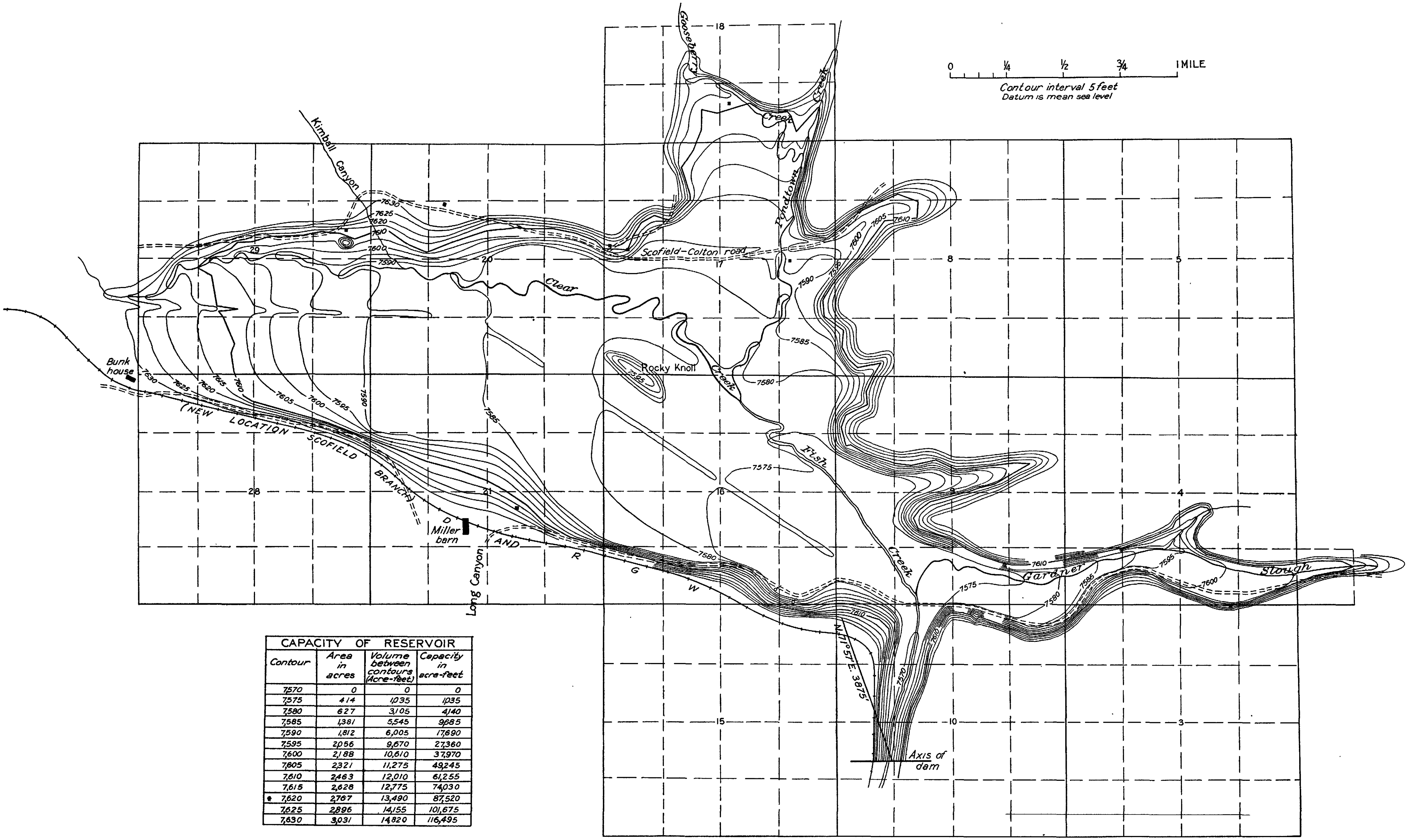
ELEV. IN FT.	AREA IN ACRES	VOLUME IN ACRE-FT.
100	0	0
105	37.7	78
110	62.8	327
115	84.8	699
120	102.0	1166
125	115.5	1710
130	131.5	2328

FIGURE 22.—Paradise Park reservoir site

by the State engineer has been made contingent upon facts obtained by further study of the water supply, involving two years of measurements of the stream above and below the "sinks" on Dry Fork.

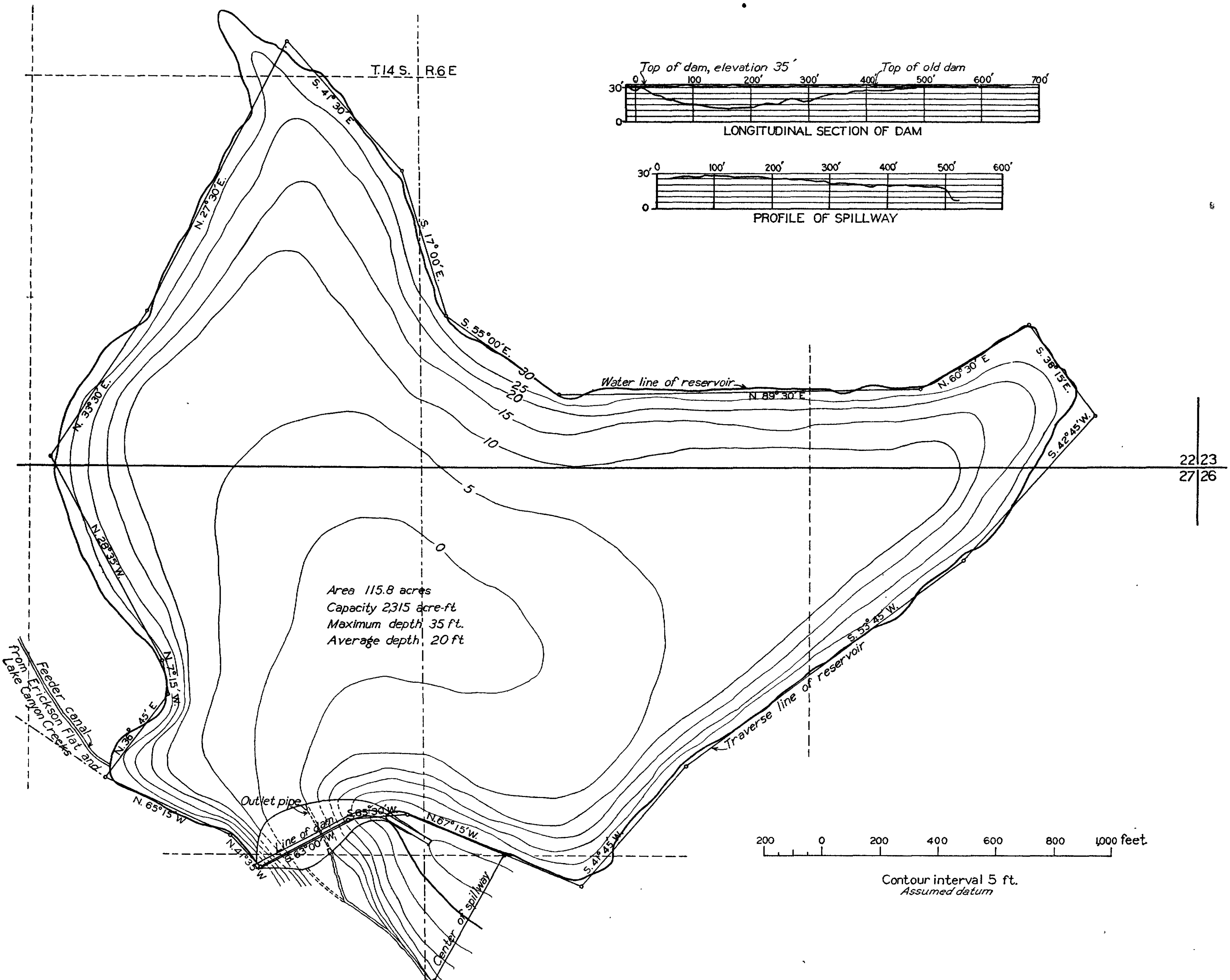
LOWER GREEN RIVER BASIN

More than 100 filings have been made in the State engineer's office covering water-storage projects for irrigation and power use of the streams in the lower Green River Basin. Many of these,

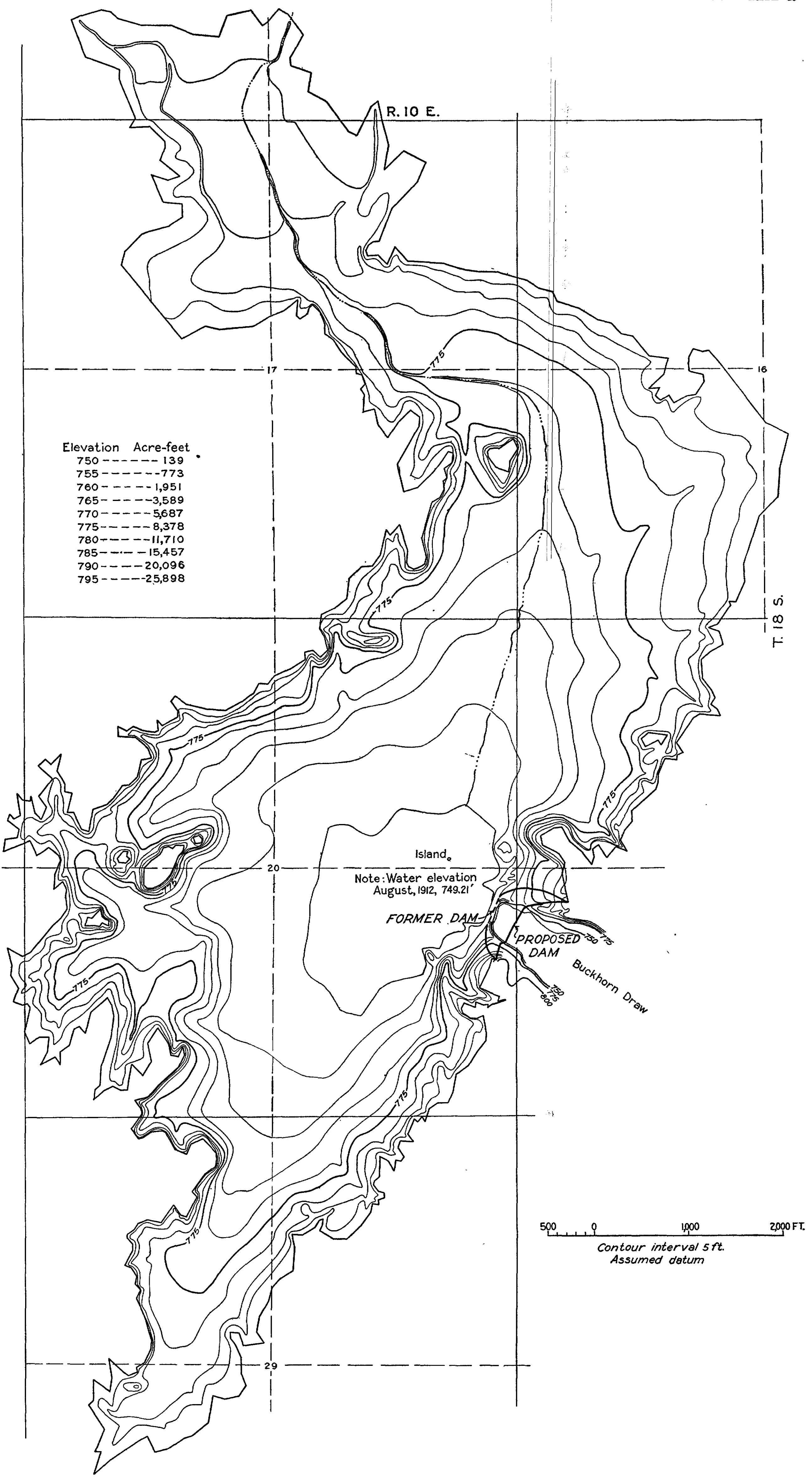


CAPACITY OF RESERVOIR			
Contour	Area in acres	Volume between contours (Acre-feet)	Capacity in acre-feet
7,570	0	0	0
7,575	414	1,035	1,035
7,580	627	3,105	4,140
7,585	1,381	5,545	9,685
7,590	1,812	6,005	17,690
7,595	2,056	9,670	27,360
7,600	2,188	10,610	37,970
7,605	2,321	11,275	49,245
7,610	2,463	12,010	61,255
7,615	2,628	12,775	74,030
7,620	2,767	13,490	87,520
7,625	2,896	14,155	101,675
7,630	3,031	14,820	116,495

PLEASANT VALLEY RESERVOIR



CLEVELAND RESERVOIR



BUCKHORN RESERVOIR

however, cover the same reservoir site, and only a few of them have been built. At least 65 different projects of 100 acre-feet or more capacity have been proposed, and nearly all of them are in the drainage basins of the Price and San Rafael Rivers. The salient facts pertaining to the most important of these projects are shown in the table on pages 152–153, and a more detailed description of some of them is given in the text.

PLEASANT VALLEY RESERVOIR (9BJ R2)

Location.—In Pleasant Valley immediately north of Scofield, in Carbon County. The dam is in the SE. ¼ sec. 10, T. 12 S., R. 7 E., Salt Lake base and meridian. (See pl. 23.)

Dam site.—A broad, flat U with sandstone bedrock at a maximum depth of about 28 feet. Crest length of a dam 50 feet high at an altitude of 7,620 feet is 435 feet. Dam rock fill and earth, constructed to altitude of 7,620 feet to store water at 7,610 feet. Altitude of proposed ultimate height of dam 7,635 feet.

Basin.—A small valley about 5 miles long and 2 miles maximum width.

Capacity.—See Plate 23.

Drainage area.—About 150 square miles, ranging in altitude from 7,570 to more than 10,400 feet above sea level. The headwaters lie within the Manti National Forest.

Water supply.—Fragmentary stream-flow records for Fish Creek near the dam site indicate an average annual water supply of about 50,000 acre-feet.

Remarks.—This reservoir is a part of the Price River Water Conservation District project. It replaces the old Mammoth Reservoir, which failed in 1917. Its principal value is for irrigation. Available storage capacity at this site and others above it is greatly in excess of the available water supply. Water filings and maps of project are on file in State engineer's office.

HUNTINGTON RESERVOIR (9BK R2)

Location.—On the Spring Canyon branch of Huntington Creek in secs. 20 and 21, T. 14 S., R. 6 E., Salt Lake base and meridian. Location commonly known as Erickson Flat. (See sheet 3 of Manti Forest Atlas.)

Dam site.—A broad, shallow cross section. Crest length of a dam 56 feet high is 1,000 feet. Earth-fill dam, clay and sandstone abutments.

Basin.—A small mountain meadow.

Capacity.—With dam 56 feet high, 2,460 acre-feet.

Drainage area.—About 7 square miles, ranging in altitude from 8,900 to more than 10,000 feet above sea level. All within the Manti National Forest.

Water supply.—From Spring Canyon and tributaries and a feeder canal about 1 mile long carrying water from Lake Canyon on the south. No stream-flow records exist to show the quantity available, but the fact that it is largely dependent upon precipitation on a relatively small drainage basin precludes the possibility of any great amount of surplus water.

Remarks.—This reservoir site was surveyed as early as 1901 for obtaining additional irrigation supply for lands under the Huntington Canal and Agricultural Association project, now known as the Huntington Canal and Reservoir Association. Work was begun on the dam that same year and carried on for five or six years, at the end of which the dam was 50 feet high. In 1919–20 it was raised to the present height to obtain 600 acre-feet additional storage capacity. About 5,000 acres of land is irrigated under the project. Maps and other data are on file in State engineer's office, also in United States General Land Office, Salt Lake City.

Reservoirs and reservoir sites in lower Green River Basin

Constructed reservoirs

Name	Index No.	Minor drainage basin	Source of supply	Location [a]	Approximate height of dam (feet)	Approximate area (acres)	Capacity (acre-feet)	Remarks
Fairview	9BJ R1	Price River	Gooseberry Creek	Tps. 13 and 14 S., R. 5 E.			2,000	See sheet 3, Manti Forest Atlas. Water used to irrigate lands around Fairview. Feeder canal from Boulger Creek in addition to Gooseberry Creek.
Pleasant Valley	9BJ R2	do	Fish Creek	T. 12 S., R. 7 E	50	2,500	61,000	See p. 151.
Kyune	9BJ R3	do	Kyune Creek	T. 11 S., R. 9 E	30		800	Owned by Price Reservoir & Irrigation Co. Ultimate development 1,950 acre-feet.
Twin Peaks	9BJ R4	do	Miller Creek	T. 16 S., R. 9 E	18	115	550	Data from survey filed in General Land Office. Used to irrigate 260 acres, United States Fuel Co. dairy ranch.
Waterman	9BJ R5	do	do	T. 15 S., R. 10 E	9	15	100	Application in State engineer's office. Filing for right of way in General Land Office. Ultimate development 200 acre-feet capacity. For irrigation.
Olson	9BJ R6	Wash	Price River	T. 16 S., R. 11 E			700	Partly constructed. Ultimate capacity 3,500 acre-feet with 50-foot dam and area of 260 acres. Plan and specifications filed in State engineer's office.
Desert Lake	9BJ R7	Price River	Miller Creek, Washboard Flat, and Huntington Creek.	T. 17 S., R. 10 E	20	600	5,000	Feeder canal from Huntington Creek through Cleveland Canal. Capacity may be increased easily to 7,300 acre-feet with 30-foot dam. Survey in General Land Office files.
	9BJ R8	do	Surface run-off	T. 15 S., R. 12 E	20	22	150	See Wellington topographic map. In sec. 1. Private irrigation project.
Lake Fork	9BK R1	San Rafael	Lake Fork	T. 14 S., R. 6 E	15	20	200	At head of Lake Fork, in sec. 19. Crest length of dam 365 feet. Owned by Cleveland Canal & Agricultural Co. See sheet 3, Manti Forest Atlas. Used for irrigation.
Huntington	9BK R2	do	Spring Canyon Creek	T. 14 S., R. 6 E	56	118	2,460	See p. 151.
Rolfson	9BK R3	do	Rolfson Canyon Creek	T. 14 S., R. 6 E	36	45	900	Plans and specifications filed in State engineer's office. For supplemental supply to 9BK R4. Under construction; owned by Cleveland Canal & Agricultural Co.
Cleveland	9BK R4	do	Lake Canyon Creek	T. 14 S., R. 6 E	40	116	2,315	See p. 154.
Duck Fork	9BK R5	do	Duck Fork and Lake Fork.	T. 19 S., R. 4 E	15	40	230	Drainage area 6.3 square miles. Irrigation use. Filing in State engineer's office.

Indian Creek	9BK R6	do	Indian Creek and springs.	T. 19 S., R. 4 E	(b)	56	672	Survey data filed in General Land Office. See sheet 9, Manti Forest Atlas. Drainage area 1.6 square miles. Used by Ferron Canal & Reservoir Co.
Willow Lake	9BK R7	do	Willow Lake stream	T. 19 S., R. 5 E		24	116	Filing in State engineer's office. Drainage area 1.3 square miles. Manti Forest Atlas. Irrigation use.
Buckhorn	9BK R8	do	Bull Hollow and Huntington Creek.	T. 18 S., R. 10 E	20	139	1,000	See p. 154.
Reservoir sites								
Gooseberry	9BJ 1	Price River	Gooseberry Creek	T. 13 S., Rs. 5 and 6 E	100	700	30,000	See p. 155.
Mammoth	9BJ 2	do	do	T. 13 S., R. 6 E	125	926	35,200	Was built and used for few years. Dam washed out in 1917, and Pleasant Valley Reservoir has been built in its stead. This site now abandoned. Water supply insufficient for this project and others now proposed.
McDonand & Waterous	9BJ 3	do	Willow Creek	T. 12 S., R. 10 E	15	53	400	Data from survey filed in General Land Office. Proposed use, irrigation. Water filing in State engineer's office lapsed.
Trail Canyon	9BJ 4	do	Trail Canyon Creek	Tps. 13 and 14 S., R. 8 E	(c)	60		Feeder canal from Trail Creek 1½ miles. See Scofield topographic map.
Oman	9BJ 5	do	Bob Wright Creek	T. 14 S., R. 8 E	150	135	8,100	Drainage area 10 square miles. See Scofield topographic map.
Anderson	9BJ 6	do	Soldier Creek	T. 13 S., R. 11 E	50	52	1,076	See Wellington topographic map. Plans and specifications filed in State engineer's office. Crest length of dam 400 feet; 2-mile feeder canal from Soldier Creek.
Olson	9BJ 7	do	Price River	T. 16 S., R. 11 E	35	260	3,500	Water taken through Carbon Canal out of Price River to reservoir. Partly built. Filing in State engineer's office.
Pace & Dugout	9BJ 8	do	Pace and Dugout Creeks.	T. 13 S., R. 12 E		112	1,000	See Wellington topographic map. Filing in State engineer's office by Clark Valley Irrigation Co. for 1,000 acre-feet.
Mead & Perkins	9BJ 9	do	do	T. 14 S., R. 12 E	24; 18	25	230	Plans and specifications filed in State engineer's office. Under construction 1927. Crest length of 1 dam 285 feet, other 1,018 feet.
Woodside	9BJ 10	do	Price River	T. 17 S., R. 13 E	100	450	18,000	See p. 156.
Russell	9BK 1	San Rafael River	Huntington Creek	T. 14 S., R. 6 E	105	105	5,280	
Brockbank	9BK 2	do	do	T. 17 S., R. 8 E	65	135	2,700	
Lower Joes Valley	9BK 3	do	Seely Creek	Tps. 17 and 18 S., R. 6 E	180	1,500	87,860	See p. 156.
Bell View	9BK 4	do	Molen Seep Wash	Tps. 20 and 21 S., R. 8 E	36	431	6,500	Water filing in State engineer's office lapsed. Data from survey filed in General Land Office.
Mexican Bend or Sheep Bridge.	9BK 5	do	San Rafael River	Tps. 20 and 21 S., Rs. 12 and 13 E.	180	1,469	147,000	See p. 158.

a All locations referred to Salt Lake base and meridian.

b 4 small dams.

c 2 small dams across saddles.

CLEVELAND RESERVOIR (9BK R4)

Location.—In a small basin tributary to the Left Fork of Huntington Creek, in secs. 22 and 27, T. 14 S., R. 6 E., Salt Lake base and meridian, Emery County, Utah. (See pl. 24, also Scofield topographic map and sheet 3 of Manti Forest Atlas.)

Dam site.—Broad, shallow cross section. Crest length of 666 feet for dam 40 feet high. Dam earth fill with concrete cut-off wall and stone paving on upstream face.

Basin.—A small, roughly triangular basin with all sides gently sloping toward the center. The maximum dimensions of the reservoir are about 3,700 by 3,000 feet. The area is 115.8 acres.

Capacity.—With a dam 40 feet high and a maximum depth of water in the reservoir of 35 feet the capacity of the reservoir is 2,315 acre-feet.

Drainage area.—About 8.4 square miles, including the area tributary to the Huntington Reservoir (9BK R2). About 7 square miles of drainage area is made tributary to both reservoirs by canals. All the drainage basin is in the Manti National Forest and ranges from 8,800 to more than 10,000 feet above sea level.

Water supply.—From Spring Canyon and tributaries and a feeder canal about 1 mile long carrying water from Lake Canyon to the Huntington Reservoir, whence a supply canal about 1½ miles long leads southeastward to the Cleveland Reservoir. No stream-flow records are available showing the run-off of these streams. However, owners of the reservoir assert that the water supply is sufficient to fill the reservoir each year. An additional supply to that obtained from these creeks is furnished by several springs within the reservoir basin.

Remarks.—This reservoir is one of the oldest in the San Rafael River drainage basin. It was built by the Cleveland Canal & Agricultural Co. for irrigation, and the water is used on lands in the vicinity of Cleveland. The company has about 20,000 acres under canal. Maps and other data are on file in the State engineer's office and the United States General Land Office, Salt Lake City.

BUCKHORN RESERVOIR (9BK R8)

Location.—Near Buckhorn Flat, about 14 miles east of Castle Dale. The reservoir as proposed at various times would cover lands in secs. 16, 17, 20, 21, and 29, T. 18 S., R. 10 E., Salt Lake base and meridian. (See pl. 25.)

Dam site.—A narrow cross section with comparatively steep side walls. Present dam about 20 feet high and 400 feet long, built of earth and located near the east quarter corner of sec. 20, T. 18 S., R. 10 E.

Basin.—A roughly crescent-shaped basin trending almost due south with gentle slopes toward the outlet at the southeast. The total length of the proposed reservoir is about 3 miles, and the maximum width is about 1 mile. The area of the reservoir with the present dam is about 139 acres. The ultimate proposed development would have an area of about 1,200 acres.

Capacity.—The capacity already developed with the dam about 20 feet high is about 1,000 acre-feet. The additional capacity that may be developed is indicated in plate 25.

Drainage area.—The area naturally tributary to this reservoir site is only a few square miles, mostly desert plateaus with scanty and uncertain amount of annual precipitation. The project, however, contemplates a supply canal about 15 miles long to bring water from Huntington Creek. The drainage area tributary to the proposed Huntington Creek diversion is about 200 square miles, ranging in altitude from 6,000 to more than 10,000 feet above sea level, mostly within the Manti National Forest.

Water supply.—An estimated amount of 5,000 to 6,000 acre-feet annually from Bull Hollow and other wet-weather channels draining into the reservoir. Principal supply, according to plans for the project made in 1909, was to be taken from Huntington Creek, diverted through the Cleveland Canal, enlarged and extended to the Bull Hollow drainage basin, a total distance of about 15 miles. Investigations of this project made at different times indicate that there is some unused flood water in Huntington Creek, but as to its amount there is considerable uncertainty. It is estimated in one report of 1922 to be sufficient for about 7,000 acres of new ands.

Remarks.—Although some storage is developed at this site it is not used except for watering stock. Several unsuccessful attempts were made in 1909 and a few years later to promote this project as a Cary Act enterprise to irrigate lands south of the reservoir on what is known as Buckhorn Flat. Construction costs would be high for such a project, and difficulties of operation would be considerable, on account of the nature of the material through which the supply canal would pass. Maps and other data relative to this project are on file at the State engineer's office and the United States General Land Office, Salt Lake City.

GOOSEBERRY RESERVOIR SITE (9BJ 1)

Location.—Near the south end of lower Gooseberry Valley, about 7 miles northeast of Fairview, Utah, on Gooseberry Creek in secs. 24 and 25, T. 13 S., R. 5 E., and secs. 19 and 30, T. 13 S., R. 6 E., Salt Lake base and meridian.

Dam site.—In SW. ¼ sec. 19, T. 13 S., R. 6 E. Crest length of 100-foot dam would be 520 feet.

Basin.—A portion of lower Gooseberry Valley about 1½ miles long and 1 mile wide. A broad, flat bowl cross section with rather gently sloping sides. Area with 100-foot rise of water surface at dam about 700 acres.

Capacity.—

Depth of water at dam site (feet)	Capacity (acre-feet)	Depth of water at dam site (feet)	Capacity (acre-feet)
0	0	60	8,000
10	500	70	12,300
20	1,000	80	18,200
30	1,500	90	26,000
40	3,000	100	36,000
50	4,500		

Drainage area.—About 8 square miles, ranging in altitude from about 8,600 to nearly 10,000 feet above sea level, principally within the Manti National Forest.

Water supply.—From Gooseberry Creek, which flows through the reservoir site, and the headwaters of Boulger Creek, which are brought into the Gooseberry Creek drainage basin by a canal about 2 miles long. There are no stream-flow records showing amount of water available for storage in this site, but estimates by engineers who have analyzed the project range from 13,000 to 19,000 acre-feet annually.

Remarks.—This reservoir site is part of an irrigation project which proposes to divert the water from the reservoir through a tunnel 5,640 feet long into the headwaters of Cottonwood Creek, a tributary of the San Pitch River in the Sevier River drainage basin. The water is to be used to irrigate lands in the vicinity of Fairview and Mount Pleasant. The San Pete Water Co. is now (1927) working on plans to finance and construct the project; the first stage of the development to be an 80-foot dam to provide a storage capacity of 18,000 acre-feet. A bond issue of $800,000 is proposed to build the project.

WOODSIDE RESERVOIR SITE (9BJ 10)

Location.—On the Price River about 10 miles northwest of Woodside, in secs. 9, 10, 15, 16, 21, and 22, T. 17 S., R. 13 E., Salt Lake base and meridian. The dam site is in the NE. ¼ sec. 22.

Dam site.—A V cross section with sandstone walls several hundred feet high on the left bank and 130 feet high on the right bank of the stream. A dam 95 feet high would have a crest length of 400 feet and a length at the bottom of 200 feet.

Basin.—Long, narrow, and irregular, following the meanderings of the stream and confined between steep canyon walls. The total length is a little more than 4 miles, and the maximum width is about 1 mile. Its area is about 343 acres at high-water level.

Capacity.—Available storage capacity above the outlet with a dam 95 feet high above the natural stream bed is 14,000 acre-feet.

Drainage area.—About 1,510 square miles, ranging in altitude from 4,800 to more than 10,000 feet above sea level.

Water supply.—From the Price River. Stream-flow records are available for a number of years showing the run-off at a point near Helper, but only a short record (from July, 1909, to December, 1910) has been made of the run-off at Woodside, near the reservoir site. These records, however, indicate that in 1910 about 240,000 acre-feet of water passed the reservoir site, and this is several times more than the capacity of the site.

Remarks.—This reservoir project was at one time a part of a Carey Act enterprise which embraced about 7,000 acres of land on both sides of the Price River near Woodside. Of this area 5,000 acres was included in a Carey Act segregation and the rest was in private and State ownership. The estimated cost of the project was $400,000.

LOWER JOES VALLEY RESERVOIR SITE (9BK 3)

Location.—In Lower Joes Valley, about 15 miles northwest of Castle Dale, at the head of Straight Canyon, on Seely Creek, a tributary to Cottonwood Creek, in secs. 29, 30, 31, and 32, T. 17 S., R. 6 E., and secs. 5, 6, 7, and 8, T. 18 S., R. 6 E., Salt Lake base and meridian. The dam site is in the NE. ¼ sec. 5. (See fig. 23.)

Dam site.—A flat-bottomed V cross section in which a dam about 180 feet high would have a crest length of 810 feet.

Basin.—A long, narrow valley, sloping gently from each end toward an outlet at a central point in the east side. Several small streams drain into the valley and converge near this outlet. The hills forming the east boundary of the basin rise steeply from the valley floor, but those on the west have comparatively gentle slopes. The proposed reservoir would have a water surface about 4 miles long and a maximum width of about 1½ miles.

Capacity.—

Contour (feet above sea level)	Area (acres)	Capacity (acre-feet)	Contour (feet above sea level)	Area (acres)	Capacity (acre-feet)
[a]6,820	0	0	6,925	492	17,230
6,850	32	480	6,950	745	32,680
6,875	120	2,380	6,975	1,085	55,560
6,900	289	7,480	7,000	1,500	87,860

[a] Approximate.

Drainage area.—About 145 square miles, ranging in altitude from 7,200 to more than 10,000 feet above sea level. All of the area is within the Manti National Forest and is subject to considerable annual precipitation.

Water supply.—Seely Creek and a number of tributary streams that flow into it within the reservoir site. No stream-flow records are available to show the

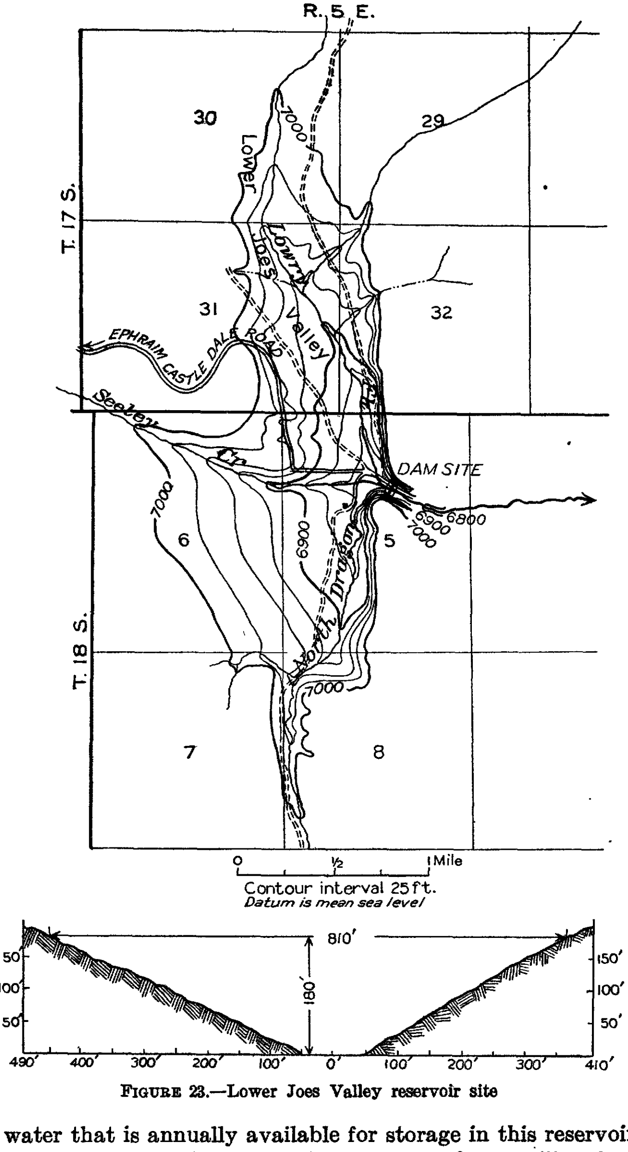


FIGURE 23.—Lower Joes Valley reservoir site

amount of water that is annually available for storage in this reservoir site, but records for several years of Cottonwood Creek near Orangeville, about 5 miles below the proposed dam site, show an average annual run-off at this gaging station of 97,500 acre-feet. The drainage area above the station is 200 square miles.

Remarks.—As early as 1907 a survey was made of this reservoir site in connection with irrigation projects in Castle Valley and along the lower San Rafael

River. Right of way was granted by the Interior Department for building the project, and a small amount of excavation work was done at the dam site, but further than this nothing has been done.

MEXICAN BEND OR SHEEP BRIDGE RESERVOIR SITE (9BK 5)

Location.—On the San Rafael River at Mexican Bend, about 16 miles due west of Green River, Utah. The dam site is at Sheep Bridge, just above point indicated as mile 58 on sheet B of the plan and profile of the San Rafael River below Castle Dale, Utah, published by the United States Geological Survey in 1926.

Dam site.—A broad cross section with an inner gorge that is about 10 feet wide at a height of 50 feet or less above the stream. The crest length of a dam 180 feet high would be 530 feet.

Basin.—An oxbow bend in the canyon where the walls have been pushed back by erosion so that the water surface with a 180-foot dam would be about a mile in maximum width and about 9½ miles long.

Capacity.—About 147,000 acre-feet with a depth of water at the dam of 180 feet and a surface area of 1,469 acres in the reservoir, according to detailed surveys made of the project in 1906–1909.

Drainage area.—About 1,600 square miles ranging from 4,400 to more than 11,000 feet above sea level. Part of this drainage area lies within the Manti National Forest and is well timbered. The topography of the area is greatly diversified, consisting of sharp mountain peaks, broad plateaus, and deeply cut canyons. That part in the San Rafael Swell is rugged and barren. Sandstone reefs and towering battlements of precipitous rocks stand in sharp relief over this part of the area.

Water supply.—A stream-flow gaging station was established on the San Rafael River about 16 miles southwest of the town of Green River in 1909, and continuous records are available through September, 1918. During this period there were only two years when the run-off of the river was too small to fill this proposed reservoir. The mean annual run-off for the period was 212,600 acre-feet.

Remarks.—For several years subsequent to 1906 there was considerable activity in surveying and promoting several reservoir projects on the San Rafael River. These were primarily for irrigating about 50,000 acres of land lying between the San Rafael and Green Rivers, but after unsuccessful attempts to finance them, a further effort was made to interest capital in them as power enterprises. This effort was also unsuccessful, and finally they were abandoned. These projects were originally conceived before there were any stream-flow records of the river, and considerable time was spent in making a survey of what is known as the San Rafael Irrigation Co. reservoir site. The dam site for this project is at the mouth of the San Rafael Canyon, about 7 miles down the river from the Mexican Bend or Sheep Bridge dam site. This survey indicated that a dam 350 feet high would have a crest length of about 1,200 feet and would create a reservoir of about 7,865 acres with a capacity of 1,376,000 acre-feet, or more than six times the annual run-off of the river. Some work was done in 1909 to test the foundation conditions for a dam at this place, but it was not finished because of loss of equipment in an unexpected flood.

In 1913 a reconnaissance investigation was made of the power resources of the San Rafael River by a representative of the Electric Bond & Share Co., of New York. The information then obtained indicated a possible reservoir site along that part of the river immediately above the head of the Black Box Canyon, but no survey data were obtained regarding it until the topographic survey of the entire river was made by the United States Geological Survey in 1925. This survey indicates that a dam 145 feet high at the head of this canyon will back the water up the river about 12 miles, but the resulting reservoir would be narrow and would have a capacity of only about 65,000 acre-feet.

SILT AND EVAPORATION DATA

A study of silt and evaporation is not vital to all reservoir projects, but where water supply and available storage capacity are scanty to begin with, the combination of much silt and high evaporation may have considerable bearing on the feasibility of a project. Specific data covering these items within the Green River Basin are practically lacking, but it is believed that the following general information as to the silt conditions within the basin and the evaporation records for a number of places in and adjacent to the Colorado River Basin should be of value in considering these questions with relation to storage projects.

SILT

In the upper Green River Basin above Green River, Wyo., there is no silt problem. At the places where storage might be developed the streams are crystal-clear. This is also true of the headwater streams of Blacks Fork and Henrys Fork, on the north slope of the Uinta Mountains.

At the Flaming Gorge reservoir site, on the Green River at the Utah-Wyoming line, the river carries some silt when the wet-weather streams are flushing the bad-land area that is tributary to it. For a period of 24 days in April, 1915, the United States Bureau of Reclamation conducted some silt observations at the dam site for this reservoir in Horseshoe Canyon. Daily samples of 100 cubic centimeters of river water were taken and allowed to settle for 24 hours. From the 2,400 cubic centimeters of samples a total of 11 cubic centimeters of silt was obtained. This had a dry weight of 1.775 grams. Thus the silt content was determined to be 739.6 parts per million, or less than 0.1 per cent by weight. From December 28, 1916, to May 22, 1917, further silt observations were made by the Bureau of Reclamation a short distance above Horseshoe Canyon. Samples were taken every four or five days, and it was observed that the greater amount of the silt was carried in the first high water in the spring. The combined results of these observations, however, indicate that silt is not a serious problem in connection with the Flaming Gorge storage project.

The headwater streams of the Yampa, White, Duchesne, Price, and San Rafael Rivers are all fairly free from silt, but during flood periods the lower reaches of these rivers carry a load of silt and débris into the Green River, but in terms of the annual discharge of the Green River at its mouth the silt content has been estimated to be about 0.5 per cent by volume.

EVAPORATION

By Robert Follansbee

AVAILABLE RECORDS

Records of evaporation are available for 17 points in and adjacent to the Colorado River Basin. They represent evaporation measured in pans of different sizes, either set in the ground, resting on top of it, or floating in ponds and reservoirs. These records do not represent directly the evaporation to be expected from a reservoir surface but have to be corrected by an amount depending upon the type of pan. This discussion presents these records as reduced to the common reservoir equivalent. So far as the writer knows the only comprehensive experiments to determine the proper reduction factors for pans of various diameters, depths, and immediate surroundings were those made by the Office of Public Roads and Rural Engineering in Denver during 1915 and 1916.[56] In this investigation evaporation was measured simultaneously in pans of the varying dimensions and surroundings most commonly used. Although the investigation lasted only from November, 1915, to November, 1916, it was carefully made and determined the relative effect of the different pans under conditions existing at the open-air laboratory in Denver. The results obtained for pans having diameters of 4 feet and 12 feet have been checked by experiments in the Escalante Valley near Milford, Utah, by the United States Geological Survey during the summer of 1925.

By means of the coefficients determined by the Denver investigation, the records in and adjacent to the Colorado River Basin have been reduced to reservoir equivalents. The monthly means for each station, together with observed temperatures and wind velocities so far as available, are presented in the following table. The records of temperature and wind velocity, except those for Farmington, which were based on Weather Bureau records at Albuquerque, were taken close to the evaporation pan, the anemometer being only a foot or two above the ground. They are not directly comparable with records at regular Weather Bureau stations, which are usually taken on the tops of buildings from 35 to 60 feet above the ground. Temperatures at the higher positions do not differ widely from those near the ground, but wind velocities show wide variations. (See tables, pp. 161–165.) The figures in parentheses are interpolated.

[56] Jour. Agr. Research, vol. 10, pp. 209–242, 1917.

Mean monthly reservoir equivalent for evaporation stations in and adjacent to Colorado River Basin

Wagonwheel Gap, Colo. (1920–1924) [a]

Month	Temperature of air (°F.)	Wind velocity (miles per hour)	Reservoir equivalent	
			Inches	Per cent of annual
January	15	1.7	(0.85)	3.9
February	18	1.8	(.77)	3.5
March	22	2.2	(1.21)	5.6
April	29	2.4	(1.95)	9.0
May	42	2.6	(2.83)	13.0
June	53	2.6	3.36	15.4
July	55	2.2	3.04	14.0
August	52	1.8	2.36	10.8
September	46	1.7	2.10	9.6
October	35	1.7	1.35	6.2
November	24	1.5	(1.17)	5.4
December	17	1.4	(.78)	3.6
Annual	34	2.0	21.77	100

Myton, Utah (1918–1925) [a]

Month	Temperature of air (°F.)	Wind velocity (miles per hour)	Inches	Per cent of annual
January	14	(3.1)	(0.43)	1.1
February	23	(3.6)	(.65)	1.6
March	36	4.3	(1.68)	4.2
April	46	4.1	4.14	10.4
May	57	3.4	5.92	14.8
June	66	2.9	6.75	17.0
July	72	2.4	6.50	16.4
August	70	2.4	5.55	13.9
September	61	2.6	4.15	10.4
October	48	2.5	2.48	6.2
November	34	2.1	(1.20)	3.0
December	20	(1.6)	(.40)	1.0
Annual	46	3.0	39.85	100

Provo, Utah (1908–1916, 1918–1925) [a]

Month	Temperature of air (°F.)	Wind velocity (miles per hour)	Inches	Per cent of annual
January	27	(1.0)	(0.68)	2.4
February	32	(1.2)	(.77)	2.7
March	40	1.8	2.40	8.4
April	46	1.9	2.84	9.9
May	57	1.6	3.74	13.1
June	65	1.0	4.16	14.5
July	72	.9	4.46	15.5
August	69	.9	3.81	13.3
September	61	.9	2.74	9.6
October	49	1.0	1.61	5.6
November	38	.7	.83	2.9
December	29	(.9)	(.60)	2.1
Annual	49	1.2	28.64	100

Santa Fe, N. Mex. (1913–14, 1916–1925) [a]

Month	Temperature of air (°F.)	Wind velocity (miles per hour)	Inches	Per cent of annual
January	29	2.8	1.13	2.5
February	34	3.1	1.50	3.4
March	38	3.6	2.75	6.2
April	46	3.9	4.27	9.6
May	56	3.5	5.94	13.4
June	66	3.0	7.01	15.7
July	69	2.1	5.80	13.1
August	67	1.6	5.14	11.6
September	61	1.8	4.48	10.1
October	50	2.2	3.35	7.5
November	40	2.4	1.98	4.5
December	31	2.5	1.07	2.4
Annual	49	2.7	44.42	100

[a] Footnote at end of table.

Mean monthly reservoir equivalent for evaporation stations in and adjacent to Colorado River Basin—Continued

Farmington, N. Mex. (1915–1925) [a]

Month	Temperature of air (°F.)	Wind velocity (miles per hour)	Reservoir equivalent	
			Inches	Per cent of annual
January	36	----------	0.69	1.5
February	41	----------	1.33	2.9
March	48	----------	2.88	6.3
April	55	----------	4.90	10.6
May	64	----------	6.34	13.7
June	71	----------	6.90	15.0
July	75	----------	7.24	15.7
August	72	----------	5.62	12.1
September	65	----------	4.37	9.5
October	55	----------	3.20	7.0
November	44	----------	1.76	3.8
December	37	----------	.87	1.9
Annual	55	----------	46.10	100

Mesa Experiment Farm, Ariz. (1917–1925)

Month	Temperature of air (°F.)	Wind velocity (miles per hour)	Inches	Per cent of annual
January	49	1.6	1.85	3.6
February	54	1.9	2.44	4.7
March	57	2.0	3.82	7.4
April	63	2.2	5.31	10.3
May	72	1.9	6.99	13.5
June	82	1.7	7.53	14.6
July	86	1.5	6.91	13.4
August	84	1.1	5.51	10.6
September	78	.9	4.32	8.4
October	68	1.0	3.20	6.2
November	57	1.4	2.18	4.2
December	50	1.5	1.62	3.1
Annual	66	1.6	51.68	100

Piute Dam, Utah (1918–1925) [a]

Month	Temperature of air (°F.)	Wind velocity (miles per hour)	Inches	Per cent of annual
January	26	(3.4)	(0.94)	2.0
February	31	(3.5)	(1.03)	2.2
March	37	(3.8)	(1.79)	3.8
April	44	3.9	4.84	10.4
May	56	3.6	6.08	13.0
June	64	3.4	7.81	16.8
July	71	2.8	7.11	15.2
August	68	2.8	6.31	13.5
September	60	2.9	5.20	11.1
October	47	3.0	3.35	7.2
November	36	2.9	1.44	3.1
December	28	(3.0)	(.80)	1.7
Annual	47	3.2	46.70	100

Yuma evaporation, Ariz. (1917–1925) [a]

Month	Temperature of air (°F.)	Wind velocity (miles per hour)	Inches	Per cent of annual
January	51	1.4	2.14	3.9
February	55	1.7	2.80	5.2
March	59	1.7	3.99	7.4
April	64	1.9	5.10	9.5
May	70	1.4	5.70	10.6
June	79	1.0	6.20	11.5
July	87	1.2	7.20	13.5
August	86	1.6	7.10	13.2
September	80	1.3	5.57	10.3
October	69	1.0	3.77	7.0
November	57	1.1	2.41	4.5
December	53	1.2	1.83	3.4
Annual	68	1.4	53.81	100

[a] Footnote at end of table.

Mean monthly reservoir equivalent for evaporation stations in and adjacent to Colorado River Basin—Continued

Roosevelt Dam, Ariz. (1916–1925) [a]

Month	Temperature of air (°F.)	Wind velocity (miles per hour)	Reservoir equivalent	
			Inches	Per cent of annual
January	48	1.5	1.54	2.7
February	52	1.6	2.17	3.8
March	57	1.9	3.57	6.3
April	64	2.0	5.08	8.9
May	74	2.0	7.14	12.5
June	84	1.8	8.56	15.0
July	87	2.1	8.29	14.5
August	85	1.6	7.05	12.4
September	80	1.5	5.80	10.2
October	67	1.3	3.88	6.8
November	57	1.2	2.44	4.3
December	49	1.3	1.49	2.6
Annual	67	1.6	57.01	100

Agricultural College, N. Mex. (1918–1925) [a]

January	43	2.1	1.98	3.3
February	46	2.8	2.88	4.9
March	51	3.4	5.10	8.6
April	59	3.5	6.37	10.8
May	68	2.3	7.48	12.6
June	77	2.0	7.95	13.5
July	79	2.0	7.42	12.5
August	77	1.5	6.49	11.0
September	71	1.5	5.20	8.8
October	60	1.6	4.04	6.8
November	48	1.8	2.52	4.3
December	40	1.9	1.74	2.9
Annual	60	2.2	59.13	100

Lees Ferry, Ariz. (1922–1925) [a]

January	33	1.4	1.15	2.0
February	43	1.4	2.07	3.5
March	50	2.9	3.84	6.6
April	59	2.8	5.21	8.9
May	72	2.7	7.79	13.2
June	80	2.4	8.72	15.0
July	86	2.1	8.87	15.2
August	81	1.9	7.04	12.1
September	74	1.7	5.76	9.8
October	60	1.9	4.65	8.0
November	47	1.5	1.96	3.4
December	37	1.6	1.32	2.3
Annual	60	2.0	58.38	100

Wilcox, Ariz. (1917–1925) [a]

January	41	3.8	2.25	3.7
February	44	3.9	3.11	5.1
March	48	4.4	5.12	8.4
April	55	4.5	6.67	10.9
May	63	3.5	7.78	12.8
June	72	2.8	8.06	13.2
July	76	2.5	7.02	11.5
August	73	1.8	5.95	9.8
September	69	2.3	5.35	8.7
October	58	2.3	4.44	7.3
November	48	3.0	3.08	5.0
December	41	3.4	2.22	3.6
Annual	57	3.2	61.05	100

[a] Footnote at end of table.

Mean monthly reservoir equivalent for evaporation stations in and adjacent to Colorado River Basin—Continued

Month	Temperature of air (°F.)	Wind velocity (miles per hour)	Reservoir equivalent	
			Inches	Per cent of annual
Deming, N. Mex. (1914–1925) [a]				
January	43		2.60	4.2
February	46		3.12	5.1
March	53		5.48	9.0
April	60		6.78	11.1
May	66		7.39	12.1
June	70		7.97	13.1
July	73		6.03	9.9
August	72		5.42	8.8
September	69		5.42	8.8
October	63		4.84	7.9
November	51		3.49	5.7
December	45		2.66	4.3
Annual	59		61.20	100
Yuma Reservoir, Ariz. (1903) [a]				
January			3.02	4.1
February			3.17	4.2
March			4.80	6.4
April			6.56	8.7
May			8.95	11.9
June			9.33	12.4
July			9.70	12.9
August			9.73	12.8
September			8.24	10.9
October			5.27	7.0
November			3.46	4.6
December			3.08	4.1
Annual			75.39	100
Elephant Butte Dam, N. Mex. (1916–1925) [a]				
January	41	3.9	1.94	2.9
February	47	4.3	2.92	4.4
March	52	5.4	5.30	7.9
April	59	5.7	7.12	10.7
May	69	5.4	8.91	13.4
June	79	4.8	9.30	13.9
July	79	3.9	8.08	12.1
August	78	3.4	7.13	10.7
September	73	3.8	6.11	9.1
October	63	4.7	5.24	7.9
November	50	3.8	2.67	4.0
December	41	3.9	2.02	3.0
Annual	61	4.4	66.74	100

[a] Footnote at end of table.

Mean monthly reservoir equivalent for evaporation stations in and adjacent to Colorado River Basin—Continued

Yuma citrus, Ariz. (1921-1925) [a]

Month	Temperature of air (°F.)	Wind velocity (miles per hour)	Reservoir equivalent	
			Inches	Per cent of annual
January	54	2.0	2.89	3.6
February	60	2.6	4.01	4.9
March	62	3.0	5.51	6.8
April	67	3.5	7.19	8.9
May	77	3.1	9.45	11.6
June	85	3.2	10.63	13.1
July	88	3.4	11.76	14.5
August	90	3.0	10.28	12.6
September	85	2.4	8.00	9.8
October	72	1.8	5.53	6.8
November	62	1.7	3.58	4.4
December	56	1.8	2.45	3.0
Annual	72	2.6	81.28	100

[a] Unpublished records furnished through courtesy of Weather Bureau and Forest Service.

Wagonwheel Gap: Mean of records for 2 class A Weather Bureau stations on near-by slopes, 1 having a northern exposure and the other a southern exposure; coefficient, 0.66.

Provo: On vacant city lot fully exposed. From 1908 to 1916 records taken by pan 3 feet square and 17 inches deep set in ground; coefficient taken as 0.78. Class A Weather Bureau stations installed in 1918; coefficient 0.66.

Myton: Class A Weather Bureau station; coefficient 0.66.

Santa Fe: Records 1913-14 taken by floating pan in reservoir 1 mile west of city; coefficient 0.91. Class A Weather Bureau station established in open space on edge of city in 1916; coefficient 0.66.

Farmington: Floating pan on slough near city; coefficient 0.91.

Piute Dam: Class A Weather Bureau station in Sevier River bottom 8 miles south of Marysvale; coefficient 0.66. Piute Reservoir 500 feet to the south, and Sevier River 200 feet to the southeast.

Yuma evaporation: Class A Weather Bureau station in alfalfa field 1 mile west of Mesa, in Salt River Valley; coefficient 0.66.

Lees Ferry: Class A Weather Bureau station in canyon of Colorado River 10 miles south of Utah line; coefficient 0.66. Walls of canyon 100 and 250 yards distant; river 400 to 600 feet wide and 140 feet distant from pan.

Roosevelt Dam: Class A Weather Bureau station, 1 mile east of dam and south of reservoir, on steep gravelly slope having little or no vegetation; coefficient 0.66.

Wilcox: Class A Weather Bureau station in alfalfa field 3 miles northwest of town, in north-central part of Sulphur Springs Valley, which has nearly level floor 9 miles wide; coefficient 0.66.

Agricultural College: Class A Weather Bureau station on campus near Las Cruces; coefficient 0.66.

Deming: Floating pan in pond of considerable size; coefficient 0.91.

Elephant Butte Dam: Class A Weather Bureau station 200 feet from reservoir near east end of dam, on hill 75 feet above reservoir; coefficient 0.66.

Yuma Reservoir: Floating pan on railroad reservoir in Yuma; coefficient 0.91.

Yuma citrus: Class A Weather Bureau station on barren mesa 8 miles southwest of Yuma and 100 feet higher; coefficient 0.66.

A study of the foregoing table shows for all the stations an average of 50 per cent of the annual evaporation occurring in the 4-month period from June to September; the extremes are 59 per cent at Myton, Utah, and 43 per cent at Wilcox, Ariz.

Mean annual reservoir equivalents of evaporation in and adjacent to Colorado River Basin

[Arranged in order of magnitude]

Station	Number of years of record	Reservoir equivalent (inches)	Temperature of air (°F.)		Wind velocity (miles per hour)		Altitude (feet)
			Pan	Near-by Weather Bureau station	Pan	Near-by Weather Bureau station	
Wagonwheel Gap, Colo	5	21.77	35		2.0		9,610
Provo, Utah	17	28.64	49		1.2		4,650
Lander, Wyo.[a]		31.80		42			5,372
Myton, Utah	8	39.85	46		3.0		5,030
Santa Fe, N. Mex	12	44.42	49	49	2.7	7.1	7,010
Farmington, N. Mex	10	46.10	55				5,300
Piute Dam, Utah	8	46.70	47		3.2		5,900
Mesa, Ariz	9	51.68	66	69	1.6	5.2	1,225
Yuma evaporation, Ariz	9	53.81	68	72	1.4	5.4	127
Roosevelt Dam, Ariz	10	57.01	67	69	1.6	5.2	2,175
Lees Ferry, Ariz	4	58.38	60		2.0		3,140
Agricultural College, N. Mex	7	59.13	60	60	2.2	7.5	3,683
Wilcox, Ariz	8	61.05	57		3.2		4,190
Deming, N. Mex	10	61.20	59				4,300
Elephant Butte Dam, N. Mex	10	66.74	61		4.4		4,265
Yuma Reservoir, Ariz	1	75.39					127
Yuma citrus, Ariz	5	81.28	72	72	2.6		220

[a] Lander records computed by Dalton-Meyer formula; description of computations and monthly values iven in Follansbee, Robert, Surface waters of Wyoming and their utilization: U. S. Geol. Survey Water-gupply Paper 469, pp. 323 et seq., 1923.

NOTE.—Records of temperature and wind velocity at near-by Weather Bureau stations where available are presented for comparison with the records taken close to the evaporation pans.

FACTORS INFLUENCING RATE OF EVAPORATION

The rate of evaporation is governed by the difference between the vapor pressure of the water surface and that of the air adjacent to it. For any given temperature the difference in vapor pressures is dependent upon the relative humidity or percentage of possible saturation of the air. The greater the relative humidity the nearer to saturation is the vapor in the air, the nearer its pressure approaches the vapor pressure of the water surface, which is at the saturation point, and the less the rapidity with which the water particles are given off into the air as evaporation. An increase in temperature decreases the vapor pressure of the air and increases that of the water surface. This increase in difference of pressure increases the rate of evaporation. If the air is still, a blanket of vapor is soon formed after evaporation begins, and as this blanket increases the humidity of the air the rate of evaporation decreases. If, on the other hand, the wind is blowing, it carries away the vapor blanket, replacing it with drier air, which keeps down the relative humidity of the air, and the original rate of evaporation is more nearly maintained. Any increase in wind velocity beyond that necessary to keep the air dry above the water surface does not affect the rate of evaporation except that the formation of waves may throw spray into the air and thus increase evaporation slightly.

COMPARISON OF RECORDS

From the foregoing discussion it is evident that the chief factors influencing the difference in vapor pressure of the air and water surface are relative humidity, temperature, and wind velocity. These three factors are so interdependent that it is impossible to compare, with any considerable degree of accuracy, the evaporation at different points on the basis of a single factor.

The combined effect of relative humidity and wind velocity is shown by the records of the Yuma evaporation and Yuma citrus stations, the mean annual temperatures for which differ by only 4°. Although actual records of relative humidity are not available, it is known that the humidity must be considerably higher at the evaporation station than at the citrus station, as the former is in an alfalfa field and the latter on a barren mesa where the absence of vegetation and a wind velocity 85 per cent greater than at the evaporation station must cause low relative humidity. The effect of the difference in humidity and wind velocity is shown by the difference in recorded evaporation (reduced to reservoir equivalent), which amounts to 53.8 inches and 81.3 inches, respectively.

The evaporation at the higher altitudes is influenced greatly by the slope on which the records are taken. The records for Wagonwheel Gap (altitude 9,610 feet) are the combined results of measurements made on a slope having a northern exposure and one having a southern exposure. The former receives the direct rays of the sun for a shorter period than the latter, and the resulting difference in temperature and relative humidity is strikingly shown by the evaporation on the two slopes during the period from June to October, in which it is possible to measure evaporation without interference from freezing. The following table shows the mean monthly figures, each covering five years' records, for the two slopes:

Evaporation (reservoir equivalent) on slopes of northern and southern exposure a Wagonwheel Gap, Colo.

Month	Reservoir equivalent (inches)	
	Northern exposure	Southern exposure
June	2.91	3.82
July	2.39	3.69
August	1.59	3.12
September	1.23	2.96
October	.45	1.89
	8.57	15.48

Reservoirs of any considerable size at the higher altitudes are usually surrounded by slopes of both exposures, and the evaporation from the water surface will approximate the mean of the figures for the two slopes.

VARIATION IN ANNUAL EVAPORATION

In the arid Southwest the factors influencing evaporation for any particular month have a relatively small variation from year to year, and this causes a small variation in the total evaporation for each year. The following table shows the percentage of mean evaporation measured each year at Farmington, N. Mex., and Mesa, Ariz.:

Annual evaporation at Farmington, N. Mex., and Mesa, Ariz., 1915–1925

Year	Farmington		Mesa	
	Inches	Per cent of mean	Inches	Per cent of mean
1915	39.11	87		
1916	43.34	96		
1917	45.69	101	44.21	86
1918	44.18	98	51.52	100
1919	48.57	108	51.86	101
1920	45.01	100	54.76	106
1921	45.58	101	58.63	114
1922	47.21	105	51.27	99
1923	47.04	104	52.85	103
1924	51.71	112	54.97	106
1925	52.62	114	46.13	89

IRRIGATION AND AGRICULTURE

GENERAL CONDITIONS

IRRIGATION

Nearly all of the Green River Basin lies within the portion of the United States commonly known as the arid region, where irrigation is necessary to the successful production of diversified agricultural crops. The length of the growing season in the basin is sufficient for only a moderate number of crops. Accordingly agricultural development has been slow, and its expansion must await such future time as the demand for the crops that can be grown successfully will make further development economically feasible.

Irrigation in this basin apparently had its beginning in 1854, when some Mormon immigrants established a supply station above old Fort Bridger, in southwestern Wyoming, built a flour mill, and took some ditches out of Blacks Fork to irrigate adjacent lands. Twelve years later the first Federal legislation was passed by Congress, recognizing all rights, by priority of possession, to the use of water for mining, agricultural, manufacturing, or other purposes whenever "the same are recognized and acknowledged by local customs, laws, and the decisions of courts." A few years later the "desert-land act" was passed, providing that title to 640 acres of arid land could be procured by conducting water upon and reclaiming the land within three years from the filing of a declaration statement and by paying $1.25 an acre.

This law offered some encouragement to the individual settler, but after Maj. John W. Powell, formerly Director of the Geological Survey, had made some study of the irrigation problems incident to redeeming the arid lands he recognized clearly and reported definitely in 1879 that the subject was one which should be considered by the Federal Government. From year to year this subject attracted more and more attention, and a thorough investigation of the water resources of the arid region was authorized by a joint resolution of Congress in March, 1888. In October of the same year an appropriation of $100,000 was made for the purpose of investigating the extent to which the arid lands could be irrigated, "the work to be performed by the Geological Survey under the direction of the Secretary of the Interior."

From about this time into the early nineties many large irrigation enterprises were undertaken by promoters who hoped to make big profits from the increased land values created by irrigation. This enthusiasm was not tempered with the proper amount of reason, and the settlers were not always appraised of the conditions to be met. Consequently, many of the projects were failures, and a period of inactivity followed this boom.

In 1894 Congress passed the Carey Act, "to aid the public-land States in the reclamation of the desert lands therein." It provided for granting to each of the States containing desert land not exceeding 1,000,000 acres of such land under the condition that the State should cause it to be irrigated, reclaimed, and occupied, with not less than 20 acres of each 160-acre tract cultivated by actual settlers, within 10 years after the passage of the act. This time, however, was extended by an amendment to 10 years from the date of segregation of the lands. In 1908 it was again amended so as to grant additional areas to several States, including 1,000,000 acres to Wyoming. The States were required to file maps showing the proposed mode of irrigation and the source of water supply. Upon approval of these maps and plans by the Department of the Interior the lands applied for were segregated and reserved from entry. Although this act was not used to any considerable extent until several years after its passage, its terms were accepted by Colorado and Wyoming in 1895 and by Utah in 1897, and at the end of June, 1905, Colorado had made applications for the segregation of 43,530 acres, Utah for 236,457 acres, and Wyoming for 529,266 acres. The period from 1905 to 1910 witnessed considerable activity under this act, and the total area applied for by Colorado, Utah, and Wyoming was increased to 728,881, 410,246, and 1,371,153 acres, respectively. None of these lands, however, had gone to patent at the end of June, 1910, except 92,229 acres in Wyoming. The conditions as of June 30, 1926, are shown in the following table:

Summary of activities under the Carey Act in Colorado, Utah, and Wyoming

State	Area applied for to June 30, 1926 (acres)	Area segregated to June 30, 1926 (acres)	Area patented to June 30, 1926 (acres)	Per cent of area segregated that had passed to patent June 30, 1926	Area irrigated under Carey Act projects, 1919 (acres)	Area Carey Act projects were capable of irrigating, 1919 (acres)
Colorado	460, 431	284, 654	37, 706	13. 2	2, 430	15, 000
Utah	606, 704	141, 815	37, 240	26. 2	16, 000	35, 000
Wyoming	1, 772, 244	1, 413, 967	200, 709	14. 1	36, 230	72, 215
	2, 839, 379	1, 840, 436	275, 655	14. 9	54, 660	122, 215

This table shows that only about 15 per cent of all the lands segregated under the Carey Act in these three States had passed to patent by June 30, 1926, 32 years from the time the act had been placed on the statute books. Furthermore, less than 20 per cent of all these patented lands and less than 3 per cent of the segregated lands were irrigated in 1919, although many irrigation projects were initiated under this act, especially during the decade 1900 to 1910. Some of them had real merit, but most of them apparently were lacking in some of the essential features for economically sound projects. Irrigation securities became generally unmarketable, and irrigation development dropped into a status of comparative inactivity, from which it has not yet fully recovered.

The rate of growth of irrigation development in the States of Colorado, Utah, and Wyoming and the relation of the irrigated area in the Green River Basin to the total irrigated area in these States are shown in the table below.

Irrigation in Colorado, Utah, and Wyoming and in the Green River Basin

[Data from reports of U. S. Census Bureau, U. S. Bureau of Reclamation, State engineer's reports, and miscellaneous sources]

State	Total in States						
	Area irrigated (acres)				Increase in area irrigated (acres)		
	1889	1899	1909	1919	1889–1899	1899–1909	1909–1919
Colorado	809, 735	1, 611, 271	2, 792, 032	3, 348, 385	801, 536	1, 180, 761	556, 353
Utah	263, 473	629, 293	999, 410	1, 371, 651	365, 820	370, 117	372, 241
Wyoming	229, 676	605, 878	1, 133, 302	1, 207, 982	376, 202	527, 424	74, 680
	1, 302, 884	2, 846, 442	4, 924, 744	5, 928, 018	1, 543, 558	2, 078, 302	1, 003, 274

State	Green River Basin					
	Area irrigated (acres)			Approximate per cent of total irrigated area in State	Estimated, additional irrigable lands (acres)	Estimated total ultimate irrigated area (acres)
	1902	1921	Increase for period			
Colorado	82, 451	[a] 124, 500	42, 049	4	342, 900	467, 400
Utah	53, 934	293, 000	[b] 239, 066	21	267, 400	560, 400
Wyoming	118, 566	[c] 235, 000	116, 434	20	520, 000	755, 000
	254, 951	652, 500	397, 549	7	1, 130, 300	1, 782, 800

[a] Conditions in 1926 not materially different from those in 1921.
[b] This great increase due to opening of Uinta Indian Reservation in 1905.
[c] Estimate of U. S. Bureau of Reclamation for 1922; not materially different from conditions in 1921.

Several interesting facts are disclosed by this table. The greatest irrigation development in the three States as a whole occurred during the period from 1899 to 1909. The rate of increase in Utah has been remarkably uniform for the period shown, but the increase in Colorado dropped during the period 1909 to 1919 to about one-half of the amount for the period 1899 to 1909, and that in Wyoming dropped to about one-seventh.

AGRICULTURE

Agriculture in the Green River Basin is almost wholly dependent upon irrigation, and for this reason the same factors that limit the development of irrigation limit the development of agriculture. Some experiments with dry farming have been tried in the most likely localities, but these have met with only a slight degree of success.

The agriculture development in this basin has lagged behind the development in other parts of Colorado, Utah, and Wyoming because of less favorable climate and lack of transportation facilities. Very few data are available to show exactly what the rate and success of this development have been, but it is believed that some of the general agricultural statistics of the three States should prove of interest here in indicating the growth and status of this industry, and thus furnish a basis for an opinion as to what might be expected within the Green River Basin.

It is illuminating to note some of the things shown by the following tables. For instance, the farm population of these States in which the Green River Basin lies is only 28.2 to 34.5 per cent of the total population. In Colorado 36.9 per cent of the total land area is in farms, and only 31.7 per cent of this area is improved; in Utah 9.6 per cent of the area is in farms, and 34 per cent of it is improved; and in Wyoming 18.9 per cent of the total area is in farms, and 17.8 per cent of it is improved. In other words, improved farm land constitutes a little more than 10 per cent of the area of Colorado and a little more than 3 per cent of the area of Utah and Wyoming.

From the following table the rate of increase in the number of farms for several decades prior to 1920 is readily obtained. The relative average value per acre of all farm property is shown for the same periods, and the average in the Green River Basin is in general below that throughout the three States.

Farms and farm property in Colorado, Utah, and Wyoming, 1850–1920

[From U. S. Census, 1920]

Year	Number of of farms	Average area per farm (acres)		Average value per acre (all farm property
		All land	Improved land	
COLORADO				
1870	1,738	184.3	55.0	$16.31
1880	4,506	258.6	136.7	36.03
1890	16,389	280.6	111.3	25.54
1900	24,700	383.6	92.1	17.00
1910	46,170	293.1	93.2	36.32
1920	59,934	408.1	129.2	44.02
UTAH				
1850	926	50.6	17.6	20.13
1860	3,635	24.7	21.2	34.40
1870	4,908	30.2	24.2	25.55
1880	9,452	69.4	44.0	29.49
1890	10,517	125.9	52.1	29.83
1900	19,387	212.4	53.2	18.26
1910	21,676	156.7	63.1	44.38
1920	25,662	196.8	66.8	61.63
WYOMING				
1870	175	24.8	1.9	85.82
1880	457	272.3	181.9	81.28
1890	3,125	585.7	152.6	18.45
1900	6,095	1,333.0	130.0	8.31
1910	10,987	777.6	114.3	19.57
1920	15,748	749.9	133.5	28.32

The next table is given for the purpose of pointing out to what extent the farmers are self-supporting in food production and emphasizing the necessity of encouraging manufacturing and other industries which are correlative with agriculture.

The average value per acre of farm land and buildings in the Green River Basin in 1920 was as follows:

Colorado:
- Yampa River Basin .... Less than $25
- White River Basin .... $25–$50

Utah:
- Uinta Basin and lower Green River Basin .... $25–$50
- North side of Uinta Mountains .... Less than $25

Wyoming:
- Sweetwater and Uinta Counties .... Less than $25
- Remainder of basin .... $25–$50

Source of farmers' food supplies in Green River Basin region, 1922

[Percentages]

	Mountain region [a]	Colorado	Utah	Wyoming
Produced on farm	52.2	48.9	64.6	49.6
Produced in locality but not on farm (not brought in by railroad)	12.5	14.8	13.8	6.6
Not produced in locality and can not be replaced by local products	25.6	26.9	14.1	30.6
Not produced locally but might be	9.7	9.4	7.5	13.2
	100	100	100	100

[a] Montana, Wyoming, Colorado, New Mexico, Arizona, Utah, Nevada, Idaho.

Some of the products mentioned for greater local production are listed below, with the possible percentages of increase.

Fruits	10.4	Meats	10.1
Vegetables (general)	9.8	Butter	5
Food cereals	7.1	Cheese	8.5
Wheat (flour)	12.2	Sugar	7.6
Canned goods	8.8		

It is no doubt surprising to many to note that only 52.2 per cent of the farmers' food supply in the mountain region is produced on the farms. This might be increased by 9.7 per cent, but even then there is still 38.1 per cent that must be either manufactured in the locality or imported.

PRESENT DEVELOPMENT AND FUTURE POSSIBILITIES

UPPER GREEN RIVER BASIN

Although irrigation in the upper Green River Basin had its beginning as early as 1854, the progress since that time has been very slow, especially in that part of the basin north of the city of Green River. The State engineer of Wyoming in his report of 1894 says: "A description of irrigation along the Green River and its tributaries is chiefly striking for the showing it makes of the opportunities which are unused rather than the value and importance of what has been accomplished."

From 1894 to 1900 the State engineer issued 189 ditch and canal permits to irrigate 62,343 acres, chiefly for hay and grass pasture along the bottom lands of the streams. The rigorous climate of the basin made it necessary for the early irrigators to do some experimenting with different kinds of crops, in order to determine just what might be raised successfully. The native grasses were first replaced to some extent with redtop and timothy, both of which added to the quality of the hay produced. In the extreme northern part of the basin frost is not uncommon any month of the year, and the maximum growing season rarely exceeds 75 days. Accordingly hay is practically the only crop produced. In that part of the basin lying below an altitude of 7,000 feet there are fewer years during which killing frost is experienced each month, and the normal growing season is from 60 to 115 days. Here alfalfa, wheat, oats, field peas, potatoes, and hardy garden vegetables are grown with moderate success.

Present irrigation in the basin is nearly all done by small individual ditches built by range stockmen along the bottom lands of the streams to raise winter feed for the livestock. More than 90 per cent of these lands are devoted to hay and have never been leveled or cultivated. The crop yields are very low, and the practice in the use of the water is somewhat extravagant. However, this practice seems to meet the peculiar requirements of the stockmen, because operating costs are low and little personal attention is required. The land holdings in general are large and were mostly acquired and developed at low cost. This fact, combined with the opportunities afforded by vast areas of free range near by, has enabled comparatively few owners to control the development of the basin.

After opportunities to extend the development of these bottom lands had been exhausted, attention was directed toward the irrigation of the adjacent bench lands. It was soon found, however, that the costs involved in these enterprises so greatly exceeded those

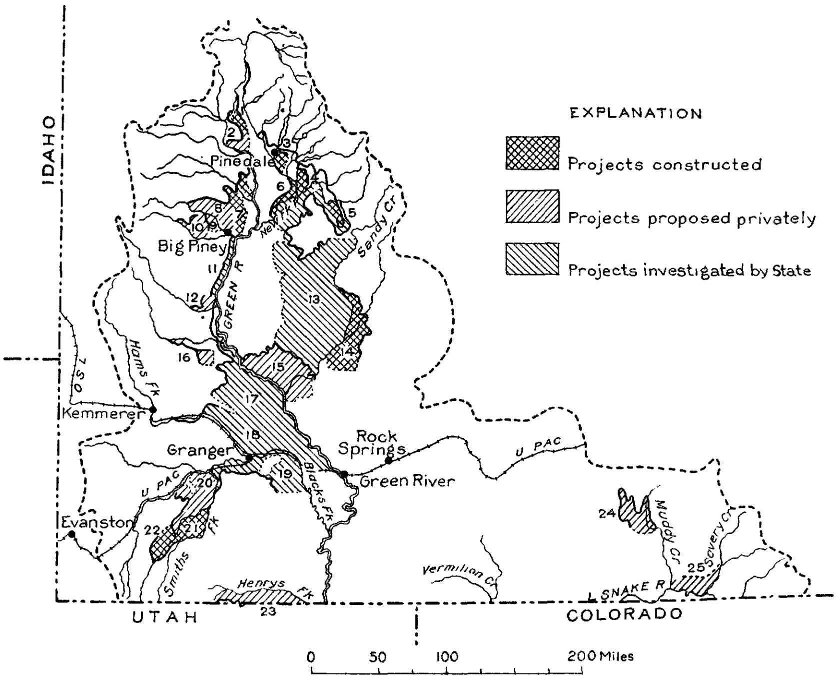


FIGURE 24.—Map of Green River Basin in Wyoming showing principal irrigation projects. For explanation of numbers see table on page 175

involved in irrigating the bottom lands that a higher type of cultivation and larger acreage return from crops were necessary to make the projects financially successful. These requirements, of course, can be met only to an extent limited by the adverse climatic conditions, and as a result development on such projects has been extremely slow and is now practically at a standstill. At first this bench-land development was undertaken by corporate enterprises and later as Carey Act projects, but the results generally have been disappointing. The present status of the active Carey Act projects is shown in the following table (see also fig. 24):

Status of active Carey Act projects in upper Green River Basin, 1928

Project (see fig. 24)	Area (acres)	Status
1. Apex	3,800	Built. Nearly all land irrigated.
2. Uinta-Fremont	13,976	No construction work done.
3. Highland Canal (Fremont Lake)	5,800	Built. Part of land patented.
4. Boulder	6,000	Built. Most of land patented.
5. East Fork	4,900	Built. Patent for lands applied for.
6. Paradise Canal	4,000	Construction work about half done.
7. Cottonwood	18,000	Partly constructed.
8. North Piney	3,229	Built. Patent for land pending.
9. Sixty-seven Reservoir	2,160	Built.
10. Tepee Canal	15,378	Carey application rejected on account of water supply.
11. Big Piney-Labarge	13,361	No construction work done.
12. Labarge	4,067	Carey application rejected.
13. Bonneville	312,000	No construction work done.
14. Eden	43,000	Constructed for 28,000 acres. Mostly patented.
15. Green River	75,257	No construction work done.
16. Fontenelle	4,010	Do.
17. Seedskadee	180,000	Do.
18. Opal	125,000	Do.
19. Church Buttes	95,000	Do.
20. Uinta	41,084	Some construction work done.
21. Blacks Fork	19,552	Built. Lands irrigated.
22. Pine Grove	5,000	Do.
23. Antelope	38,199	No construction work done.
24. Washakie (Big Bend)	33,136	Carey application rejected on account of water supply.
25. Savery Creek		Lands not yet designated.
26. Canyon	5,257	Some work done on project northwest of Cora.

The principal irrigated areas in the basin may be segregated as to general location and classified as to kind of development about as follows:

	Acres
Above Green River, Wyo:	
Irrigation projects	20,000
Small ditches	120,000
	140,000
Hams Fork: Small ditches	12,000
Blacks Fork:	
Lyman Canals	31,000
Small ditches	29,000
	60,000
Henrys Fork: Small ditches	8,000
Little Snake River: Small ditches	15,000
Grand total	235,000

In this area as a whole the crop yields are low. Census figures show the average yield of alfalfa to be slightly more than 1 ton to the acre and native hay 0.8 ton to the acre, with variations from these figures according to the climatic conditions. Oats and wheat are produced in the more favorably located areas.

The quality of the land is also an influential factor in the crop yields. In the northern part of the basin the soil is very gravelly. In other places it ranges from sandy to heavy clay. The stream bottoms are mostly dark-colored clay or clay loam, with considerable sand in a few places. Alkali is scattered in patches over the entire basin, and areas of bad lands are not uncommon.

In the Blacks Fork district irrigation and cultivation have been more intensive than in other parts of the basin, and accordingly the natural summer flow of these streams is overappropriated. This condition is felt seriously in the years of low run-off and has incited a keen interest in building reservoirs to control some of the spring floods that run to waste each year. The same condition exists to a lesser extent along Hams Fork, but in that part of the basin above the town of Green River the water supply is plentiful except in a few places along the small tributary streams.

Dry farming has made no progress in the basin because of insufficient precipitation at the lower altitudes, where the length of the growing season will permit the maturing of grains, and the shortness of the growing season at the higher altitudes, where there is sufficient precipitation.

The undeveloped irrigation possibilities have been the subject of considerable study and investigation for more than 25 years. Extensive systems have been proposed as private enterprises, as Carey Act projects, or as public enterprises to be developed by either the State or the Federal Government or cooperatively by these two agencies. The most comprehensive investigation, no doubt, was made in 1915, by the United States Bureau of Reclamation and the State of Wyoming, each of which paid one-half of the expenses incurred. A cooperative report covering the work done under this agreement was submitted to a board of review, which indorsed the conclusions and recommendations of the report and made further conclusions and recommendations regarding the policies that should govern the agricultural development of this territory. Among the conclusions reached by this board the following are none the less relevant to-day.

Immediate future development must primarily be the reclamation and settlement of the choice selection of bench lands. Viewed in the light of present economic and industrial conditions in the district considered, those are the lands whose reclamation appears most feasible from a commercial standpoint.

Ultimate future development can not be more than mere conjecture at this time. * * *

Unaided settlement on irrigated bench lands in this region has been a practical failure, despite low construction costs and favorable physical conditions generally surrounding projects. Better results in the future, under existing methods, can not be expected.

Some questions arose regarding certain project areas outlined in this cooperative report, and in 1918 a further reconnaissance was made by the Bureau of Reclamation; then the State was not satisfied with the data given out regarding the irrigable area in the Bonneville project, and further investigation of this project was made by the State engineer during the summer of 1922. The results of all these investigations may be summarized in the statement that the run-off from the streams in the upper Green River Basin is not sufficient to irrigate all the available lands; it is physically impossible, because of a lack of reservoir sites at the necessary places, to utilize all this run-off for irrigation; and the future irrigation development will be limited by the available water supply that can be maintained throughout the irrigation season at the proposed projects.

The present irrigation practice in the basin indicates that water is diverted for the land in about the following amounts per acre throughout the irrigation season:

	Acre-feet
May 15–31	0.25
June	.93
July	.92
August	.40
Total	2.50

It is estimated that of this total amount, 1.1 to 1.5 acre-feet is actually consumed and that the remainder finds its way back into the stream as return flow. The annual flow of the Green River at Flaming Gorge may thus eventually be depleted by 1.5 acre-feet for every additional acre that is brought under irrigation in the upper Green River Basin. Conservative estimates of the additional irrigable lands, based upon the controllable water supply, place the area at about 520,000 acres, and this is classified as to principal drainage basins in the table below. Of this area 508,000 acres would be irrigated with water that now flows in the Green River at Flaming Gorge, and in the event that all this area is irrigated, as well as the present irrigated area, the annual run-off of the river at Flaming Gorge will be reduced from its present amount by not more than 762,000 acre-feet or approximately 38 per cent.

Irrigated and irrigable land in Green River Basin in Wyoming, in acres

Drainage basin	Irrigated areas			Estimated additional irrigable area	Estimated ultimate irrigated area
	1902 [a]	1919 [a]	1922 [b]		
Green River and tributaries above town of Green River	66,251	123,770	140,000	404,000	544,000
Blacks Fork	28,139	65,980	60,000	47,000	107,000
Hams Fork	(c)	(c)	12,000	45,000	57,000
Henrys Fork	6,813	8,290	8,000	12,000	20,000
Little Snake River	17,363	13,460	15,000	12,000	27,000
	118,566	211,500	235,000	520,000	755,000

[a] U. S. Census.
[b] U. S. Bureau of Reclamation. Present irrigated areas not appreciably different from areas in 1922.
[c] Included in Blacks Fork areas.

NOTE.—Detailed data regarding the projects that include the irrigable areas here shown may be obtained from the biennial reports of the Wyoming State Engineer, the Commissioner of Public Lands and Farm Loans of Wyoming, 67th Cong., 2d sess., S. Doc. 142, and the U. S. Bureau of Reclamation. Most of the areas are covered by Carey Act projects. (See general map in pocket of this report.)

YAMPA AND WHITE RIVER BASINS

In general the basins of the Yampa and White Rivers are hilly and broken, containing only a small amount of tillable land. The valleys in the upper portions of the basins are comparatively small, and along the main streams they are very narrow. Thus the irrigated lands and those that might be irrigated at a reasonable cost, are limited to narrow strips of bottom lands on the principal streams. The widest of these bottoms occur at Meeker, on the White River, and at Craig, Hayden, and Sidney, on the Yampa River, and range from about 3 to 5 miles in width. Extensive fertile mesa lands lie in scattered tracts back from these valleys and the canyons of the streams, but, as they are high above the streams and beyond rough valley walls, diversion of water onto them is generally difficult and expensive.

The altitude of the irrigable land ranges from 5,000 to 8,000 feet above sea level, but most of it lies between 6,000 and 7,000 feet. Over the greater part of the area irrigation is necessary for the successful production of crops, especially in the western two-thirds, where the annual precipitation averages less than 14 inches. Dry farming has been tried extensively. In general the results have been disappointing in the western portions of the basins; to the east, there is more rainfall, and grain cereals are successfully produced up to altitudes approaching 7,500 feet, but above this altitude frost is likely to damage grain crops before they are matured and the dry-farming practice is therefore confined mainly to raising forage. Yields of forage crops average more than 1 ton to the acre. On the lands where grains can be raised by dry farming, wheat crops average about 12½ bushels and oats and barley about 20 bushels to the acre.

The principal limit to the production of irrigated crops lies in the length of the growing season. At Rangely, in the White River Basin, at an altitude of 5,050 feet, this is about four months, or sufficient for growing all common crops, including some fruits such as apples and plums. At Meeker, farther up on the White River, at 6,177 feet, and at Craig, 6,102 feet, and Hayden, 6,337 feet, both on the Yampa River, the growing season averages about one month less than at Rangely. Here the successful crops are alfalfa, wheat, oats, and barley. Alfalfa produces two cuttings that yield a total of 3 tons to the acre, wheat yields are about 25 bushels to the acre, oats 50 bushels, and barley a little less than the oats.

The growing season shortens as the altitude increases. Toward the heads of the valleys above Meeker on the White River and Hayden on the Yampa River the growing season rapidly shortens until at altitudes above 6,500 feet the average frost-free period is not much more than two months. Accordingly, the irrigated crops are limited to wild hay, timothy, and clover, although in the Yampa Basin in the vicinity of Steamboat Springs and Yampa strawberries and lettuce are important cash crops.

The soils in these basins are generally fertile and of excellent quality. The stream bottom lands are made up of alluvium—silt loam in the upper valleys and clay loam in the lower valleys. The clay soils are rather heavy in texture and contain in places noticeable amounts of alkaline salts. In the upper valleys the upland soils are largely easily tilled sandy loams of good depth and fertility. In the lower valleys, however, they are clayish, more difficult to till, and less productive.

In these basins there is so much noncultivable pasture and range land supporting a good growth of native forage that the entire region is exceptionally well adapted for the raising of livestock. This fact, together with the additional fact that general farming is not profitable because of adverse climatic conditions and lack of cheap transportation facilities, limits the raising of crops to those which can be profitably marketed locally and principally to those incident to the livestock industry.

Irrigation in these basins had its beginning in the early eighties, when the first settlements were made there. Since that time about 135,000 acres has been put under irrigation, and the capital invested in irrigation enterprises is about $1,400,000. There are no long canals or expensive structures in these enterprises. Most of the ditches are small, the average carrying capacity being about 6 second-feet, and these are owned and maintained by their individual users. Some studies of the information available regarding the present irrigation practice in these basins indicate that from 1.75 to 5 acre-feet of water to the acre is diverted annually into the ditches. It has been estimated by the United States Bureau of Reclamation that the consumptive use ranges from 1.75 acre-feet to the acre in the low-lying valleys near the Utah State line to 1 acre-foot to the acre for the high mesa lands, the average being about 1.38 acre-feet to the acre. The water supply for the lands under irrigation is usually more than ample and is often referred to as being the most abundant in the State.

Irrigation development has been very slow in this region and has virtually been at a standstill since 1912. A rather unprecedented growth, however, was made from 1908 to 1912, when considerable activity in irrigation development was exhibited throughout the West. At that time several extensive systems were surveyed in these basins, covering large areas of attractive mesa lands, but in general the results of these surveys were disappointing, for they revealed the fact that large stretches of rough country would have to be crossed by canal lines before reaching the irrigable areas, and the cost of getting the water to the land would be greater than the economic benefits to be derived.

During the period 1905 to 1915 nine Carey Act projects were outlined, involving a total area of about 458,500 acres. Two of these projects apparently covered the same lands in the Vermilion Creek Basin, about 28,000 acres, and the others covered lands in the White and Yampa River Basins. None of these Carey Act projects have yet been built, and the only outstanding area now withdrawn is in the drainage basin of Fourmile Creek north of Craig, near the Colorado-Wyoming line. This condition indicates that there has been no economic demand for the agricultural products that can be raised in these basins that would justify the building of these projects, and until such demand arises they will remain infeasible.

Other projects were proposed by the United States Bureau of Reclamation, based upon filings of projects made with the State engineer of Colorado and upon field examinations and unpublished reports by Reclamation Bureau engineers at different times since 1904. Nearly all of these are modifications and extensions of the Carey Act projects and involve a total area of about 515,000 acres, of which about 27,000 acres lies in Wyoming and 60,000 acres in Utah. Numerous data pertaining to these projects were published in 1922 in Senate Document 142, Sixty-seventh Congress, second session, but subsequently more extensive studies were made by the Bureau of Reclamation of the available water supply for these projects, and revisions were made in the project areas accordingly. An agreement was also made between the Bureau of Reclamation and the State of Utah for a complete investigation to be made of the lower White River project, commonly known as the Deadman Bench project. This investigation was made during the later part of 1922, and three different plans for developing the project were investigated in detail.

Plan A proposed the use of water from the White River for irrigating with 172 miles of main canal 44,400 acres in Utah and 33,200 acres in Colorado.

Plan B proposed the use of water from the Yampa River. Storage was to be provided at the Juniper reservoir site, and a canal extended down each side of the river to Cross Mountain, where by means of two tunnels with a total length of about 7 miles the south-side canal was projected through the divide into the White River drainage basin and thence westward to the lands to be irrigated. The length of the main canal would be 154 miles, and the areas to be irrigated included 44,400 acres in Utah and 41,100 acres in Colorado.

Plan C differed from plan B in that the north-side canal instead of the south-side canal was projected around the north end of Cross Mountain and then extended southward across the river and through the divide to the lands covered in plan B. The length of the main canal would be 159 miles, and the areas to be irrigated amounted to 44,400 acres in Utah and 37,600 acres in Colorado. Plans B and C contemplate storage of about 142,000 acre-feet in the proposed Juniper reservoir.

The cost per acre for the building of this project as determined by this investigation is as follows: Plan A, $312, exclusive of reservoirs; plan B, $225, and plan C, $293, both including storage. On account of these high costs the project was considered to be infeasible.

Engineering investigations of many other irrigation projects have yielded field surveys of more than 300 reservoir sites having a capacity of 100 acre-feet or less and many of greater capacity. About 80 reservoirs have been constructed, ranging in capacity from 3 to about 1,200 acre-feet, but these are mostly small enterprises to irrigate lands of the individual owners. Practically all the other irrigation projects have been abandoned from time to time as the wave of enthusiasm for irrigation development gradually died out and facts ascertained relative to stream run-off and climate indicated that the projects were either physically impossible or economically unsound. The year 1909 witnessed somewhat of an epidemic of irrigation enthusiasm in this region, and many investigations were made of reservoir sites, canal lines, and land areas. All possible irrigation projects seem to have been surveyed, but after analysis of water supply, climate, and economic feasibility, they were abandoned. Similar work, though less extensive, had been done in 1906 and 1908, and it continued with 1909 as the peak year through 1910 and 1913. Then a lull came, and practically nothing has been done in this line since that time.

In the meantime much of the land that was included in these projects has been taken up by settlers and devoted to dry farming, which has been found to be encouragingly successful over that part of the Yampa Basin east of Craig. As a matter of fact it seems to have precluded the need of several of the proposed irrigation projects, because crops are produced on the lands without the building and maintenance of irrigation systems. The extent of this dry-farming activity as compared to that of irrigation is indicated by the fact that the area in dry farms is at least half as much as that under irrigation.

Irrigated and irrigable land in Green River Basin in Colorado, in acres

Drainage basin	Irrigated area			Estimated additional irrigable area	Estimated ultimate irrigated area
	1902 [a]	1919 [a]	1926		
Green River direct	(b)	(b)	Negligible.		
Small tributaries of Green River	(b)	180	800	[c] 900	1,700
Yampa River direct	(b)	18,030	22,600	[d] 255,000 (both Yampa rows)	349,900
Yampa River tributaries	(b)	50,170	72,300		
White River and tributaries	22,752	25,620	28,800	[d] 87,000	115,800
	82,450	94,000	124,500	342,900	467,400

[a] U. S. Bureau of the Census.
[b] No segregation made for 1902 census; included in total.
[c] Chase, B. T., State irrigation division engineer, division 6.
[d] U. S. Bureau of Reclamation unpublished reports.

UINTA BASIN IN UTAH

Most of the agricultural land in the Uinta Basin is less than 6,000 feet above sea level. In a few places there is sufficient rainfall for the production of small grains, but in these places the growing season is short. Accordingly, attempts at dry farming have met with little success, and irrigation is necessary to produce successful crops,

Agricultural development began in 1873, when a few families of emigrants found their way into Ashley Valley from Salt Lake City. The first settlement was made at Ashley, near the present town of Maeser, and the waters of Ashley Creek were used for irrigation as well as all domestic purposes. Development was restricted for many years to Ashley Valley, because virtually all of the basin of the Duchesne River and tributaries was set aside by Executive order of October 3, 1862, as an Indian reservation for some of the Ute tribes. Later the Uncompahgres, who were originally located on the Colorado, were removed to the Uinta Basin and located along the White River. The act of May 27, 1902, provided for the allotment of reservation lands to the Indians and the restoration of the unallotted lands to the public domain. The act of March 3, 1905, set the date of opening the reservation not later than September 1, 1905. A commission was appointed to allot the lands, and a total of 103,265 acres was alloted in 40 and 80 acre tracts. In making these allotments an attempt was made by the commission to reserve for the Indians the best agricultural lands, and as a result the allotments were mixed up with less desirable tracts without any apparent appreciation of the problems that have subsequently arisen in connection with their irrigation and the joint use of canals by the Indians and homesteaders.

The unallotted lands were opened to settlement on August 28, 1905, and immediately there was a rush of homesteaders to acquire title to the most desirable lands. At that time the Indians had about 6,000 acres under cultivation, and some 2,000 acres had already been irrigated, making a total of 8,000 acres which had acquired a water right apparently through beneficial use. In Ashley Valley about 17,500 acres was under irrigation.[57]

In order to irrigate the lands allotted to the Indians an extensive irrigation system was built and is operated by the United States Office of Indian Affairs. In the meantime other enterprises were built to irrigate the lands taken up by homesteaders, and it was not many years until the acreage under ditch was more than the natural flow of the streams would properly irrigate. Naturally, controversies arose as to water rights. An agreement was finally reached between the Federal Government and the other water users, whereby

[57] U. S. Bur. Reclamation Third Ann. Rept., pp. 593–594, 1905.

the streams involved in controversy are administered by a water commissioner appointed by the Federal district court. During years of high run-off the work of this commissioner is not difficult, but in years when the water supply will barely go round it becomes a perplexing task, especially if he attempts to have the water so used that it will be of most benefit to all, instead of arbitrarily adhering to priorities regardless of needs.

During the irrigation season of 1921 the commissioner made a very comprehensive study of the water requirements of the crops grown on the projects under his jurisdiction and compiled some valuable data on the duty of water. Forage crops, including alfalfa, sweet clover, timothy, and other grasses on pasture areas, predominate. Sufficient grain and garden crops are raised to supply local demands. Percentages of the total acreage under Lake Fork, the Uinta River, and the Whiterocks River devoted to these crops in 1921 were as follows: Forage crops, including hay and pasture, 80 per cent; grain, 17 per cent; garden and miscellaneous, 3 per cent. For such a crop distribution it was found that the net water duty for economical use ranges from 1.5 to 2.5 acre-feet to the acre. Average gross duty over the basin, for the primary canals, closely approximates 3 acre-feet to the acre. Under a number of canals, particularly in the Uinta River district, much of the land is wet and requires much less water than other areas. A duty of 3 acre-feet to the acre was assumed by the commissioner as an average for the Indian canals (having primary water rights), and this was modified to suit the peculiar conditions under each canal system.

The variations in demand for water from the basin streams fortunately coincides, usually, with the variation in seasonal run-off, the maximum demand occurring in June, when both forage and grain crops are being heavily irrigated. The demand begins to lessen in July, owing to the maturing of the grain crops, and continues to diminish until the end of the season, like the regimen of the streams. The schedule used by the commissioner during 1921 is given below.

Percentage of total amount of water used during irrigation season in Uinta Basin

	April	May	June	July	August	September	October	Acre-feet per acre
Uinta Basin streams (exclusive of Ashley Valley)	5	15	31	24	15	10	--------	2.99
Ashley Valley canals [a]	--------	20	19	19	12	9	6	2.74

[a] Ashley Valley streams not under jurisdiction of Federal water commissioner.

This method of water distribution is very economical and is most efficiently adapted for maximum utilization of the streams for irrigation.

The growing season over most of this basin averages 115 days. This permits maturing of all general hay and grain crops, potatoes, apples and a few other tree fruits, most bush fruits, and garden truck. Occasionally there is some damage to crops from frosts at the higher altitudes or from extreme low temperatures in winter. Within the last few years alfalfa seed has been a good cash crop, and that industry has made considerable headway.

Crop yields average well with other regions of similar climatic conditions. Alfalfa is a reliable crop for at least two cuttings a year, and often a third cutting is made. The average yield is approximately 2½ tons to the acre. Wild-hay crops average 1 ton to the acre, wheat 18 bushels, oats 25 bushels, and corn 20 bushels. All fruits and vegetables grown are consumed locally and considerable fruit is imported.

The fact that the basin has no railroad transportation adds materially to freight costs and thus restricts the agricultural development to those products which might be consumed locally and those which have a relatively high market value, such as alfalfa seed, dairy products, honey, and poultry products.

The crop census for 1920 [58] gives the following total values for all crops in Uinta and Duchesne Counties, which include virtually all the irrigated areas in this basin:

County	Seeds and cereals	Forage crops	Vegetables	Fruits and miscellaneous	All livestock
Duchesne	$366,303	$1,549,666	$202,547	$10,030	$2,129,592
Uinta	243,792	850,951	113,964	44,556	3,050,580
Total	610,095	2,400,517	316,511	54,586	5,180,172

The principal irrigated sections of the basin comprise the broad valley floors along the stream courses and the bench lands north of the Duchesne River. Alkali is not uncommon, especially along the river bottoms and the lower benches.

The soils of the basin according to Dr. D. S. Jennings, of the Utah Agricultural College may be classified in three groups. The soils of one group generally range in texture from sand and sandy loam to clay but include considerable areas of gravelly and stony types. The predominating color is brown or a light reddish brown. The group is characterized by a light-gray calcareous stratum occurring from an inch or two to several feet below the surface. This stratum is commonly very tight and impenetrable to water. The water-holding power of the soil is low; hence where the stratum is close to the surface irrigations must be frequent and light, or lateral movement of

[58] Fourteenth Census, Agriculture, pp. 258–260, 1920.

soil water will take place. Generally soils of this group occur on the bench lands. They are well developed on the Indian Bench, the Whiterocks Bench, and the bench lands in the Colorado Park district and east of Vernal. These soils are extensively utilized within the basin.

A second group of soils ranges in texture from fine sandy loam to clay, with color variations from red to light reddish brown and brownish gray. The soils are deep and have a slight compaction with the subsoil but not sufficient to interfere with the movement of water. They have the power of holding large quantities of water; hence they may be irrigated at less frequent intervals and with larger applications. These soils occur in the vicinity of Maeser and Lapoint and form some of the best agricultural land within the basin.

The alluvial soils of recent deposition form the third group. They are generally gravelly and stony and are restricted to narrow patches along the streams. The color and texture variations present a wider range and are more abrupt than in the other groups. Some good soils are found in this group but most of the area is pasture.

A small amount of land is irrigated along the banks of the Green River. As the fall of the river is so slight that ditches to reach these small patches of land would be long and costly, the water is raised from the river by pumps driven by gasoline engines. The lifts are in general less than 50 feet, but the cost of irrigating in this way is high because of high power costs as compared with the value of crop returns.

During the period of rapid development in this basin that immediately followed the opening of the lands to settlement in 1905, the question of water supply seems to have been entirely overlooked, and as a result the total acreage now under cultivation along the streams other than the Green River is greater than can be adequately supplied with normal flow water during an average season. Because of this condition the United States Indian Office in 1919 made a very comprehensive reconnaissance survey of storage possibilities along some of the streams. All the lakes and basins of any importance in this respect were carefully examined, and estimates were made of their capacity and of the cost and feasibility of development. Other investigations of similar nature have been conducted by private and corporate interests and the United States Bureau of Reclamation, covering practically every part of the basin. The results of these studies show that much of the run-off of the streams can not be used for irrigation because of lack of storage sites above possible diversion points. With this fact in mind and a very intimate knowledge of the irrigation problems of the basin, Mr. C. C. Jacob, who was Federal water commissioner from 1918 until his death in 1923, made a careful analysis of the future irrigation possibilities as determined by the usable water supply. A summary of his conclusions is shown in the following table:

Water supply and land areas in Uinta Basin west of Green River

Stream basin	Area under cultivation, 1921 (acres)	Total area irrigable without additional storage (acres)	Total area irrigable with feasible storage (acres)	Run-off, 1920 (acre-feet)	
				Possible to utilize	Impossible to utilize
Duchesne River (above Myton)	17,080	32,500	80,500		
Duchesne River (below Myton)	1,300	6,500	6,500		
Strawberry River (below reservoir, including Currant and Red Creeks)	3,750	6,300	6,300	415,400	130,000
Rock Creek	4,090	[a] 14,000	28,000		
Lake Fork	55,300	[b] 55,300	63,500	192,000	30,000
Uinta River	50,200	[b] 50,200	50,200	114,000	29,000
Whiterocks River	15,700	[b] 15,700	20,000	60,000	61,000
Ashley Creek	27,600	[b] 27,600	[c] 40,000	([d])	([d])
	175,020	208,100	295,000	781,400	210,000

[a] Practicable development without storage confined to enlargement of present development on Blue Bench. Upper Blue Bench project involves storage on Rock Creek.
[b] Stream overdeveloped without additional storage. Feasible storage sufficient for present development only.
[c] Estimated.
[d] No data.

NOTE.—Proposed developments along the Green River aggregate about 15,000 acres. More detailed information regarding data in this table may be obtained from manuscript copy of report on "Water supply of Uinta Basin, Utah, and its utilization," available for inspection at the offices of the U. S. Geological Survey in Washington, D. C., and Salt Lake City, Utah.

This table shows that the area irrigated in 1921, which is believed to have changed very little since that time, can be increased by 120,000 acres by proper use of the water supply as limited by the available storage sites, and even then in years of average run-off there will be about 210,000 acre-feet of water that will flow into the Green River unused. The greater part of this irrigable area is distributed among the following projects, each of which has been the subject of several investigations:

	Acres
Castle Peak project (formerly Lott Carey Act project)	48,000
Blue Bench districts	23,000
Colorado Park	12,000
East Ashley Creek	15,000
Ratliff project on Green River	12,000
	110,000

The Castle Peak project lies south and southeast of Myton, about 5,200 to 5,300 feet above sea level. The nearest railroad station is Price, on the Denver & Rio Grande Western Railroad, 78 miles southwest of the project. The soil is sandy loam with gravelly subsoil, and the gross area susceptible of irrigation is estimated to be about 79,000 acres, but detailed investigation of the project by the United States Bureau of Reclamation indicated that the available water supply is sufficient for only about 48,000 acres. Water would be taken from the Duchesne River a few miles below the town of Duchesne. Storage would be necessary and was proposed on the Strawberry River at the Starvation reservoir site with a feeder canal leading to the reservoir from the Duchesne River. Further details of the project may be found in the Twentieth Annual Report of the Bureau of Reclamation.

The Blue Bench districts comprise land on what are commonly called Blue Bench and Upper Blue Bench, north of Duchesne. Originally it was proposed to irrigate most of this land by a canal from Rock Creek, but a later plan contemplated an exchange of water between the Duchesne River and Lake Fork.

Colorado Park is a gently sloping body of land lying between the Green and Duchesne Rivers a few miles north of Ouray. The altitude is 4,800 feet above sea level, and the soil is sandy loam. The plans suggested to irrigate this land involve storage on the Uinta River and enlargement of the Ouray Valley Canal, which already reaches part of the park, or the installation of a pumping plant on the Green River to raise water from that stream. The latter plan, however, would necessitate a pumping lift of about 200 feet.

The east Ashley Creek project contemplates the irrigation of about 15,000 acres lying between Ashley and Brush Creeks and extending southward to Green River. The water supply would be taken from Ashley Creek, and storage would be provided to utilize the high-water flow, in the Stanaker Draw reservoir site. Estimates made by engineers as to the feasibility of the project indicate that more than enough high water is available to fill the proposed reservoir, but the natural low-water flow of the creek is overappropriated, and the project is accordingly dependent entirely upon storage water.

The Ratliff project contemplates the diversion of 200 second-feet of water from the Green River at Split Mountain, above Jensen, by tunnel and canal to irrigate lands on each side of the Green River above Jensen. This project also includes the development of power and is more fully described as a power project on page 242.

LOWER GREEN RIVER BASIN

The growing season in the lower part of the Green River Basin averages from 115 days in the higher agricultural areas near Price and Castle Dale to 150 days along the Green River, but the annual precipitation over the agricultural areas is very much too low to produce crops without irrigation. At some places where the precipitation is greatest because of high altitude and other more favorable conditions, attempts have been made to raise crops by dry-farming methods on small scattered tracts of land, but the success of these ventures has been disappointing. In view of this fact and the additional fact that the available tillable areas are small, dry farming will not be much of a factor in the agricultural development of the basin.

The principal irrigated lands lie along the east base of the Wasatch Plateau in the valleys through which flow the Price and San Rafael Rivers and their tributaries. These valleys are separated by low shale and clay hills, and patches of alkali and jutting knobs of shale give them a spotted appearance. Along the lower courses of these two streams and the Green River itself irrigable areas are restricted to comparatively small irregular tracts adjacent to the streams because of the bad lands which constitute a large part of the region.

The soils are principally heavy clay made from the bluish Mancos shale, which is the dominant geologic formation now exposed. They vary greatly in depth over the region, and in many places they form only a thin layer over the parent shale. Large areas have poor drainage and are impregnated with alkali, so that it is difficult and expensive to cultivate them.

In 1921 the Bureau of Soils, of the United States Department of Agriculture, made a soil survey of some 77,000 acres in the Gunnison Valley on both sides of the Green River, surrounding the town of Green River and lying below an altitude of 4,350 feet above sea level.[59] This work was done in connection with an investigation, conducted by the Bureau of Reclamation, of the irrigation possibilities of this area, locally known as the Green River project. The results of this survey show that only a small part of the area is agricultural land, 15,000 acres in all, 9,200 acres on the east side of the river and 5,800 acres on the west side. Most of the area is badly eroded and much broken, with deficient drainage and varying amounts of alkali, usually too much for crop production. Although this is the only extensive detailed soil survey that has been made in the lower Green River Basin, the same conditions exist generally throughout this area and are a deterrent factor in its agricultural development. The land along the Green River now being irrigated amounts to about 2,300 acres, and the available water supply is sufficient for many times this area, but the soil conditions and rough topography make further irrigation development unattractive.

Along the Price and San Rafael Rivers the problem of adequate water supply is added to the difficulties of poor soil and rough topography, and reservoirs are necessary for further irrigation development.

The records of the State engineer's office indicate the periods of activity in irrigation development in this part of the Green River Basin. For example, during the years 1907 to 1910 there were 70 or more applications for water rights for irrigation filed in the State engineer's office. Some of these applications outlined rather large

W. M. The Green River project, Utah, unpublished report of U. S. Bur. Reclamation.

projects, which were undertaken as Carey Act enterprises, but none of the large ones have been built. During 1910 and 1911 nine small private projects were built in the Price and San Rafael River Basins, and then there was a period of almost total inactivity until 1916 and 1917, when many small enterprises of less than 100 acres were completed and one project of 9,000 acres was built in the San Rafael River Basin. The next outstanding increase of irrigated area was made in 1921, with the completion of a 5,000-acre project in the San Rafael Basin. In 1926 the Price River water conservation district put its uncompleted Pleasant Valley Reservoir into service to the extent of about 15,000 acre-feet of storage, and in 1927 over 40,000 acre-feet of water was stored. The capacity of the reservoir as now built is 68,000 acre-feet, and the water is to be used on 27,000 acres of land extending from Helper to Farnham, in the Price River Valley. This project is the outgrowth of an earlier one which was first outlined about 1896, when the Mammoth Reservoir Co. was organized to build a reservoir on Gooseberry Creek some miles above the present Pleasant Valley Reservoir. Some construction work was done in 1902 on the Mammoth Reservoir, but after about $60,000 had been spent in making roads, foundation trenches, outlet tunnel, and buildings, the work was abandoned until 1907, when a new company, the Utah Irrigation & Power Co., took over the project and commenced construction again in August of that year. In 1909 the project was controlled by the Irrigated Lands Co., and at that time it consisted of a little more than 21 miles of main canal, a diversion dam in the Price River a few miles above Price, and the Mammoth Reservoir, which was constructed to a capacity of about 4,000 acre-feet. The dam was an earth-fill structure with concrete core wall and was designed for a maximum height of 125 feet, giving an ultimate reservoir capacity of 42,800 acre-feet. In 1917, as a result of financial difficulties, the project was under the control of the Price River Irrigation Co. The dam was completed to a height of 72 feet, and about 8,000 acres was being cultivated under the project. On June 24 of that year the dam failed, releasing 11,000 acre-feet or more of water from storage. The result was a complete destruction of the dam and several hundred thousand dollars' worth of damage to property along the trail of the resulting flood. Soon after this failure the United States Bureau of Reclamation was requested to examine the enterprise and determine what steps could be taken to provide a water supply to the settlers who were on it. As a result of this examination the Pleasant Valley reservoir site was suggested, and steps were taken immediately to organize the Price River Water Conservation District, to build the reservoir and rehabilitate the project.

Crops in the lower Green River Basin are principally alfalfa, wheat, oats, and corn, with some of the hardy fruits and garden vegetables. All crops produced are consumed locally or find a ready market at one of the near-by coal-mining camps. The production of vegetables, fruits, and dairy products is insufficient to supply the demand, and accordingly relatively high prices are obtained for these products. Crop yields for the region as a whole average well. The average yield of wheat is about 16 bushels to the acre, oats 30 bushels, and corn 30 bushels. Potatoes yield more than 100 bushels to the acre, and alfalfa, which is normally cut three times a season, yields about 2½ tons to the acre; wild hay yields 1¼ tons to the acre. Along the Green River, where the growing season is longer than in the higher valleys, alfalfa will yield four cuttings in a season. In the vicinity of the principal towns considerable areas are planted to orchards and melons, but the leading agricultural industry is livestock, because the greater part of the lands of the region are most suitable for grazing. The undeveloped irrigation possibilities of this region have been investigated many times by private, State, and Federal agencies, and the results of these investigations are briefly outlined in the following descriptions of the principal projects that have been proposed.

Woodside project: The lands under the Woodside project are near Woodside, in Emery County, on the main line of the Denver & Rio Grande Western Railroad, and the water supply is to be taken from the Price River. Including private, State, and Carey Act lands, the total area is 7,000 acres. About 2,500 acres lie on the north side of the river, and the rest on the south side. The project contemplates a storage reservoir on the river about 10 miles above Woodside, with a usable capacity of 14,000 acre-feet, and a distribution system comprising 25 miles of main canal. A Carey Act segregation of 5,000 acres was approved in 1910 for this project, considerable engineering work was done on it, and construction work was started by driving a tunnel 40 feet into the cliff at the dam site in preparation for a large blast to bring down rock for building the dam, but nothing has been done since then.

Buckhorn project: The Buckhorn project is in the San Rafael River drainage basin about 12 miles east of Castle Dale. A Carey Act segregation was made of 29,820 acres on what are known as the Melville and Buckhorn Flats, in 1909, but it was canceled in June, 1924, because the project had virtually been abandoned and no construction work of consequence had been done on it. The lands lie in a basin surrounded by high sandstone cliffs and drain with easy uniform slopes into the San Rafael River. The altitude above sea level is about 5,500 feet. The soil is a deep reddish-brown sandy loam, but the natural precipitation on it is insufficient to support anything more than a sparse growth of shadscale. The plan of development involves the conduct of flood and waste waters of Huntington Creek through a feeder canal and an inverted siphon to a storage reservoir in Bull Hollow with a capacity of 22,000 acre-feet. From the outlet of this reservoir two main canals were proposed to serve the lands, which are reached immediately after leaving the reservoir. The area to be irrigated was 10,000 to 12,000 acres. A considerable amount of engineering work has been done on this project by several companies that have unsuccessfully attempted to promote it. These engineering studies show that the construction costs of building the project are high and that the water supply from Huntington Creek is uncertain in amount and is apparently insufficient for a project of this size. These conditions and the fact that transportation facilities must also be provided at high cost have no doubt been the major factors in making the project economically infeasible.

Green River project: Extensive preliminary surveys of the Green River project were begun about 1910, and a Carey Act segregation was later made. The total area to be covered by the projected canal system was 264,000 acres, of which 240,000 acres was classed as irrigable. Of this irrigable area 187,000 acres was to be served by gravity canals and 53,000 acres by 15 pump stations, which were to deliver from 20 to 120 second-feet of water under heads ranging from 50 to 200 feet. About 46,000 acres of the land was in private ownership, 27,400 acres was State school land, and 166,600 acres was Carey Act land. The plan of the project was a combined diversion and storage dam on the Green River just below the mouth of Coal Creek, about 26 miles upstream from the town of Green River. (See pl. 35, *A*.) The main canal was to follow down the river along the west wall of Gray Canyon, crossing the Price River with an inverted siphon. At a point about 1 mile north of Gunnison Butte a branch canal was proposed to cross the river and serve lands on the east side, the main canal continuing on into the valley on the west side. A hydroelectric power plant was also proposed at this division point. The town of Green River is in the north-central part of the project area, the canals on the east side of the river extending to a point about 6 miles south of the town and those on the west side to a point about 21 miles south of the town, including all the lands of the lower San Rafael River Valley, much of which was at about this same time being included in another reclamation project which was to build a large reservoir on the San Rafael River and use water from that stream. This San Rafael project, however, was not able to obtain a Carey Act segregation of all the lands included in it because of the conflict with the Green River project, which had a prior claim.

Reconnaissance studies of the Green River project were made by the United States Bureau of Reclamation in 1914 to 1918. In 1921 a detailed study was made by the Bureau of Reclamation in cooperation with the Salt Lake Commercial Club and Chamber of Commerce. The results of this study are given in an unpublished report on the Green River project, copies of which are available for inspection in the offices of the United States Bureau of Reclamation, the State engineer at Salt Lake City, and the Salt Lake Chamber of Commerce. It was concluded from this investigation that the cost of the Green River project as originally proposed would be prohibitive, and that the most feasible development would be a water-power pumping plant at the mouth of Gray Canyon to raise water into the canals under a maximum lift of 249 feet. The area included under the highest proposed canals is 77,000 acres, and the soil survey shows that only about 20 per cent of this area, or about 15,000 acres, is irrigable. The estimated cost of building such a project is more than $179 an acre, and accordingly the enterprise is declared economically infeasible at this time.[60]

SUMMARY

Irrigated and irrigable land in Green River Basin in Utah, in acres

Drainage basin	Irrigated areas			Estimated additional irrigable area	Estimated ultimate irrigated area
	1902 [a]	1919 [a]	1921 [b]		
Green River direct	1,372	2,541	2,000	28,000	30,000
Ashley Creek	15,834	26,787	27,600	[c] 12,400	40,000
Duchesne River and tributaries	([d])	138,446	147,400	107,600	255,000
White River	0	0	0	[b] 44,400	44,400
Price River	6,621	23,811	24,000	[b] 33,000	57,000
San Rafael River	21,546	77,290	80,000	[b] 34,000	114,000
Other tributaries	8,560	12,000	[e] 12,000	8,000	20,000
	53,933	280,875	293,000	267,400	560,400

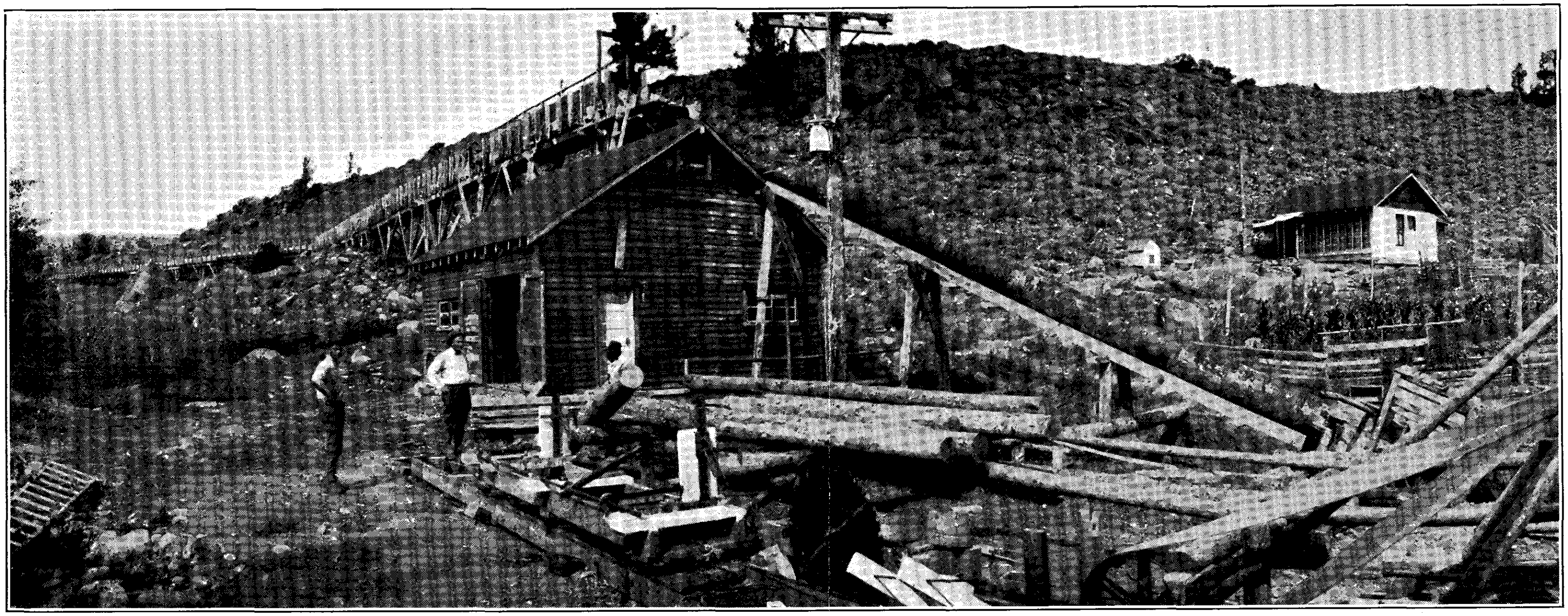
[a] U. S. Census.
[b] U. S. Bureau of Reclamation.
[c] Based upon available water supply and feasible storage.
[d] Not segregated in 1902; included in "Other tributaries."
[e] Estimated.

WATER POWER

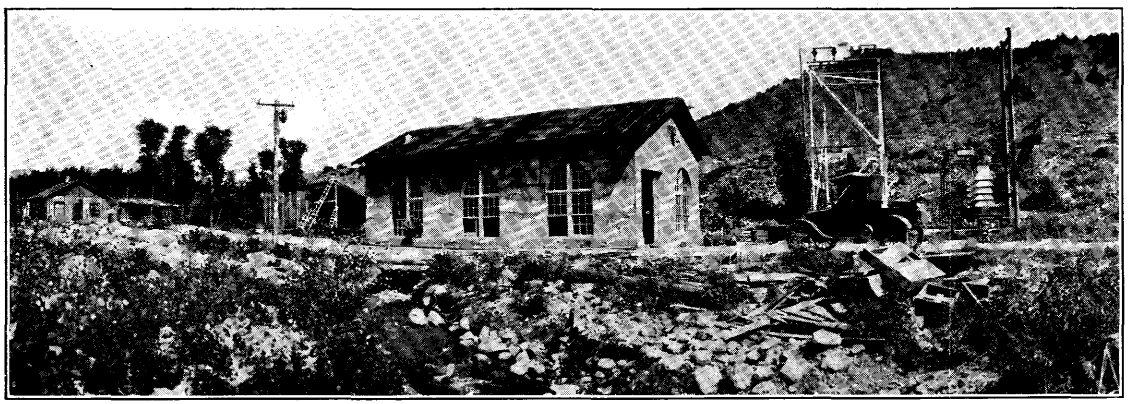
GENERAL FEATURES

The amount of hydroelectric power developed in the Green River Basin at this time is insignificant compared with the potential power. The basin is sparsely settled, and the centers of population consist of small towns rather widely scattered. The largest of these towns are situated in or adjacent to producing coal fields, where electric power is developed by steam plants. The demand for power within the basin outside of these mining centers is too small to justify the cost of developing the water-power sites and building the long transmission lines required to deliver the power to the rural population. Furthermore, most of the sites are too small and remotely situated to be developed as isolated projects or connected into any existing interconnected system.

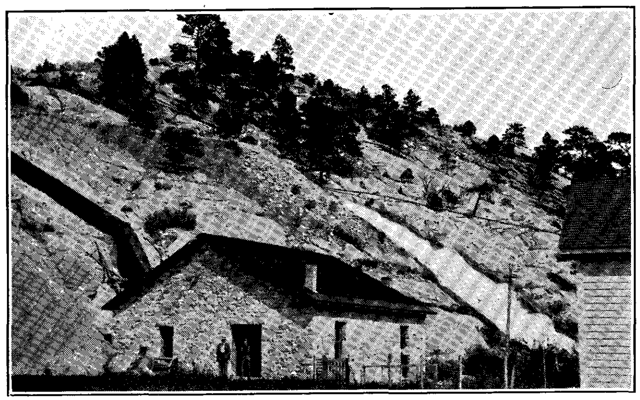
[60] U. S. Recl. Service Twenty-first Ann. Rept., p. 131, 1922.



A. HYDROELECTRIC POWER PLANT ON PINE CREEK NEAR PINEDALE, WYO.



B. HYDROELECTRIC POWER PLANT ON THE UINTA RIVER NEAR ROOSEVELT, UTAH



C. HYDROELECTRIC POWER PLANT ON ASHLEY CREEK NEAR VERNAL, UTAH

The total population of the entire basin is about 93,000, and the total land area is about 44,900 square miles, so that the density of population is about two persons to the square mile. This fact, and the additional fact that approximately 47 per cent of the total population is rural, makes it obvious that the cost of serving the basin with electric power would be very high and much in excess of the revenue that could be expected.

At this time about 13,000 persons in the upper Green River Basin, or 46 per cent of the population, are using electricity, All but 250 of these are in the towns of Rock Springs, Green River, Kemmerer, Diamondville, and Cumberland. Each one of these places is served by a steam generating plant, because all of them except Green River are coal-producing centers, and cheap coal is available to Green River because of its close proximity to Rock Springs.

The one other town in this part of the basin that boasts of an electric-light plant is Pinedale, where a small hydroelectric plant is in use. The combined boiler capacity of the steam plants is about 16,700 horsepower, and that of the hydroelectric plant is about 65 horsepower.

In the basins of the Yampa and White Rivers about 5,700 people, or 29 per cent of the total population, are using electricity, all of which except the output from a 100-horsepower hydroelectric plant at Meeker is furnished from steam plants at several of the principal towns.

The demand for electric power in the Uinta Basin in Utah is supplied from three small hydroelectric plants, which have a combined capacity of less than 1,000 kilowatts and serve a population of about 4,000, or approximately 20 per cent of the total population.

A very small proportion of the power used in the lower Green River Basin is generated within the basin. Most of it is brought in over the transmission lines of the Utah Power & Light Co. One small hydroelectric plant at Green River supplied that town, and a small one on Cottonwood Creek near Castle Dale until recently added its bit to the needs of that community and vicinity, but these are no longer in use, and power is now supplied from the Utah Power & Light Co.'s system. About 70 per cent of the population of this basin are being served with electricity.

In view of the conditions above outlined, the hydroelectric sites throughout the Green River Basin are not attractive to capital as sources of electric power, except some of the large ones from which power might be taken to outside markets and industrial centers, such as Salt Lake City and Denver.

46050—30——14

FACTORS AFFECTING HYDROELECTRIC DEVELOPMENT

All factors involved in the development of hydroelectric sites may be summed up in the one question, Is the project economically feasible? In other words, will the revenue to be received from the sale of the energy be sufficient to warrant the expenditure necessary to build and operate the project? To answer this question satisfactorily, complete and accurate data are highly desirable, but the numerous factors entering into the computations are subject to uncertainty, and accuracy is often difficult to obtain. Such factors as the fall of a stream and the topography at dam and reservoir sites can be determined readily by surveys. It is also possible to obtain within a reasonably short time the necessary data regarding transportation facilities and accessibility of suitable construction materials. Other factors which require more time for complete study are foundation conditions for dams, power houses, and other project works; stream regimen, where records are not already available; and market conditions for absorbing the power. If the proposed project is to be an additional unit in a large operating system the question of market is not necessarily serious, but under other conditions it may involve uncertainties which require careful consideration.

Ordinarily the development of the power and irrigation resources of the country begins with the building of the most easily and cheaply constructed projects; these are followed by the more expensive ones in the order of their economic feasibility. This has apparently been true of the developments that have thus far been made in the Green River Basin.

However, the importance of data relative to the regimen of the streams has not always been appreciated, and as a result available information for planning a project is inadequate to determine its economic feasibility. The amount of water, of course, can be measured, but one measurement, or even many measurements of a flashy mountain stream are not enough to determine the low and high water periods of the stream. Consequently they are not sufficient to use as a basis for the design of project structures. Furthermore, it is desirable to know something regarding ice conditions, the amount of silt the stream carries, and the probable magnitude of floods with their usual burden of débris. Also, in the Green River Basin, as in all other parts of the arid West, the question of other uses of the streams, such as irrigation or domestic water supply, must receive careful consideration. Where streams are used for transportation, navigation adds another factor to the problem, but this use is not material in the Green River Basin.

As a prerequisite to a careful study of all these items, continued records of stream flow over a period of years are necessary, as well as information relative to any irrigation use of the water and the possible future demand for such use. Stream-flow records to be of most value should cover many years and of course should be obtained with due care. Accordingly it is very desirable that the work of obtaining them should be thoroughly organized and conducted continuously, so that the records may be available whenever any project involving their use is undertaken.

Ice conditions are usually noted on the records of stream gaging stations that are maintained continuously, but in the Green River Basin winter records are almost entirely lacking in the Wyoming and Colorado areas, and such notations as "Stream seriously affected by ice" or "Stream frozen over each winter" are common for the stations within the Utah area where winter records have been kept. According to climatologic records, temperatures below zero are common throughout the basin, and such minima as −39°, −54°, and −26° no doubt have a serious effect on the flow of the streams. The few available records of winter conditions indicate that the smaller streams at least are often frozen up.

At the small hydroelectric plant on Pine Creek near Pinedale, Wyo., ice causes considerably trouble each winter, and some changes are found to be necessary in the project works in order to alleviate this trouble. Ice also affects the operation of the plant at Pole Creek, on the Uinta River near Whiterocks, and the one on Cottonwood Creek near Castle Dale, Utah, but the plant on Ashley Creek near Vernal, Utah, is free from this trouble, no doubt because most of the winter flow of the creek issues from one large spring about a mile above the headworks of the project and does not freeze before reaching the plant.

The silt problem is not serious on any of the streams of the Green River Basin that might be used for developing power. For the greater part of the year these streams are clear. However, during the period of high water in the spring and in occasional heavy storms some of them rise high enough to cause considerable damage by taking out bridges, canal headgates, etc., and at these times they usually carry heavy loads of débris.

It is obvious from the facts above set forth that each project offers a separate problem, whose solution depends upon the local conditions, and the design of hydraulic structures as well as other structures of the project should be made to fit into these local conditions. Accordingly a careful analysis of all the factors involved in the question of economic feasibility is necessary to the proper development of hydroelectric power sites.

DEVELOPED POWER

Descriptions of the hydroelectric plants in the Green River Basin are given below. The index numbers refer to the map (pl. 1) showing the location of the plants. No attempt is made to describe all the "special-use" plants, such as flour mills and sawmills, which do not generate hydroelectric power except for lighting their own plants or some other use incident to their business. The following abbreviations are used in the descriptions:

Q50, flow available 50 per cent of the time.
Q90, flow available 90 per cent of the time.

Summary of developed power sites in Green River Basin, 1927

Name of plant	Location	Installed water-wheel capacity (horsepower)
Pinedale	Pine Creek near Pinedale, Wyo	70
Meeker	White River at Meeker, Colo	150
Vernal	Ashley Creek near Vernal, Utah	380
Uinta River	Uinta River and Pole Creek near Whiterocks, Utah	[a] 800
Lake Fork	Lake Fork near Myton, Utah	[b] 150
Green River	Green River at Green River, Utah	200
Orangeville	Cottonwood Creek near Castle Dale, Utah	100
		1,850

[a] Only 1 unit in use; ultimate development, 2 or 3 additional units.
[b] Plant obsolete, being held in reserve.

UPPER GREEN RIVER BASIN

PINEDALE PLANT (9AC 1)

Location and plan of development.—On Pine Creek about 2 miles northeast of Pinedale, Wyo., in sec. 27, T. 34 N., R. 109 W. sixth principal meridian. Boulders in the stream bed turn the water into a wooden flume along the left bank of the creek. Flume terminates in wooden penstock at power house. (See pl. 26, A.)

Ownership and market.—Owned by few individuals. Market at Pinedale and environs.

Chronologic summary.—Plant built by present owners in 1924.

Water supply.—Source of water, Pine Creek. Rights acquired through State engineer of Wyoming. Right granted to use of 42 second-feet. Estimated Q90 35 second-feet, Q50 45 second-feet. Corresponding power capacities, 84 and 108 horsepower.[61]

Hydraulic features.—No dam except large boulders strewn over the stream bed. The conduit was originally a wooden flume made of native pine with a head gate to regulate the stream flow to the plant. Part of the conduit and penstock were changed in 1926 to pipe section. Conduit about 545 feet long and 42 second-feet capacity.

Power house and transmission system.—Power house a cheaply constructed frame building 24 feet square. Installation a 21-inch Fitz-Burnham vertical-shaft water wheel belt connected to a 37½-kilovolt-ampere Westinghouse generator, 1,200 revolutions per minute, 3-phase, 60-cycle, 2,300 volts. A small exciter generator is direct connected to the main generator. The water wheel has a power capacity of about 70 horsepower under a head of 32 feet. The operating head at the plant is 30 feet. Current is transmitted from the plant to Pinedale, about 2 miles distant. The load now used is about 20 kilowatts.

Remarks.—Ice is troublesome at the plant and was the cause of changes being made in the penstock and flume line. The cost of the project is about $12,000.

[61] Horsepower = $Q \times H \times 0.08$. (Q = flow in second-feet, H = static head in feet, 0.08 = factor for 70 per cent efficiency.)

YAMPA AND WHITE RIVER BASINS

MEEKER PLANT (9BF 1)

Location and plan of development.—On White River at Meeker, in secs. 23 and 28, T. 1 N., R. 94 W. sixth principal meridian.

Ownership and market.—Owner, town of Meeker, Colo. Leased and operated by Meeker Heat, Light & Power Co. Market, Meeker and adjacent farms.

Chronologic summary.—Built in 1912.

Water supply.—Souce of water, White River. Rights acquired through appropriation and use. Canal capacity about 125 second-feet. Estimated Q90 250 second-feet, Q50 350 second-feet. With a head of 40 feet the corresponding power capacities are 800 and 1,120 horsepower.

Hydraulic features.—A rock-crib dam in White River about 4 feet high and 75 feet long, with concrete headworks opening into a canal which is about three-quarters of a mile long. The penstock is a vertical square-section which furnishes a head of about 15 feet on the water wheel.

Power house and transmission system.—The power house is about 14 by 34 feet in size. The installation is a 35-inch vertical Leffel turbine, belt connected to a Westinghouse generator, 2,400 volts, 60-cycle, 900 revolutions per minute, 125 kilovolt amperes. The water wheel operates at a speed of 150 revolutions per minute. There are about 10 miles of transmission and distribution lines, all 2,400 volts.

Remarks.—The average power demand is about 75 kilowatts. The plant has a decreed water right of 104.9 second-feet, but it is capable of using 125 second-feet or more. According to Mr. R. C. Graham, the manager of the plant, there is always enough water available to operate the plant, and about 250 second-feet could be used continuously for power development. He suggests that the head at the plant could be increased 25 feet by carrying the water in a pipe line instead of a canal.

UINTA BASIN IN UTAH

VERNAL PLANT (9BA 1)

Location and plan of development.—In Uinta County about 9 miles up Ashley Creek from Vernal. The diversion dam is in the NE. ¼ sec. 12, T. 3 S., R. 20 E., and the power house is in lot 1, sec. 18, T. 3 S., R. 21 E., Salt Lake base and meridian. Waterway is a canal along the east side of the creek. (See pl. 26, *C*.)

Ownership and market.—Owned by Utah Power & Light Co. Market, Vernal and immediate vicinity.

Chronologic summary.—Construction work started September 10, 1907; completed November 1, 1910. Plant built by Vernal Milling & Light Co. Sold to Fank A. Reed in 1925 and transferred to Utah Power & Light Co. in December, 1926.

Water supply.—Source of supply, Ashley Creek. Rights acquired through application made in the State engineer's office March 4, 1907. Amount of water appropriated 55 second-feet. No regulation of stream flow. Q90 estimated 30 second-feet, Q50 45 second-feet. Corresponding power capacities, 200 and 300 horsepower.

Hydraulic features.—Dam, low timber and rock structure, crest length 125 feet, height 10 feet. Water spills over crest. Intake, wooden flume section 10 feet wide, 6 feet deep, equipped with two wooden gates. Conduit, open canal, 12 feet wide on bottom and 16 feet wide on top, side slopes 1:1, length 4,700 feet; terminates in a masonry basin 9 by 18 feet, equipped with trash rack at the canal end. Wing wall of the basin on upper side is equipped with two 6-foot waste-way gates which open into an open channel leading to the creek below the power house. Penstock, riveted steel pipe about 150 feet long and 42 inches in diameter, tapped into masonry basin above described; lower end reduced to 36 inches in diameter by a tapered section connecting to the turbine. Tailrace, open channel about 300 feet long from power house to creek.

Power house and transmission system.—Power house, stone masonry on east bank of creek at foot of sandstone ledge. Dimensions 34 by 40 feet. Foundation for machinery and floor of power house, reinforced concrete. Installation, one 20-inch Leffel horizontal turbine water wheel, 380 horsepower, direct connected to a 250-kilowatt 2,300-volt 63-ampere 600 revolutions per minute General Electric generator. One exciter generator belted to the main generator shaft. Operating head on water wheel 84 feet. Current is generated at 2,300 volts and transmitted over a 3-wire wooden-pole line about 10 miles to a flour mill at the edge of Vernal. Here the voltage is reduced; part of the power is used at the mill, and part is transmitted through a distribution system serving the town and vicinity. An extension of the primary line about 8 miles to the southwest of Vernal furnishes power for coal mining.

UINTA RIVER PLANT (9BE 1)

Location and plan of development.—On Uinta River about three-fourths of a mile above the mouth of Pole Creek and about 10 miles northwest of Whiterocks. Project contemplates diversion of water from both Pole Creek and Uinta River; Pole Creek portion completed. Diversion from Pole Creek in SE. ¼ sec. 14; proposed diversion from Uinta River in NW. ¼ sec. 4 and proposed diversion of Spring Branch in SW. ¼ sec. 5, all in T. 2 N., R. 2 W., Uinta special base and meridian. Water from Spring Branch to be put into Uinta River above proposed diversion on that stream by canal a little more than a quarter of a mile long. Water from Uinta River to be carried in a canal along the east side of the stream to a forebay basin in the SE. ¼ sec. 23 and there commingled with water from Pole Creek, which is carried in another canal along the west side of that stream. From this basin two penstock pipe lines will lead to the power house. One penstock is now installed and in operation. (See pl. 26, *B*.)

Ownership and market.—Owner, Uinta Power & Light Co. Market, Myton, Roosevelt, Fort Duchesne, and other towns in the basin.

Chronologic summary.—Work started on project in 1919. Pole Creek unit installed January 7, 1921.

Water supply.—Source of supply, Uinta River and Pole Creek. Rights acquired through application made in the State engineer's office July 12, 1918. Amount of water claimed, 180 second-feet. No regulation of stream flow. Q90 estimated 65 second-feet; Q50 100 second-feet. Corresponding power capacities 2,080 and 3,200 horsepower.

Hydraulic features.—Dam, concrete, on Pole Creek, 52 feet crest, about 5 feet above stream bed, with control spillway regulated by flashboards. Intake opens into wooden flume 4 feet wide with spill gate leading back to creek and gates for controlling flow into canal. Conduit, about 5,200 feet of open canal about 4 feet wide, terminating in a forebay basin; thence 4,300 feet of 36-inch wood stave pipe and 1,080 feet of riveted steel-pipe penstock 32 inches in diameter at the upper end and 30 inches at the lower end. A Y at the lower end of the penstock is designed to serve two Pelton water wheels. Only one unit is installed. The tailrace is an open channel about 500 feet long.

Power house and transmission system.—Power house, concrete, designed for four turbo-generator units; house built for three units, with temporary wall at west end to allow for future extension. Present dimensions inside 24 feet 6 inches by 50 feet 3 inches with 16 feet 6 inches ceiling. A 5-ton hand-operated crane serves the entire building. Floor and machinery footings concrete. Installation, one 800-horsepower Pelton water wheel direct connected to a 600-kilowatt 2,300-volt 3-phase 60-cycle 360 revolutions per minute General Electric generator; a 125-volt 15-kilowatt 1,700-revolutions per minute General Electric exciter generator belt driven from main generator shaft. Temporary static head on present unit, 430 feet; static head proposed for completed development, 401 feet. Current generated at 2,300 volts, stepped up through outdoor transformer station to 44,000 volts. Transmission system comprises 46.75 miles of primary lines—18 miles of 44,000-volt line to Roosevelt and 28.75 miles of 11,000-volt lines serving Fort Duchesne, Myton, Lake Fork, and Upalco.

Remarks.—The complete development of this project as proposed comprises two or three more turbo-generator units sufficiently large to make complete utilization of the site. The present penstock is designed large enough for two 800-horsepower units, and another penstock is planned to serve the additional units that may be installed. The project will be developed as demand for power warrants.

LAKE FORK PLANT (9BC 1)

Location and plan of development.—On Lake Fork about 10 miles northwest of Myton. Dam in the SE. ¼ sec. 20; pipe line along east side of creek to power house in SW. ¼ sec. 28, all in T. 2 S., R. 3 W., Uinta special base and meridian.

Ownership and market.—Owner, Uinta Power & Light Co. Market, towns of Roosevelt, Myton, Duchesne, and vicinity.

Chronologic summary.—Construction work completed in May, 1914. Plant held in reserve since 1921.

Water supply.—Lake Fork. Rights acquired through application made in the State engineer's office February 8, 1910. Amount of water appropriated, 25 second-feet. No regulation of stream flow. Flow of stream affected by irrigation diversions above, and supply for power uncertain.

Hydraulic features.—Dam, temporary loose rack. Intake, wooden head gate opening into pipe line. Conduit, wooden-stave pipe line 6,700 feet long and 30 inches in diameter.

Power house and transmission system.—Power house, frame building 28 by 40 feet on east bank of stream. Installation, two 15-inch Leffel horizontal-turbine water wheels, 75 horsepower each; two 60-kilowatt-ampere 2,300-volt 3-phase 60-cycle 1,200 revolutions per minute Allis-Chalmers generators, each belt driven from one of the water wheels; two 30-kilowatt 120-volt 25-ampere 135 revolutions per minute Allis-Chalmers exciter generators belt driven from the main generator shafts. Operating head on water wheels 80 to 85 feet. Current generated at 2,300 volts and stepped up to 11,000 volts for transmission to Myton and vicinity.

Remarks.—Plant held in reserve since beginning of operation of the Uinta River plant in 1921.

LOWER GREEN RIVER BASIN

GREEN RIVER PLANT (9BJ 1)

Location and plan of development.—On Green River at the town of Green River, Utah. Entire development in SE. ¼ sec. 17, T. 20 S., R. 16 E., Salt Lake base and meridian. Canal carries water along the west side of the river to the power house.

Ownership and market.—Owner, Utah Power & Light Co. Market, town of Green River.

Chronologic summary.—Plant originally built as steam pumping plant for irrigation about 1906. Later the pumps were driven by water wheels, and a hydroelectric unit was installed to furnish electric power for the town.

Water supply.—Green River. Rights acquired through the State engineer's office. Certificate issued for 220 second-feet. No regulation of stream. Flow more than ample at all times.

Hydraulic features.—Dam, low timber crib, rock-filled weir type, about 700 feet crest length. Intake, wooden head gates opening into a canal. Conduit, canal 100 to 115 feet wide on top, about 60 feet wide in the bottom, and 8 feet deep, length 2,349 feet to the power house.

Power house and transmission system.—Power house, corrugated-iron building originally used as a steam pumping plant. Building and pumping equipment owned by irrigation interests; hydroelectric unit only owned by the power company. Installation, one twin-runner 35-inch Leffel horizontal water turbine shaft connected to a 175-kilovolt-ampere 60-cycle 3-phase 2,400-volt Westinghouse generator. Water wheel rated at 200 horsepower under 10-foot operating head. Head at plant ranges from 6 to 11 feet, depending upon the stage of the river. Current was taken from the plant to the town of Green River, about 6 miles. Some power was also supplied to several farms along the river between the plant and the town. Power is now (1929) supplied from Utah Power & Light Co.'s system.

Remarks.—This is not a suitable site for extensive power development. The present plant is somewhat of a temporary expedient to supply the small local market for power. In times of high water the head is cut down so that the output of the plant is greatly reduced, and during part of the winter needle ice in the canal gives considerable trouble. Plant shut down.

ORANGEVILLE PLANT (9BK 1)

Location and plan of development.—On Cottonwood Creek about 2½ miles northwest of Castle Dale, in Emery County, Utah. The dam is in the NE. ¼ sec. 24, T. 18 S., R. 7 E., and the power house is in the NE. ¼ sec. 30, T. 18 S., R. 8 E., Salt Lake base and meridian.

Ownership and market.—Owner, Utah Power & Light Co. Market, roller mill at Orangeville and electric power for domestic purposes in Castle Dale and environs.

Chronologic summary.—Built in 1910 by Electric Power & Milling Co., Orangeville, Utah. Purchased in 1929 by present owner.

Water supply.—Source of supply, Cottonwood Creek. Rights acquired through application in the State engineer's office. Certificate issued for 20 second-feet in January, 1912. No regulation of stream flow. Amount of water limited by decree when creek flow is sufficient, and during periods of drought its share is uncertain. The project is built to use water that is afterward used by the Blue Cut ditch, and accordingly the amount of water available for power depends largely on the use of water by this ditch.

Hydraulic features.—Dam, concrete, 4 feet high, with wooden superstructure 3 feet high; total usable height 7 feet; crest length of concrete structure, 60 feet. Conduit, open canal with head gate intake; canal known as Orangeville Mill ditch; length 9,280 feet, top width 6 feet, bottom width 4 feet, depth 3 feet. Penstock, 18-inch riveted steel pipe to the power house.

Power house and transmission system.—Power house, rubble masonry, about 14 by 18 feet. Installation, one 60-inch Pelton water wheel rated at 75 horsepower, drives a 50-kilowatt 3-phase 60-cycle generator. The operating head at the plant is 70 feet. This plant originally furnished power to the settlements of Orangeville and Castle Dale, but in 1926 the distribution system was connected into that of the Utah Power & Light Co., and this plant is now out of use. The transmission line of the Utah Power & Light Co. has also been extended south to Ferron and serves that town with electric power.

UNDEVELOPED POWER

UPPER GREEN RIVER BASIN

The power sites in the upper part of the Green River Basin are all small compared with the hydroelectric projects that are commonplace to-day. They are far from a market in which they could be used by interconnection into a superpower system, and there is no local market that warrants their development.

The regimen of the streams in general is affected by ice for about five months of each year, and during that time no stream-flow records have been obtained. This is particularly unfortunate in studying the power possibilities of the streams, because the maximum power demand usually comes in the winter season. It is quite probable, however, that the winter flow is the minimum for the year, because of a general freezing up of sources of supply.

From the stream-flow records that are available it is apparent that the streams flowing into the basin from the east rim have a greater run-off per unit of drainage area than those from the west. This is especially true of those streams emptying into the New Fork River, which drain the high snow-capped peaks of the Wind River Mountains, and for this reason these particular streams have a regimen better suited for power developments than the others of the basin.

It is not the purpose of this report to consider every small power possibility that might be developed for sawmills or local farm use, but only those which are believed to be the best sites, although none of them at this time are attractive to capital.

The Green River itself for a distance of 148 miles above the town of Green River, Wyo., flows in a broad U-shaped canyon cut through vast stretches of badlands. Its grade is less than 10 feet to the mile for the greater part of the distance, and it winds through bottom lands that are covered with a heavy growth of willows. Its grade above the mouth of Horse Creek is somewhat steeper, and in a few places the valley narrows to such an extent that dams might be built across it. Three of these places are suggested by the topography of the valley, and for identification these are designated the Big Bend site, Wells site, and Aspen Ridge site.

The Big Bend site is about 5½ miles downstream from the outlet of the Green River Lakes, in secs. 4 and 9, T. 39 N., R. 109 W. (9AA 1). Here the valley is narrowed to some extent by the foothills that flank the north slopes of Little Sheep Mountain. (See Fremont Peak topographic map.) These hills are alluvium and gravel, and no geologic study has been made of them to determine their suitability as foundation material for a dam. A rise of 110 feet in the water surface at the dam site would require a dam with a crest length of about 1,400 feet. This would create a storage reservoir with a capacity of 97,000 to 100,000 acre-feet, and it is estimated that with about 50 feet drawdown the stream flow could be equalized at 130 second-feet. The power house would be at the dam, and the average head on the water wheels would be about 80 feet. Accordingly the power capacity of the site is about 830 horsepower (622 kilowatts).

The Wells site is in sec. 2, T. 38 N., R. 110 W. (9AA 2). Here the sides of the valley converge, and the topography suggests a dam about 100 feet high. The crest length of such a dam would be approximately 1,000 feet. (See Gros Ventre topographic map.) Foundation conditions at this site have not been determined. The storage capacity of the reservoir formed would be about 111,600 acre-feet, and it is estimated that with a drawdown of 45 feet the stream flow might be equalized at 190 second-feet. The power capacity of the site with this stream flow and an average head of 70 feet is 1,064 horsepower (798 kilowatts).

The Aspen Ridge site is in a stretch of the river where the stream for about a mile has cut its way through a series of gravel hills (9AA 3). The topography is smooth and rolling, and the narrowest cross section for a dam appears to be in sec. 34, T. 36 N., R. 111 W. (See Gros Ventre topographic map.) Here a dam 125 feet high would have a crest length of about 800 feet, and the resulting reservoir would have a capacity of about 77,000 acre-feet. It is estimated that with a power house at the dam and a drawdown on the reservoir of about 25 feet a flow of not less than 160 second-feet could be maintained. Under this condition the average head on the plant would be about 110 feet, and the power capacity of the site would be 1,400 horsepower (1,050 kilowatts).

Of the power sites on the smaller streams of the upper Green River Basin, those on the New Fork River below New Fork Lake, Lake Creek, Pine Creek, Pole Creek, and Boulder Creek are here described. The physical characteristics on each stream are similar. Each of the small streams that drain the high rugged peaks of the Wind River Mountains collects in a glacial lake on a morainal bench flanking the mountain range, and upon leaving the lake the descent to the valley floor is rapid. These lakes are thus ideally situated for reservoirs, and with low dams storage capacity can be developed to furnish regulation of the streams, a condition which is vitally important to their value for power development, because of the fact that the natural flow during the winter is too small to make the streams attractive as sources of power.

The New Fork site is on the New Fork River, just below New Fork Lake (9AC 1). The plan of development suggested by the topographic features is a dam at the outlet of the lake in sec. 15, T. 36 N., R. 110 W., and a pipe line leading from the dam along the south side of the canyon for about 2 miles and thence a penstock about half a mile long leading to the power house, on the stream near the south line of sec. 20, T. 36 N., R. 110 W. The total head that might be developed is about 174 feet, of which 32 feet would be due to the dam. The mean head therefore, allowing for the draft on the storage behind the dam, would be about 160 feet. The equalized flow of the stream as estimated by comparison of drainage area with that of Pine Creek, where fragmentary stream-flow records are available, is about 80 second-feet. The power capacity of the site is accordingly 1,024 horsepower (768 kilowatts). A dam was built at the lake outlet in 1925 for irrigation storage, but it washed out in December, 1927. The Q90 and Q50 natural flows at this site are estimated to be about 12 and 15 second-feet, respectively, and the corresponding power capacities with a head of 142 feet are 136 and 170 horsepower.

The Lake Creek site is on Lake Creek just below Willow Lake (9AC 2). A dam a short distance below the outlet of the lake in sec. 19, T. 35 N., R. 109 W., would develop storage capacity in the lake sufficient to equalize the flow of the creek, and a pipe line is suggested leading from the dam along the south side of the canyon for about 5,000 feet, thence a penstock to a power house at the head of the irrigation canal in sec. 19, T. 35 N., R. 109 W. A head of about 320 feet could thus be developed, and with an estimated equalized stream flow of 57 second-feet the power capacity of the site is about 1,460 horsepower (1,095 kilowatts). Some storage for irrigation is now developed in Willow Lake by a low dam at this site, but a higher dam would be necessary to equalize the flow of the creek. The natural Q90 and Q50 flows are estimated to be about 11 and 14 second-feet, respectively. With a head of 310 feet the power capacities would thus be 273 and 347 horsepower.

The Pine Creek site is on Pine Creek within 2 miles north of Pinedale (9AC 3). The topographic features along Pine Creek suggest a low diversion dam across the creek less than a mile downstream from Fremont Lake, in sec. 27, T. 34 N., R. 109 W., a pipe line from the dam along the south side of the creek, and a penstock leading to a power house on a small flat just below the cascades. A head of 150 feet could thus be developed. Some fragmentary stream-flow records are available on Pine Creek at a gaging station a short distance below the outlet of Fremont Lake. The natural Q90 and Q50 flows of the stream are estimated from available records to be about 35 and 45 second-feet, respectively. The corresponding power capacities of the site with a 150-foot head would be about 420 and 540 horsepower. If the lake were to be used as a reservoir with sufficient storage capacity to regulate the stream, the estimated equalized flow is about 165 second-feet, and thus the power capacity of the site would be 1,980 horsepower (1,485 kilowatts). A portion of this site is now used by the small hydroelectric plant described elsewhere in this report under the subject "developed power." Further development of the site must also be governed by the irrigation diversion, which is about half a mile below the lake outlet.

The Pole Creek site is on Pole Creek below the Half Moon Lakes (9AC 4). The topographic features suggest two possible sites, both of which could be developed and the lakes utilized as storage reservoirs. Within about half a mile below Little Half Moon Lake the creek falls about 90 feet. A dam at the lake outlet near the south line of sec. 14, T. 34 N., R. 108 W., would serve as a diversion dam and a storage dam. A pipe line along the east side of the creek would pass over a low saddle in the hill, cutting a bend in the course of the creek, and thence a short penstock would lead to the power house near the south line of sec. 23, T. 34 N., R. 108 W. No stream-flow data are available for this creek, but an estimate derived by comparison of its drainage area with that of Pine Creek and a study of all records available in the basin indicates that an equalized flow of about 90 second-feet might be maintained by means of storage in the lakes. The power capacity of the site is accordingly about 790 horsepower (592 kilowatts), by using a combination storage and diversion dam.

For a little more than a mile below this site the creek flows through a small basin with a fall of about 20 feet to the mile, and then it enters the canyon, dropping down from the morainal plateau to the floor of New Fork Valley. The grade through this canyon is fairly uniform, broken slightly by a succession of alternate still places and short rapids. The topographic features suggest the following plan of development for power of this stretch of the stream (9AC 5): A low diversion dam at the head of the canyon, with a pipe line along one or the other side of the canyon about 2½ miles long, leading to a power house near the center of sec. 4, T. 33 N., R. 108 W. The available head is about 210 feet, and with an estimated stream flow of 90 second-feet the power capacity of the site is 1,512 horsepower (1,134 kilowatts). The natural Q90 and Q50 flows of the creek are estimated to be about 16 and 20 second-feet, respectively, and the corresponding power capacities of the two sites are about as follows: Upper, 115 and 144 horsepower; lower, 269 and 336 horsepower.

The Boulder Creek site is on Boulder Creek just below Boulder Lake (9AC 6). The plan of development, as suggested by the topographic features, comprises a dam at the lake outlet in sec. 14, T. 33 N., R. 108 W., and a pipe line extending from it, along the east side of the creek, to a power house at the head of the irrigation canal in sec. 23, T. 33 N., R. 108 W. Greater head could be developed with a longer pipe line down the other side of the creek, where the hill slope does not break away so suddenly, and a power plant could be located farther down the creek, but this plan would be restricted in the use of water during the irrigation season by the operation of the above-mentioned canal. Apparently a dam sufficiently high to regulate the flow of the creek completely could be built in the canyon a short distance below the lake, and from a study of the incomplete stream-flow records that are available for this creek, it is estimated that an equalized flow of 100 second-feet could be obtained. The head available with a 45-foot dam would be from 110 to 150 feet. On the assumption that the mean head under operating conditions would be 130 feet, the power capacity of the site with a stream flow of 100 second-feet is 1,040 horsepower (780 kilowatts). Without storage the Q90 and Q50 flows of Boulder Creek are about 36 and 45 second-feet respectively, and the corresponding power capacities of the site with a 110-foot head would be 317 and 396 horsepower.

Undeveloped power sites in the upper Green River Basin

[Estimate of power based on static head and over-all plant efficiency of 70 per cent]

Index No.	Power site	Stream	Static head (H) (feet)	With existing flow				With regulated flow	
				Q90	Q50	Horsepower		Q90	Horsepower (0.08H ×Q90)
						0.08H ×Q90	0.08H ×Q50		
9AA 1	Big Bend	Green River	60-110					130	830
9AA 2	Wells	do	45- 90					190	1,064
9AA 3	Aspen Ridge	do	90-120					160	1,400
9AC 1	New Fork	New Fork River	142-174	12	15	136	170	80	1,024
9AC 2	Lake Creek	Lake Creek	310-320	11	14	273	347	57	1,460
9AC 3	Pine Creek	Pine Creek	150	35	45	420	540	165	1,980
9AC 4	Pole Creek (upper)	Pole Creek	90-110	16	20	115	144	90	790
9AC 5	Pole Creek (lower)	do	210	16	20	269	336	90	1,512
9AC 6	Boulder	Boulder Creek	110-150	36	45	317	396	100	1,040
						1,530	1,933		11,100

YAMPA AND WHITE RIVER BASINS

Water-power sites in the basins of the Yampa and White Rivers have received little serious consideration by anyone. A number of preliminary studies and reconnaissance investigations have been made at different times, but the conclusions seem to be the same each time, namely, that the local market can be more cheaply served by steam-generated power than by development of the smaller hydroelectric sites, and the large sites that are available are too costly and too remote from sufficient market to make them economically feasible at present.

The regimen of the streams, like that of the streams in the upper Green River Basin, is seriously affected by ice during the winter, and this condition of course detracts from their value for power use. Furthermore, although the streams of this part of the Green River Basin, especially those draining the eastern part, have a high run-off per square mile, there is a wide fluctuation between high and low water stages of stream flow that must be equalized by storage reservoirs if the power value of the stream is to be made worth considering.

The principal power sites in these basins are described below.

The Upper Bear site (9CA 1) is on the Yampa River about 14 miles south of Steamboat Springs. A power development is suggested at this place as an incident to the development of the Upper Bear reservoir site. The topographic features suggest a dam 190 feet high, with the power house at the dam. This plan would create a reservoir having a capacity of 125,000 acre-feet, and by using the upper 80 feet of the storage for stream control and regulation, the available static head would not fall below 100 feet, dropping from 180 feet to that point as the water was used from storage. It is estimated that in this way a flow of about 157 second-feet could be maintained, or by increasing the flow through the plant from 126 to 220 second-feet as the water might be drawn down in the reservoir and the head on the plant diminished, the power output would be about 1,820 horsepower (1,365 kilowatts).

The Morrison Creek (9CA 2) site is on Morrison Creek about 13 miles south of Steamboat Springs. This creek for about 3 miles below its junction with Silver Creek flows through a steep, narrow canyon with a fall of about 900 feet. Some detailed survey studies were made of this site by Mr. A. V. E. Wessels, of Steamboat Springs, and records were kept of the flow of the creek near its mouth for about three and one-half months in 1927. The plan of development that is suggested by the topographic features along the stream is a dam at the head of the canyon above mentioned, located approximately in the NE. ¼ sec. 10, T. 3 N., R. 84 W. with a pipe line leading from the dam to a power house near the north quarter corner of sec. 33, T. 4 N., R. 84 W. The survey work on the project suggests a dam 80 feet high, and this would create a reservoir that would have a surface area of about 880 acres. The stream-flow records available are insufficient to indicate the annual run-off of the creek, but by comparison with records on the Yampa River at Yampa and Steamboat Springs it is estimated at possibly 25,000 to 30,000 acre-feet. The proposed reservoir site is large enough to afford complete regulation of the stream. The estimated natural Q90 flow of the stream is about 10 second-feet, and the Q50 flow about 15 second-feet; the corresponding power capacities are 720 and 1,080 horsepower. The estimated regulated flow is about 38 second-feet, and the corresponding power capacity 2,740 horsepower (2,055 kilowatts). Winter conditions are likely to be troublesome at this power site and others in this region. This is apparent from the fact that stream-flow records were being collected in 1921 and 1922 on Walton Creek near Steamboat Springs, in connection with power studies of that stream, and owing to the low stage of the stream during the winter this work was discontinued and the stream was considered impracticable for power use.

The Elk River site (9CA 3) is on the Elk River about 4 miles above Clark. The Elk River at this place has an annual run-off of about 280,000 acre-feet, but about 66 per cent of this is discharged during May and June. Accordingly the natural regimen of the stream is not suitable for general power use. Furthermore, the grade of the river is rather flat, and this precludes any economical high-head development, so that the power potentialities of the stream are not considered first class. However, the topographic features suggest the possibility of a reservoir at Hinman Park (see p. 120) to store 43,600 acre-feet and a pipe line from the dam in sec. 18, T. 9 N., R. 84 W., along the north side of the river, terminating in a penstock leading to a power house about half a mile above the mouth of Willow Creek, in sec. 13, T. 9 N., R. 85 W. (See Hahns Peak topographic map, U. S. Geol. Survey.) This plan would provide a fixed head of about 110 feet in the pipe line and a maximum additional head of 150 feet, depending on the depth of water at the dam in the reservoir. If the reservoir were not used the natural Q90 and Q50 flows of the stream would be about 65 and 100 second-feet, respectively, and the corresponding power capacities of the site would be 572 and 880 horsepower. By using the amount of regulation afforded by the reservoir, the stream flow could probably be maintained at about 165 second-feet, which with the additional head incident to the use of the reservoir would make the power capacity of the site about 2,440 horsepower (1,835 kilowatts).

The Mad Creek sites (9CA 4) are along Mad Creek in the 5½-mile stretch below the unsurveyed north line of sec. 29, T. 8 N., R. 84 W. The total fall of the creek in this stretch is 1,750 feet, and the topography as shown on the Hahns Peak topographic map suggests a development of this fall in two projects, which are here designated upper and lower sites. The same plan of development is suggested for both sites—a low diversion dam to turn the water into a pipe-line conduit along the north and west side of the canyon, terminating in a penstock leading to a power house. At the upper site the dam would be approximately at the north line of unsurveyed sec. 29, T. 8 N., R. 84 W., about 8,500 feet above sea level. The proposed pipe line would be about 2 miles long, and the penstock about 2,100 feet long. The power house would be about on the north line of T. 7 N., R. 84 W., on the north side of the creek, at an altitude of about 7,550 feet. The gross head thus available is 950 feet. The diversion dam for the lower site is suggested just below the upper power house, at an altitude of 7,500 feet. The pipe line for this site would be a little more than 3 miles long, and the penstock about 2,100 feet long. The power house would be about 2,000 feet upstream from the mouth of the creek, in sec. 14, T. 7 N., R. 85 W., at an altitude of about 6,750 feet. The head would accordingly be 750 feet. The natural regimen of Mad Creek is no doubt responsible for its name. The flow ranges from 8 second-feet or less during the low-water season to more than 900 second-feet during the spring run-off. Complete stream-flow records of the creek are lacking. There are no records for the months of December, January, February, and March, and those for the remaining months are complete for only two years. The Q90 flow of the stream is estimated at 5 to 8 second-feet; the Q50 flow about 20 to 25 second-feet. With these stream flows the corresponding combined power capacity of both sites would be about 860 and about 3,000 horsepower. It is estimated that by utilizing the Swamp Park reservoir site a Q90 flow of about 30 second-feet could be maintained, and the power capacity of the sites would then be about 2,280 horsepower (1,710 kilowatts) for the upper site, and 1,800 horsepower (1,350 kilowatts) for the lower site. The total annual run-off from Mad Creek is estimated to be about 92,000 acre-feet, but there are insufficient reservoir sites to equalize the flow, and this fact detracts from the power value of the stream, as its natural regimen is so unsuitable for power use.

West of the Elk River drainage basin the streams tributary to the Yampa River are even less suitable for power use than those already mentioned. Their regimen in general is characterized by wide variations in stage, with very low minimum flow; their grade is comparatively flat, so that long conduits would be necessary to obtain any amount of head; and the topographic conditions generally would necessitate high unit construction costs for the amount of power that could be developed. Accordingly these streams are considered as having no power value.

The power possibilities along the Yampa River west of Craig were made the subject of a special survey and investigation by the Geological Survey in 1922. Previous surveys by the Bureau of Reclamation of the Cross Mountain and Juniper reservoir sites were available, and accordingly the mapping work of the Geological Survey began at Cross Mountain and extended downstream to the mouth of the river, a distance of 59 miles. The results of this work with that previously done by the Bureau of Reclamation are published by the Geological Survey under the title "Plan and profile of Yampa River, Colo., from Green River to Morgan Gulch," consisting of 5 sheets (3 plans and 2 profiles). The plan sheets show the topography along the stream with a contour interval of 20 feet on land and 5 feet on the river surface. The scale is 2 inches to 1 mile. In addition to these general sheets is one on a scale of 1 inch to 200 feet with a contour interval of 10 feet, showing greater detail at sections of the canyon designated the Browns Draw, Johnsons Draw, and Sand Draw dam sites. Warren Oakey accompanied this topographic survey party as a hydraulic engineer, and liberal use of information contained in his manuscript report on the "Power and storage possibilities of Yampa River between Craig, Colo., and the junction of Yampa and Green Rivers" is made in this report. Six power sites are suggested in the 93-mile stretch of the Yampa River from Juniper Canyon to its mouth. These are designated the Juniper, Cross Mountain, mile 39.5, Browns Draw, Johnsons Draw, and Sand Draw sites, in order of their position downstream. In Mr. Oakey's discussion of these sites a fixed plan of development is suggested for the Juniper and Cross Mountain sites. Then by using the Johnsons Draw and Sand Draw sites in combination with either the mile 39.5 or the Browns Draw site, as these are alternate sites, four plans of development have been prepared. In each of these plans, however, the total amount of power that may be developed is approximately the same.

The Juniper site (9CB 1) is in Juniper Canyon about 10 miles southeast of Maybell. The canyon is only about 2 miles long, and the proposed dam site is near its head, in the eastern part of sec. 18, T. 6 N., R. 94 W. (See sheet C of plan and profile maps.) In 1904 a survey was made of this site by the Bureau of Reclamation, and in 1915 three borings were made in the river bed to determine the bedrock conditions. (See pl. 9.) Holes 1 and 2 were about 1,800 feet from the head of the canyon, and bedrock was found in these at depths of 17 and 13 feet respectively. Hole 3 was about 800 feet upstream from the other two, and bedrock was found there at a depth of a little less than 24 feet. Silt observations were also taken during the period of this work, May 14 to June 30, 1915, and the results indicated a silt content of 21.75 pounds to the cubic foot of water.

In 1923 a further investigation of this site was made by the Bureau of Reclamation to determine the feasibility of its use for supplying irrigation water to the Lower White River or Deadmans Bench project. For this project a dam was designed for a depth of water of 124 feet on its upstream face. The proposed surface altitude of the full reservoir was 6,088 feet, and the total storage capacity was estimated at 638,000 acre-feet. In order to reach the lands under the project a canal would tap the reservoir at an altitude of 6,072 feet, and thus with a minimum water surface of 6,074 feet in the reservoir an available usable storage capacity of 142,000 acre-feet would be made possible. This would require dead storage in the reservoir of 496,000 acre-feet and would also add serious complications to any stream regulation of the river below the dam, as well as deplete the flow by at least 142,000 acre-feet. Cost estimates of this project indicate that $255 or more an acre would be required for its development, and accordingly the project has been declared economically infeasible at this time. As a power project it is suggested that the dam at this site be high enough to carry a water depth of 150 feet. In the upper 80 feet of the reservoir a capacity of about 700,000 acre-feet will be available, and a mean head of about 110 feet would be usable for power development.

Records of the flow of the Yampa River at Maybell, though not complete for very many years, have been studied along with records of other stations in the Green River Basin, and results of these studies indicate that the mean annual run-off of the river at this place is about 1,350,000 acre-feet. As no large tributaries enter the river between the gaging station and the proposed Juniper dam site, it is assumed that this run-off is approximately what passes the Juniper dam site. The natural regimen of the stream is quite unsuitable for power use, as it fluctuates from a minimum of less than 100 second-feet to a maximum of about 18,000 second-feet and is for 50 per cent of the time nearly 800 second-feet. Owing to the erratic nature of the flow a storage capacity of about 2,000,000 acre-feet would be required to regulate the stream completely. Accordingly, it is estimated that by using a storage capacity of 700,000 acre-feet a constant flow of about 1,450 second-feet can be maintained. Under these conditions the power capacity of the site is 12,760 horsepower (9,570 kilowatts).

The Cross Mountain site (9CB 2) is at Cross Mountain Canyon, about 15 miles down the river from Maybell. The canyon is roughly 3 miles long, and in passing through it the river falls 175 feet. Several good dam sites are available in the canyon, but the development of any of them with a high dam would inundate considerable improved land in the Maybell Valley and would also preclude the use of the canyon as a proposed railroad outlet from the Yampa River Valley westward. Accordingly the following plan of development at this site is suggested.

A low diversion dam probably 5 feet high could be built in the river about 600 feet below the head of the canyon near the east line of the NE. ¼ sec. 13, T. 6 N., R. 98 W. With a pipe line about 3 miles long or a tunnel 2½ miles long to a power house at the mouth of the canyon a head of 175 feet could be developed. Thus with the regulation of the river that could be effected by using 700,000 acre-feet storage in the Juniper Reservior as above outlined a stream flow of about 1,460 second-feet could probably be maintained. Under these conditions the power capacity of the site is 20,440 horsepower (15,330 kilowatts). If the natural flow of the river were to be developed at this site the power capacity would be about 5,000 horsepower for 90 per cent of the time and 12,500 horsepower for 50 per cent of the time, the estimated stream flow for the corresponding periods being 360 and 890 second-feet.

Immediately below Cross Mountain Canyon the river valley broadens into an area known as Lily Park, and as the river leaves this park it enters Blue Mountain Canyon. Near the head of this canyon a dam 55 feet high could be constructed without interfering with the Cross Mountain power development. The reservoir created by such a dam would have a storage capacity of about 90,000 acre-feet, which could be used for regulation of stream flow, but it is not sufficient to store more than about one-fourth of the run-off of the Little Snake River, which joins the Yampa within Lily Park. The same storage capacity could be developed, however, by building a high dam at the mile 39.5 dam site or the Browns Draw dam site.

The mile 39.5 site (9CD 1) is at mile 39.5 of the survey made of the river by the Geological Survey in 1922, approximately at the southeast corner of sec. 22, T. 6 N., R 100 W. sixth principal meridian. At this site the canyon is comparatively narrow, and the topographic conditions suggest a dam 120 feet high. This would utilize all the fall between the dam site and the power house of the Cross Mountain project and would provide about 94,000 acre-feet storage in the Lily Park area. By means of a tunnel 1,100 feet long to a point on the river at mile 38.5 a maximum head of 130 feet could be made usable. The estimated regulated stream flow with this development and the 700,000 acre-feet regulation at the Juniper site is about 1,790 second-feet, and the mean operating head would be about 110 feet. Under these conditions the power capacity of the site is 15,750 horsepower (11,810 kilowatts).

The Browns Draw site (9CD 2), which is suggested as an alternate plan of development with the mile 39.5 site, is near the east line of unsurveyed sec. 13, T. 6 N., R. 101 W. sixth principal meridian, about 1 mile below Browns Draw, at mile 32 of the above-mentioned river survey. At this place a dam is suggested to raise the water surface 265 feet. This would inundate Lily Park up to the tail-water of the proposed Cross Mountain development and would provide a storage capacity of about 194,000 acre-feet for stream regulation. By using the upper 100 feet of this dam for storage the mean operating head at the power house at the dam would be about 215 feet, and with an estimated regulated flow of about 1,980 second-feet the power capacity of the site would be 34,000 horsepower (25,500 kilowatts).

The Johnsons Draw site (9CD 3) is about half a mile above Johnsons Draw, at mile 21.5 of the Yampa River survey, about on the line between unsurveyed secs. 10 and 11, T. 6 N., R. 102 W. sixth principal meridian. According to Mr. Oakey this is the most favorable dam site in Blue Mountain Canyon, although it is very inaccessible. If the dam site at mile 39.5 is used a dam 300 feet high is suggested at the Johnsons Draw site in order to develop all the fall in the river between the two sites. With such a dam and the stream regulation that would be effected by the other upstream developments a constant stream flow of about 1,800 second-feet could be maintained. The power house would be at the foot of the dam, and thus the project would have an operating head of 300 feet. Accordingly the power capacity of the site is 43,200 horsepower (32,400 kilowatts). If a dam were built at the Browns Draw site high enough to raise the water surface 265 feet, the stream regulation thus afforded by this additional storage would give an estimated regulated flow at this place of about 2,000 second-feet. The operating head then at the Johnson Draw site would be 165 feet, and the corresponding power capacity of the site would be 26,400 horsepower (19,800 kilowatts).

Topographic conditions at this site and for several miles downstream suggest an alternate plan of development which adds 60 feet more head on the plant by means of a 6,000-foot tunnel that would connect with a power house about 6 miles downstream from the dam. In this event the power capacity of the site would be 51,840 horsepower with a stream flow of 1,800 second-feet and 57,600 horsepower with a stream flow of 2,000 second-feet.

If the Browns Draw dam site were to be developed instead of the one at mile 39.5, it would preclude the 300-foot dam at the Johnsons Draw site and leave a head of only 165 feet to be developed there, plus the 60 feet that could be gained by the proposed tunnel, making a total of 225 feet. The power capacity of the site in that case would be 30,800 horsepower with an estimated stream flow of 1,800 second-feet. This site would be flooded by the development of the Echo site on Green River.

The Sand Draw dam site (9CD 4) is about a quarter of a mile above Sand Draw, or about 1.3 miles above the mouth of the Yampa River. A dam to raise the water 140 feet at this site would develop all the fall between this and the Johnsons Draw dam site, and in case the proposed tunnel at the Johnsons Draw site were built the available head at the Sand Draw site would then be reduced to 80 feet. The estimated stream flow at this site with the regulation afforded by the Juniper development is about 1,800 second-feet; with the additional storage that might be developed at Lily Park by a high dam at the Browns Draw site it would be about 2,000 second-feet. Under these conditions the power capacity of the site with a 140-foot developed head would be 20,160 and 22,400 horsepower respectively. With an 80-foot head the corresponding power capacities would be 11,500 and 12,800 horsepower. This site would be flooded by the development of the Echo site on the Green River.

In the White River Basin there are no attractive power sites. The principal tributary streams, such as North Fork, South Fork, and Marvine Creek, have steep grades along their upper stretches, but the topography consists of rolling hills that form a broad, open valley and furnish no suitable sites for water-power conduits. The fall along the lower reaches of these streams is about 50 feet to the mile, and this may be developed in the same manner as at the plant now operating at Meeker. This would serve any small local power demand that might justify such development.

On the lower part of the White River near the Colorado-Utah line the Rangely reservoir site has been suggested as a means of stream-flow regulation and control at that place, and a power development is suggested in connection with this project. This site (9BH 1) is in sec. 12, T. 1 N., R. 104 W., at the Rangely dam site. The suggested plan of development is a dam to raise the water surface 180 feet. This would form a reservoir having a capacity of about 650,000 acre-feet. The estimated annual run-off of the river at this place is probably a little more than 500,000 acre-feet, and in view of this fact an estimated equalized flow of about 750 second-feet is considered the available flow. With a drawdown of 80 feet on the proposed reservoir the stream flow can apparently be equalized, and the operating head at a power plant located at the foot of the dam will range from 100 to 180 feet. Accordingly the power capacity of the site will average about 8,400 horsepower (6,300 kilowatts). This site is remotely situated and is therefore not attractive as a power site.

Undeveloped power sites in Yampa and White River Basins

[Estimate of power based on static head and over-all plant efficiency of 70 per cent.]

Index No.	Power site	Stream	Static head, H (feet)	With existing flow				With regulated flow	
				Q90	Q50	Horsepower			
						0.08H× Q90	0.08H× Q50	Q90	0.08H ×Q90 (horse power)
9CA 1	Upper Bear	Yampa	100–180					157	1,820
9CA 2	Morrison Creek	Morrison Creek	900	10	15	720	1,080	38	2,740
9CA 3	Elk River	Elk River	110–260	60	100	570	880	165	2,440
9CA 4	Mad Creek	Mad Creek	950	5–8	20–25	860	3,000	30	4,080
9CB 1	Juniper	Yampa River	110					1,450	12,600
9CB 2	Cross Mountain	do	175	360	890	5,000	12,500	1,460	20,440
9CD 1	Mile 39.5	do	[a] 110					1,790	15,750
9CD 2	Browns Draw	do	[a] 215					1,980	[b] 34,000
9CD 3	Johnsons Draw	do	300					1,800	[c] 43,200
9CD 4	Sand Draw	do	140					2,000	[d] 22,400
9BH 1	Rangely	White River	[a] 140					750	8,400
						7,150	17,460		[e] 135,320

[a] Mean or average.
[b] Development to this capacity would preclude development of the site at mile 39.5.
[c] Development to this capacity would preclude development of the site at Browns Draw and would back water up to mile 39.5. Thus if Browns Draw site were developed the dam at Johnsons Draw would be limited in height to 165 feet, and the power capacity of the site would then be 26,400 horsepower.
[d] Development to this capacity would back water up to Johnsons Draw site. As an alternate plan, a dam 80 feet high is suggested at Sand Draw and a tunnel driven in connection with Johnsons Draw development. This would add 60 feet more head to the Johnsons Draw site, making its capacity about 57,600 horsepower and reducing the capacity of the Sand Draw site to 12,800 horsepower.
[e] Total based on development of Browns Draw to 34,000 horsepower, Johnsons Draw to 26,400 horsepower, using 165-foot dam, and Sand Draw to 22,400 horsepower.

UINTA BASIN IN UTAH

The best power sites in the Uinta Basin are on the northern tributaries of the Duchesne River. All these streams head near the crest of the Uinta Range and flow southward. The canyons have a U-shaped cross section that is due to glaciation. Inner rock gorges have been cut through stretches of these canyons, and in some of them the bed of the stream is 50 feet or more below the general level of the valley bottom. All the canyons have a steep grade, ranging from 100 to 300 feet to the mile, and near their mouths canals divert the water for irrigating the terraces that flank the main mountain range.

Several investigations of the power resources of this basin have been made at different times since 1908. The latest one consisted of surveys of the principal streams by the Geological Survey in 1923–24. The results of these surveys are published on 6 sheets (A to F), 3 plans and 3 profiles. The scale of these maps is 2 inches to the mile, and topography is shown with a contour interval of 20 feet. The cross sections at the Hades dam site, on the North Fork of the Duchesne River, and the Stillwater dam site, on Rock Creek, are shown on a larger scale. The maps are obtainable from the Geological Survey at 60 cents for the set.

UPPER DUCHESNE RIVER

From its headwaters to the West Fork the Duchesne River falls about 5,000 feet, of which 1,700 feet is in the lower 15 miles of the canyon. From Stockmore down to Duchesne it falls about 1,700 feet in a distance of 35 miles. Below Stockmore, however, the power possibilities are negligible because of the use of the stream for irrigation.

Two power sites are suggested by the topography along the upper reaches of the river. For the purpose of identification the upper one of these is here designated the Upper North Fork site (9BB 1). It contemplates the development of the fall of 750 feet in the 5½ miles of river above the mouth of Hades Creek. Topographic conditions suggest a low diversion dam in the NW. ¼ sec. 26, T. 3 N., R. 9 W., Uinta special base and meridian, and a pipe line along the east wall of the canyon to a power house in sec. 23, T. 2 N., R. 9 W., about 1¼ miles upstream from Hades Canyon. The estimated Q90 flow at this site is 10 second-feet, and the Q50 flow is about 15 second-feet. The corresponding power capacities are 600 and 900 horsepower, or 450 and 670 kilowatts.

The other site, here designated the Lower North Fork site (9BB 2) was carefully investigated by the Great Basin Power Co. at one time, and a preliminary permit covering it was issued by the Federal Power Commisssion in 1921. No construction work was done on the project, however, and the permit expired in 1923. The proposed plan of development at this site consists of a storage reservoir on the North Fork in secs. 22, 23, 26, and 27, T. 2 N., R. 9 W.; a pipe line along the west wall of the canyon to a power house in sec. 19, T. 1 N., R. 8 W., at the mouth of the West Fork; a diversion dam on the West Fork in sec. 29, T. 1 N., R. 9 W.; and a pipe line along the north wall of the West Fork Canyon to the same power house, with an auxiliary pipe line to carry the waters of Wolf Creek into the West Fork pipe line. This plan requires about 11 miles of pipe line, and the fixed static head on the plant is 415 feet. With storage, however, the head on the North Fork would range from 415 feet with the reservoir empty to 515 feet with it full. Gaging stations were installed on the North Fork below the mouth of Hades Creek, on Wolf Creek near its mouth, and on the West Fork above its confluence with Wolf Creek. Records of stream flow are available for these stations from August, 1921, to September 30, 1923. From a study of these and other records on the Duchesne River at Tabiona and Myton it is estimated that the natural Q90 flow at this site is 45 second-feet, and the natural Q50 flow about 75 second-feet. Accordingly, with a static head of 415 feet the corresponding power capacities of the site are 1,490 and 2,490 horsepower, or 1,118 and 1,868 kilowatts.

By using the Hades reservoir site, as proposed by the Great Basin Power Co., the stream flow of the North Fork can be equalized with a storage capacity of about 25,000 acre-feet, and it is then estimated that the Q90 flow at the power house would be about 90 second-feet and that a Q50 flow of about 185 second-feet would be possible. This condition would make the power capacity of the site 3,350 and 6,880 horsepower, respectively, or 2,513 and 5,160 kilowatts.

ROCK CREEK

The East, North (or Middle), and West Forks of Rock Creek, flow through deep, rocky canyons from the lakes at their sources. The main canyon broadens below the mouth of the South Fork in sec. 21, T. 2 N., R. 7 W., Uinta special base and meridian and the stream channel is flanked on both sides by high bench lands. The total fall of Rock Creek from its headwaters to the head of the highest proposed irrigation canal near the mouth of the canyon is about 3,300 feet in a distance of approximately 16 miles. The topographic conditions suggest two power developments, here designated upper site and lower site.

At the upper Rock Creek site (9BB 3) a diversion dam is suggested near the south line of sec. 8, T. 3 N., R. 7 W., at an altitude of 9,000 feet, and a similar dam at the same altitude on the West Fork in the western part of sec. 36, T. 3 N., R. 8 W. From the first dam a pipe line would run along the west wall of the canyon to join another line along the north side of West Fork Canyon. A penstock would lead from the junction of these pipe lines to a power house at the confluence of the two streams in the SW. ¼ sec. 5, T. 2 N., R. 7 W. The pipe line from Rock Creek would be nearly 5 miles long, and the one from the West Fork about 2 miles long. The static head available is 780 feet. The pipe lines would be built along steep, rocky slopes covered with a dense growth of brush and fallen trees. The estimated Q90 stream flow is 35 second-feet, and the Q50 flow about 55 second-feet. The corresponding power capacities are 2,380 and 3,740 horsepower, or 1,785 and 2,800 kilowatts. By developing the storage in the headwater lakes above the power site about 10,150 acre-feet could be made available for regulating the stream. Accordingly, the regulated Q90 flow would be about 55 second-feet and the Q50 flow about 90 second-feet. The corresponding power capacities of the site are 3,740 and 6,120 horsepower, or 2,800 and 4,590 kilowatts. Storage in these lakes would be valuable also for supplementing and extending the present irrigation use of the stream in the lower valley.

At the lower Rock Creek site (9BB 4) the topography suggests a diversion dam just below the forks in sec. 5, T. 2 N., R. 7 W., Uinta special base and meridian, with a pipe line along the east wall of the canyon and a power house in the SE. ¼ sec. 25 of the same township. South Fork, entering from the west, could be diverted into a supplemental pipe line near the southwest corner of sec. 20 of this township, and with a pipe line 1¼ miles long it could be tapped into the main pipe line, which would be about 4½ miles long. The static head available at this site is 710 feet. The estimated Q90 and Q50 natural stream flows at the site are 55 and 85 second-feet, respectively, and the corresponding power capacities of the site are 3,124 and 4,828 horsepower, or 2,343 and 3,620 kilowatts. Approximately 1,000 acre-feet more storage than at the upper site can be made available in six other lakes. Accordingly, with a total storage capacity of 11,150 acre-feet the Q90 and Q50 stream flows at the lower site would be about 78 and 125 second-feet, respectively. The corresponding power capacities are 4,430 and 7,100 horsepower, or 3,323 and 5,325 kilowatts.

STRAWBERRY RIVER

The Starvation site (9BB 5) is on the Strawberry River at the Starvation reservoir site. A power house is suggested at the dam in secs. 28 and 29, T. 3 S., R. 5 W., Uinta special base and meridian. With a drawdown of 75 feet in the reservoir about 85,000 acre-feet of storage capacity would be available for stream regulation. The operating head would fluctuate between 50 and 125 feet If this reservoir were to be built for power use only and the water surface maintained at full stage a constant head of 125 feet would be available. The Q90 flow would be about 75 second-feet, and the Q50 flow about 125 second-feet. The corresponding power capacities would be 750 and 1,250 horsepower, or 560 and 936 kilowatts. It is not probable, however, that this site would be developed for power alone, because of the high cost for the amount of power available, and furthermore the reservoir would be more valuable for irrigation use. As an incident to irrigation, power might be developed at this site, but the Q90 stream flow would be very uncertain. The reservoir capacity is about half of the total annual run-off of the river, and during some months of the year the entire flow would be retained behind the dam.

By means of a feeder canal about 6 miles long from a point on the Duchesne River above Tabiona, the surplus water of that stream could be carried around the base of Tabiona Mountain into the Strawberry River at the head of Rabbit Gulch, above the Starvation reservoir site. This would make available for irrigation and power use at least part of the Duchesne flood flow, which usually occurs after the high water has ceased on the Strawberry River and would supply the early season draft on the reservoir. It is estimated that with this plan of development during the irrigation season at least and possibly for a period of five or six months the stream flow that could be used for developing power would be about 425 second-feet. The power capacity of the site with a 75-foot drawdown on the reservoir would then be about 2,720 horsepower, or 2,040 kilowatts.

LOWER DUCHESNE RIVER

The Pleasant Valley site (9BB 6) is on the Duchesne River below its junction with the Strawberry River. The topography suggests the following plan of power development: The ditch of the Pleasant Valley Canal Co. should be enlarged from its head, near the southwest corner of sec. 32, T. 3 S., R. 4 W., Uinta special base and meridian, to a point about 5 miles below, where a drop of 70 feet into the Gray Mountain Canal can be utilized. This project, however, involves 2 miles of difficult construction on steep hillsides and a long siphon across Cottonwood Gulch. It would be possible to use the entire flow of the Duchesne River at this site, turning what may be required into the irrigation canal and allowing the rest to flow back into the river channel. Without any regulation the Q90 flow is estimated at about 235 second-feet and the Q50 flow at about 355 second-feet. The corresponding power capacities are 1,310 and 1,990 horsepower, or 980 and 1,490 kilowatts.

By developing the Starvation reservoir site a storage capacity of 95,000 acre-feet could be obtained, and although this water would be used primarily for irrigation it could also be used for power. It is not likely, however, that any of the storage water would be available for Q90 flow, and the storing of the water would possibly affect the present natural Q90 flow. Accordingly, no estimate is given of the

Q90 flow with the reservoir in operation, but is is estimated that the Q50 flow would be about 750 second-feet. The power capacity of the site would then be 4,200 horsepower or 3,150 kilowatts.

LAKE FORK

Lake Fork is formed by the junction of the West Fork and the East or Yellowstone Fork of the Duchesne River after each one flows through a deep rugged canyon.

The West Fork is about 20 miles long, and in this distance it falls about 2,000 feet. Three lake-fed streams enter from the west, and Moon Lake occupies a basin in the main canyon about 12 miles from the source. In a distance of 6½ miles upstream from Moon Lake the fall is more than 900 feet, and from the lake outlet about 2 miles downstream to the head of the Farnsworth Canal the fall is 300 feet. Any power development on the West Fork below the Farnsworth Canal would be in conflict with irrigation use of the stream and therefore would present complications—a fact that detracts from the power value of the site. Furthermore, the topographic conditions are less suitable for power development than those farther upstream. Two power sites are suggested on the West Fork, one above Moon Lake, designated Upper West Fork site, and one just below Moon Lake, designated Moon Lake site.

At the Upper West Fork site (9BC 1) the topography suggests a diversion dam in the southeast corner of sec. 9, T. 3 N., R. 6 W., just below the junction of the three main forks of the West Fork, and a pipe line along the west wall of the canyon, terminating in a power house in the NW. ¼ sec. 1, T. 2 N., R. 6 W., above the backwater of the proposed Moon Lake reservoir development. A branch pipe line about 2 miles long could be placed up the Brown Duck Lake stream to a diversion point near the west side of sec. 11, T. 2 N., R. 6 W. The main pipe line would be about 6 miles long, and the static head is 800 feet. The pipe line would run along steep, rocky, forested hill slopes for the greater part of its length. The estimated natural Q90 and Q50 stream flows are 40 and 70 second-feet, respectively, and the corresponding power capacities 2,560 and 4,480 horsepower, or 1,920 and 3,360 kilowatts.

By developing the lake storage possibilities above Moon Lake on the West Fork about 4,730 acre-feet of water could be stored for power and irrigation. As irrigation use takes precedence over power use, and as the natural flow of this stream is not great enough to supply all irrigation needs, the stored water could be used for power only at such times as the two uses may be coordinated. Accordingly the increased flow available at the power sites would be available only during the irrigation season. The estimated stream flow under these conditions is about 50 second-feet for Q90 and 88 second-feet for Q50.

The corresponding power capacities of the sites would be 3,200 and 5,630 horsepower, or 2,400 and 4,224 kilowatts.

At the Moon Lake site (9BC 2) the topography suggests a dam in the SE. ¼ sec. 18, T. 2 N., R. 5 W., with a pipe line along the east side of the canyon to a power house in the eastern part of sec. 29, in the same township. The pipe line would be about 2 miles long and would be built on earth and rock slopes. The power house would be just above the head gate of the Farnsworth Canal. The static head is 280 feet. If a 70-foot dam were built to develop storage capacity in the lake an average additional head of 35 feet could be made available for the power development, and about 34,320 acre-feet would be available for stream regulation. Without storage the estimated Q90 and Q50 stream flows are 45 and 75 second-feet, respectively, and the corresponding power capacities are 1,000 and 1,680 horsepower, or 756 and 1,260 kilowatts.

If the reservoir water were used for power as well as for irrigation practically all of it would have to be used during July, August, and September. This use would not help a great deal in the development of power unless the plant were connected into a system that would permit the generation of all the power possible at the site without regard to the regimen of the stream. The maximum draft on the reservoir for irrigation would begin about July 1 or perhaps a week earlier, the date being dependent upon the season. The draft would then diminish gradually until the end of the season. The available power from this reservoir would be about 7,750,000 kilowatt-hours.

The East or Yellowstone Fork of Lake Fork flows from its source in a southeasterly direction for about 20 miles in a deep rocky gorge. It is joined on the east about midway down by Swift Creek, the principal tributary. About 25 miles from its source it unites with the West Fork to form Lake Fork. The total fall in the stream is over 6,000 feet of which about 2,000 feet is in the lower 16 miles of its course. (See Gilbert Peak topographic map.) In the first 3 miles below the main forks in sec. 10, T. 3 N., R. 5 W., the stream channel is in an inner rock gorge from 50 to 200 feet deep, with a rocky bench along the east side. The general topography, the location of the tributaries, and the stream-flow characteristics suggest two power sites on this stream. These are designated Upper and Lower East Fork sites.

At the Upper East Fork site (9BC 3) the suggested plan of development comprises a diversion dam just below the two forks, in sec. 10, T. 3 N., R. 5 W., and a pipe line along the east side of the canyon to a power house in the NE. ¼ sec. 26 of the same township. The pipe line would be a little more than 3 miles long, and the static head is 600 feet. The estimated Q90 and Q50 stream flows at this site are 35 and 55 second-feet respectively, and the corresponding power capacities 1,680 and 2,640 horsepower, or 1,260 and 1,980 kilowatts. By using some of the headwater lakes for reservoirs about 1,820 acre-feet can be made available for regulating the stream flow. This would give an estimated Q90 flow of 40 second-feet and a Q50 flow of 63 second-feet. The corresponding power capacities would then be 1,920 and 3,020 horsepower, or 1,440 and 2,265 kilowatts.

At the Lower East Fork site (9BC 4) the suggested plan of development includes a low diversion dam in sec. 26, T. 3 N., R. 5 W., near the east line of the section, and a pipe line along the east side of the canyon to a power house about 2 miles upstream from the Crystal ranch, in sec. 15, T. 2 N., R. 4 W. This pipe line would be about 7 miles long and would run mostly along rather smooth morainic benches, crossing Swift Creek with a trestle or siphon and taking up the waters of that stream by means of a branch pipe line nearly three-quarters of a mile long. The static head at this site is 900 feet. The estimated Q90 stream flow without regulation is 50 second-feet and the estimated Q50 flow 80 second-feet. The corresponding power capacities are 3,600 and 5,760 horsepower, or 2,700 and 4,320 kilowatts.

By using eight of the small lakes at the head of the East Fork and Swift Creek about 2,670 acre-feet of storage could be developed. If this water could be used simultaneously for power and irrigation the estimated Q90 flow would be 55 second-feet and the estimated Q50 flow 90 second-feet. The power capacities of the site would then be 3,960 and 6,480 horsepower respectively, or 2,970 and 4,860 kilowatts.

UINTA RIVER

The Uinta River for about 6 miles in its upper part flows in a sharply incised inner gorge in places 100 feet deep. The main canyon is about 20 miles long, and its general cross section is a broad U. The total fall in the river from its headwaters to its confluence with the Duchesne River, a distance of 50 miles, is over 8,500 feet, and about 2,500 feet of this is in the 22-mile stretch above the mouth of Whiterocks River. Part of this fall is to be developed by the completed project of the Uinta Power & Light Co., which contemplates the use of Uinta River as well as Pole Creek at its present power plant.

The topography of the canyon above the Uinta Power & Light Co.'s project suggests another power site, which is here designated the Uinta power site (9BE 1). This site may be developed by a diversion dam about 20 feet high across the river just below the forks, near the south line of sec. 23, T. 4 N., R. 3 W., Uinta special base and meridian, a pipe line along the west side of the canyon to a power house in sec. 32, T. 3 N., R. 2 W. with a short branch line to pick up the flow of a tributary in sec., 2, T. 3 N., R. 3 W. Such a pipe line would be about 9½ miles long, and the head available is 1,500 feet. The country along the proposed line consists of steep rocky slopes covered with trees and bushes, and there would be some difficulties in construction. The estimated Q90 flow without regulation is 55 second-feet, and the Q50 flow 85 second-feet. The corresponding power capacities are 6,600 and 10,200 horsepower, or 4,950 and 7,650 kilowatts. By developing storage in the headwater lakes about 3,480 acre-feet could be made available, and on the assumption that this could be used to advantage for both irrigation and power it is estimated that the Q90 flow would be about 62 second-feet and the Q50 flow about 98 second-feet. The corresponding power capacities of the site would then be 7,440 and 11,760 horsepower, or 5,580 and 8,820 kilowatts.

WHITEROCKS RIVER

The Whiterocks River in that part of its course below the confluence of its two main branches, near the south line of sec. 32, T. 4 N., R. 1 W., Uinta special base and meridian, has a fall of 1,900 feet in a distance of 11½ miles. The topography and location of tributaries through the canyons suggest two power sites, here designated the Upper Whiterocks and Lower Whiterocks sites. (See sheet C of Plan and profile of Duchesne River and tributaries.)

At the Upper Whiterocks site (9BE 2) a low diversion dam could be placed across the stream just below the fork, in sec. 32, T. 4 N., R. 1 W., thence a pipe line would follow down the canyon along the east wall to a power house in the NE. ¼ sec. 36, T. 3 N., R. 1 W. This pipe line would be nearly 8 miles long, and the head available is 1,200 feet. The estimated stream flows are about as follows: Q90, 40 second-feet; Q50, 70 second-feet. The corresponding power capacities are 3,840 and 6,720 horsepower, or 2,880 and 5,040 kilowatts. If the stream flow were regulated by development of storage in the headwater lakes that have been proposed as reservoirs, about 6,150 acre-feet could be made available. With this taken into consideration the Q90 flow would be about 52 second-feet and the Q50 flow about 93 second-feet. The corresponding power capacities would then be 5,000 and 8,920 horsepower, or 3,750 and 6,690 kilowatts.

At the Lower Whiterocks site (9BE 3) a low diversion dam is suggested immediately below the mouth of Paradise Creek, in sec. 36, T. 3 N., R. 1 W., and a pipe line along the east side of the canyon to a power house at the south line of sec. 19, T. 2 N., R. 1 E., all Uinta special base and meridian. Such a pipe line would be about 5 miles long, and the available head is 560 feet. The estimated Q90 stream flow without regulation is 45 second-feet, and the Q50 flow is about 75 second-feet. The corresponding power capacities are

2,016 and 3,360 horsepower, or 1,512 and 2,520 kilowatts. A storage capacity of about 8,476 acre-feet could be developed in the head-water lakes and the Paradise Park reservoir site. The Q90 stream flow would then be about 60 second-feet, and the Q50 flow about 105 second-feet, and the corresponding power capacities would be 2,688 and 4,704 horsepower, or 2,016 and 3,528 kilowatts.

DRY FORK

Dry Fork is the main west fork of Ashley Creek. The upper part of its canyon is a U-shaped trough, but the lower part is bordered by rugged walls that rise 500 to 700 feet above the stream. About 12 miles upstream from its mouth Dry Fork enters a circular basin with banks, except on the upstream side, 75 to 100 feet high. This pool seems to be bottomless, and the stream enters it through several inlets. Below this place for several miles the creek bed is usually dry except during flood stages. Some years ago an attempt was made to carry the flow of the stream around this sink in a flume, but the project was not completed. From Dry Fork post office up to this sink, about 9 miles, the stream falls 1,500 feet. Two important tributaries enter in this stretch, but their flow sinks into the channel of the main creek in the dry season. As a means of carrying the creek flow around these sinks and at the same time making it available for power use the topography suggests the following plan of development (see sheet C, Plan and profile of Duchesne River and tributaries):

At the Dry Fork power site (9BA 1) a low diversion dam in the creek above the sink, at about mile 10 of the river survey, could be used to divert the water into a pipe line along the north side of the canyon. Branch lines could be used to bring the larger tributaries into the main line. The power house could be built at the mouth of a small side canyon just north of the northwest corner of sec. 6, T. 3 S., R. 20 E., Salt Lake base and meridian. The length of the main pipe line would be about 5½ miles, and the head available is 1,000 feet.

A number of miscellaneous stream measurements of Dry Fork and its lower tributaries have been made in connection with studies of the stream, but no record of flow over a period of time has been kept. The gaging-station records on Ashley Creek near the mouth of Dry Fork are valuable, however, in studying the general run-off features from the drainage basin as a whole, but it is not possible with the data available to say with any degree of certainty how much if any of the water of Dry Fork above the sinks gets into Ashley Creek. Accordingly, the amount of water available at the power site is not known, but analysis of all the data at hand affords the basis for an estimate that is believed to be within reason. Without regulation the Q90 and Q50 stream flows are probably about 30 and 45 second-feet, respectively, and the corresponding power capacities of the site are 2,400 and 3,600 horsepower, or 1,800 and 2,700 kilowatts. An estimated storage capacity of 1,260 acre-feet could be developed in some of the headwater lakes on the stream, and with this amount of regulation the Q90 and Q50 stream flows would be about 32 and 50 second-feet respectively, and the corresponding power capacities 2,560 and 4,000 horsepower, or 1,920 and 3,000 kilowatts.

As an alternative development of power from Dry Fork the topography suggests the following plan: A low diversion dam across the creek at an altitude of about 9,150 feet (see Marsh Peak topographic map), and a pipe line along the west side of the canyon to a point about half a mile northeast of Bowles Mill, where it would turn southward across the divide into the drainage basin of Mosby Creek and lead to a power house on this creek near the south line of sec. 6, T. 3 S., R. 19 E., Salt Lake base and meridian. The pipe line would be about 6½ miles long, and the head available is 1,550 feet. The estimated Q90 flow under this plan is 20 second-feet and the Q50 flow 30 second-feet, and the corresponding power capacities of the site 2,480 and 3,720 horsepower, or 1,860 and 2,790 kilowatts. About 900 acre-feet of storage could be developed in lakes above the diversion point of this site, and with this amount of stream regulation the Q90 flow would be about 22 second-feet and the Q50 flow about 33 second-feet, and the corresponding power capacities 2,740 and 4,100 horsepower, or 2,055 and 3,075 kilowatts. Opposition to such a development as this would probably be raised by water users in Ashley Valley, as the water supply now available there is inadequate to meet their needs, and any proposed depletion would not likely be tolerated.

ASHLEY CREEK

For several miles above the present power plant on Ashley Creek the stream is in a deep, narrow canyon, in many places clogged with large boulders and glacial drift. One important tributary enters in this stretch about 3 miles above the plant. The upper end of the canyon broadens into a densely forested basin, and here the main stream is made by the junction of two tributaries. The fall in the 11½-mile stretch of stream above the power house is 2,640 feet. (See sheet C, Plan and profile of Duchesne River and tributaries.) The topography, however, suggests the following plan of development of 1,700 feet of this fall in the stream, the remainder being considered unattractive for power: A low diversion dam could be placed in the main stream at an altitude of about 8,500 feet (9BA 2); this would be below all important headwater tributaries and would be high enough to skirt along the upper rim of the canyon gorge. A pipe line along the west side of the canyon would lead to a power house about a mile above the mouth of the west tributary, at an altitude of 6,800 feet. This pipe line would be about 5 miles long, and by means of a branch line 4 miles long the water of the upper part of the west tributary could be used. The available head at the plant is 1,700 feet. The estimated Q90 stream flow without regulation is 28 second-feet and the Q50 flow about 40 second-feet, and the corresponding power capacities 3,820 and 5,450 horsepower, or 2,865 and 4,146 kilowatts.

By developing storage in the lakes at the headwaters of the creek about 2,440 acre-feet could be made available. Assuming that this could be used without interference with irrigation demands, and adding to it the storage already developed—420 acre-feet—we have a total of 2,860 acre-feet. With this amount of regulation the Q90 flow of the stream would be about 35 second-feet and the Q50 flow about 50 second-feet, and the corresponding power capacities 4,760 and 6,800 horsepower, or 3,570 and 5,100 kilowatts.

BRUSH CREEK

The Brush Creek power site (9BA 3) contemplates the use of Big and Little Brush Creeks northeast of Vernal. The project is proposed by A. E. Humphreys and others and is the subject of an application for preliminary permit with the Federal Power Commission (project 854). The project as outlined in this application is as follows: A reservoir covering 349 acres is proposed on Big Brush Creek at Oaks Park, in sec. 1, T. 1 S., R. 20 E., Salt Lake base and meridian, also a reservoir almost directly east of this on Little Brush Creek, with an area of 245 acres. By means of these two reservoirs it is expected to regulate the flow of these two streams. A third reservoir having an area of 75 acres is proposed between the two creeks, approximately in unsurveyed sec. 35, T. 1 S., R. 21 E., Salt Lake base and meridian. A power house is proposed at this third reservoir, through which the water will pass from a pipe line leading to the Little Brush Creek reservoir. The head at this plant as suggested is 565 feet, and the equalized flow 22 second-feet. Water from the Big Brush Creek reservoir may or may not be run through a power plant into this third reservoir. Two other plants are proposed—one approximately in sec. 19 and the other in sec. 32, T. 2 S., R. 22 E., Salt Lake base and meridian. Water is to be carried to these plants from reservoir No. 3, which is to be used as an equalizing reservoir. Each plant has a head of 1,500 feet, and the proposed equalized stream flow is 42 second-feet. Under these conditions the power capacity of the project is 994 horsepower for plant No. 1 and 5,040 horsepower for each of the other two, or a total of 11,074 horsepower (8,304 kilowatts). No stream-flow data are available for this project.

SUMMARY

Undeveloped power sites in Uinta Basin, exclusive of Green River

[Estimates of power based on static head and over-all plant efficiency of 70 per cent]

Index No.	Power site	Stream	Static head (H) (feet)	With existing flow				With regulated flow			
				Q90	Q50	Horsepower		Q90	Q50	Horsepower	
						0.08H×Q90	0.08H×Q50			0.08H×Q90	0.08H×Q50
9BB 1	Upper North Fork	Duchesne River	750	10	15	600	900				
9BB 2	Lower North Fork	do	415–515	45	75	1,490	2,490	90	185	3,350	6,880
9BB 3	Upper Rock Creek	Rock Creek	780	35	55	2,380	3,740	55	90	3,740	6,120
9BB 4	Lower Rock Creek	do	710	55	85	3,124	4,828	78	125	4,430	7,100
9BB 5	Starvation	Strawberry River	50–125	75	125	750	1,250	(a)	425		2,720
9BB 6	Pleasant Valley	Duchesne River	70	235	355	1,310	1,990	(a)	750		4,200
9BC 1	Upper West Fork	Lake Fork	800	40	70	2,560	4,480	50	88	3,200	5,630
9BC 2	Moon Lake	do	280–350	45	75	1,000	1,680	(a)	(a)	(b)	(b)
9BC 3	Upper East Fork	do	600	35	55	1,680	2,640	40	63	1,920	3,020
9BC 4	Lower East Fork	do	900	50	80	3,600	5,760	55	90	3,960	6,480
9BE 1	Uinta River	Uinta River	1,500	55	85	6,600	10,200	62	98	7,440	11,760
9BE 2	Upper Whiterocks	Whiterocks River	1,200	40	70	3,840	6,720	52	93	500	8,920
9BE 3	Lower Whiterocks	do	560	45	75	2,016	3,360	60	105	2,688	4,704
9BA 1	Dry Fork	Dry Fork	1,000	30	45	2,400	3,600	32	50	2,560	4,000
9BA 2	Ashley	Ashley Creek	1,700	28	40	3,820	5,450	35	50	4,760	6,800
9BA 3	Brush Creek	Brush Creeks	565, 1,500					22, 42		11,074	
						37,170	59,088			49,622	78,334

[a] Affected by irrigation.
[b] Available power from storage about 7,750,000 kilowatt-hours.

LOWER GREEN RIVER BASIN

The water-power resources of the lower part of the Green River Basin are in the drainage basins of the Price and San Rafael Rivers. Each stream is used primarily for irrigation, and the natural summer run-off is overappropriated for that use. Storage reservoirs in each basin have been studied at different times, and some reservoirs are now in use. Both streams have a flashy regimen, which adds to the difficulty of complete utilization. None of the power sites are outstanding in their attractiveness, because of their relatively small size and the fact that the power market near them is being served from a large interconnected power system. It is not unreasonable, however, to suppose that they may at some future time be economically feasible as automatically controlled units of a larger system.

PRICE RIVER

The chief water-power resources of the Price River are in the canyon from Kyune down to Panther, a distance of about 9 miles. The fall in this stretch is 1,050 feet, and the topography as shown on the Castlegate and Kyune topographic maps of the Geological Survey suggests the development of this fall in two projects, which are here designated the Kyune and Castlegate power sites.

At the Kyune site (9BJ 1) a low diversion dam could be built across the stream at the Utah-Carbon County boundary line; thence a pipe line would run along the south wall of the canyon and terminate through a penstock at a power house at the mouth of Crandall Canyon, in the southern part of sec. 22, T. 12 S., R. 9 E., Salt Lake base and meridian. About 2 miles below the intake of this proposed pipe line a short tunnel of about 500 feet would cut off a horseshoe bend in the canyon nearly 2 miles long. The head at this site is 600 feet. The estimated stream flow as determined from an analysis of the records of flow of the gaging station near Helper is about 20 second-feet for Q90 and 35 second-feet for Q50. The corresponding power capacities of the site are 960 and 1,680 horsepower, or 720 and 1,260 kilowatts.

At the Castlegate site (9BJ 2) a low diversion dam is suggested just a few hundred feet below the proposed plant of the Kyune site, also a pipe line along the south and west wall of the canyon to a power house at Panther, in sec. 12, T. 13 S., R. 9 E., Salt Lake base and meridian. This pipe line would be about 5 miles long, and the head is 450 feet. The estimated Q90 and Q50 stream flows at this site are about 25 and 40 second-feet respectively, and the corresponding power capacities 900 and 1,440 horsepower, or 675 and 1,080 kilowatts.

Immediately below the Castlegate site the valley broadens and irrigation canals are taken out on both sides of the stream. Above the power sites the country is a rather open, rolling plateau, and the streams are too small and too flat to have any power value. A reservoir is partly completed on Fish Creek, the principal source of water supply of the Price River, at what is known as Pleasant Valley. When this is completed it will store 61,000 acre-feet, all of which will be used for irrigation in the projects below the power sites. Accordingly this water will be available for use at the power sites, but its use for irrigation will not affect the Q90 and Q50 flows, except perhaps that it may diminish to some extent the Q90 flow during winter periods of storage. The water will practically all be used during June, July, and August and thus will not add to the Q50 flow. In view of this situation the value of the reservoir for developing power would depend upon the design of the power projects, which should so be planned as to use the most economical maximum flow at all times. This, of course, would require that the plants be interconnected with other sources of power, unless the power demand coincides with the regimen of the stream as it would be used for irrigation.

SAN RAFAEL RIVER

The San Rafael River is formed by the junction of Huntington and Cottonwood Creeks a short distance southeast of Castle Dale. From this place the stream follows a meandering course, passing through the San Rafael Swell southeastward into the Green River. The total length of the river is 110 miles, and the fall is 1,350 feet. The steepest stretch is through the Black Box Canyon which begins about 35 miles down the river from the confluence of the above-mentioned tributaries and extends downstream about 9 miles. The fall through this canyon is 380 feet. Both above and below this canyon the grade is very much flatter, being about 10 feet to the mile above the canyon, and from 6 to 10 feet below.

As early as 1905 the San Rafael River was the subject of study by irrigation protagonists, who proposed to store water on the river for use on lands lying west and south of the town of Green River. At that time there were no stream-flow records on the stream and no surveys of any kind, so that the resources of the stream were largely a matter of conjecture. Since then stream-flow records have become available on the headwater streams, on Ferron Creek, a large tributary 11 miles southeast of Castle Dale, and on the main stream at a point about 35 miles above its mouth. In 1925 a topographic survey was made by the United States Geological Survey from Castle Dale down Cottonwood Creek and the San Rafael River to the Green River. The results of this survey are published in a set of four sheets (A to D)—two plans and two profiles—under the title "Plan and profile of San Rafael River below Castle Dale, Utah; Buckhorn Wash to mile 3." The topography along the river is shown by contours of 25 feet interval on the land surface and 5 feet on the water surface.

The scale is 1 : 31,680, or 2 inches to the mile. These sheets are obtainable from the Director of the Geological Survey at 10 cents each, or 40 cents for the set.

The power sites within the San Rafael River drainage basin are in the canyon stretches of Huntington, Cottonwood, and Ferron Creeks before they enter Castle Valley and on the San Rafael River at the Black Box Canyon and the Mexican Bend.

The Upper Huntington site (9BK 1) is on Huntington Creek about 12 miles northwest of the town of Huntington. From "the kitchen," where several small tributaries join to form the main stream, the creek flows southeastward through about 25 miles of narrow canyon. The total fall in this stretch is 2,450 feet, or slightly less than 100 feet to the mile. The main tributary, the Left Fork, joins the creek at a point about 14 miles below "the Kitchen," and from this point down the fall is steeper than above. The Left Fork contributes a large share of the flow of the main stream, especially during the late summer, when water is released from the storage reservoirs on it. This fact and the general topographic features as shown on the Hiawatha and Scofield topographic maps suggest as the plan of power development a low diversion dam just below the mouth of the Left Fork, near the south line of sec. 20, T. 15 S., R. 7 E., Salt Lake base and meridian, and a pipe line along the east wall of the canyon terminating in a power house just above the mouth of Trail Canyon in the SE. ¼ sec. 22, T. 16 S., R. 7 E., Salt Lake base and meridian. The length of this pipe line would be about 6 miles, and the head is 750 feet. A stream-flow gaging station is maintained on the creek about 5 miles down the canyon from this proposed power house, and although the records at this station show a greater flow than would be available at the power site, the nature of the drainage basin above the station is such that the greater part of the flow originates above the proposed diversion. The estimated Q90 and Q50 flows at the power site are 18 and 30 second-feet respectively, and the corresponding power capacities 1,080 and 1,800 horsepower, or 810 and 1,350 kilowatts.

The Lower Huntington site (9BK 2) is on Huntington Creek just below the upper site. The topographic conditions here suggest a low diversion dam near the southeast corner of sec. 22, T. 16 S., R. 7 E., Salt Lake base and meridian, and a pipe line along the east side of the canyon, terminating through a penstock in a power house near the center of sec. 6, T. 17 S., R. 8 E. This pipe line would be about 5 miles long, and the head is 600 feet. The estimated Q90 and Q50 flows available at this site as determined from the stream-flow records of the gaging station near the proposed power-house site are 28 and 45 second-feet, respectively, and the corresponding power capacities are 1,344 and 2,160 horsepower, or 1,008 and 1,620 kilowatts.

Part of the stretch of stream in this lower power site was, in 1922, included in an application filed with the Federal Power Commission for preliminary permit. The project is designated as No. 290 in the files of that commission. A preliminary permit was issued in October, 1922, but no work was done on the project, and the permit expired in April, 1924.

Some stream regulation is now effected by the storage reservoirs on the Left Fork. This regulation, however, is all for irrigation, and the present regimen of the stream, as shown by the stream-flow records, includes it. Other storage projects have been suggested for further supplementing the irrigation supply from Huntington Creek, but it is hardly probable that the Q90 and Q50 flows of the stream would be greatly affected by them. One project involving about 5,280 acre-feet would be located above the power sites, and another of about 2,700 acre-feet below the power sites. The use of Huntington Creek for power would be subject to the use for irrigation, and as the use for irrigation is rather intensively developed and the further storage possibilities are limited by physical conditions, any power project, in order to utilize available storage water, must be so designed that it can turn out the maximum quantity of power economically without regard to the time when the stream flow may be available.

The Straight Canyon power site (9BK 3) is about 10 miles northwest of Castle Dale, in Straight Canyon and Cottonwood Canyon. The creek in Straight Canyon gets the greater part of its water supply from a number of small streams that drain from the north, west, and south into Lower Joes Valley at an altitude of 6,900 to 7,000 feet. The outlet to this valley is through Straight Canyon eastward. The canyon is a narrow gorge with steep but rather smooth walls for the upper 5½ miles of its length, or down to the junction with Cottonwood Canyon, from the north. From this point down the gorge broadens out and the walls break away into irregular contours. About 10 miles below Lower Joes Valley irrigation canals are taken out from the creek and deplete the stream below that point. The total fall in the 10 miles below the head of Straight Canyon is about 875 feet, and 525 feet of this is in the upper 5½ miles of the canyon. The topography as shown on the Hiawatha topographic sheet of the Geological Survey suggests as the plan of power development a low diversion dam at the head of Straight Canyon, in the north-central part of sec. 5, T. 18 S., R. 6 E. Salt Lake base and meridian, and a pipe line along the north side of the canyon to a power house at the confluence of Straight Canyon Creek with Cottonwood Creek. This pipe line would be about 5½ miles long, and the head is 525 feet. In order to use the water of Cottonwood Creek a branch pipe line is suggested along the west side of that creek, diverting from the creek at the same altitude as the main line, near the east quarter corner of sec. 36, T. 17 S., R. 6 E. This branch line would be about 1½ miles long. This plan provides for the use of all the water in the creek at the site. Between the proposed power house location and the gaging station about 2 miles below only three or four very small tributaries enter. Accordingly, the stream-flow records at this station show very closely the amount of water available at the power site. With these records as a basis the estimated Q90 flow is 20 second-feet and the Q50 flow about 34 second-feet. The corresponding power capacities are 840 and 1,428 horsepower, or 630 and 1,070 kilowatts.

The Cottonwood power site (9BK 4) is on Cottonwood Creek just below the Straight Canyon site. A low diversion dam is suggested in sec. 7, T. 18 S., R. 7 E., Salt Lake base and meridian, just below the confluence of the two streams, with a pipe line along the south side of the canyon to a power house at the head of the irrigation canal in the NE. ¼ sec. 15 of the same township and range. The length of the pipe line would be about 4 miles, and the head is about 275 feet. The estimated Q90 flow is 20 second-feet and the Q50 flow about 34 second-feet. The corresponding power capacities are 440 and 748 horsepower, or 330 and 560 kilowatts.

With the development of the Lower Joes Valley reservoir site to sufficient capacity to regulate the flow into it, the stream through the power plants could be equalized at about 130 second-feet, but this is quite impossible because of the present irrigation use of the streams. The area now irrigated requires all the natural flow during the irrigation season and often more. Also an uncertain amount of the high water is used each year, so that the question of how much water is available for storage is not easily answered. In view of this condition the capacity of this power site with the reservoir in use would be completely governed by the use of the stream flow for irrigation. The Q90 and Q50 flows as at present might or might not be seriously affected, but during the irrigation season, especially the later part, in July, August, and September, the flow would be very much different, and if the plant were designed to use this increased short-time flow and were connected into a system that would permit such design, the reservoir advantage could be converted into power whenever the stream flow would permit.

The Ferron power site (9BK 5) is on Ferron Creek about 6 miles up the creek from the town of Ferron. The creek flows through a rugged, narrow canyon. Wright Creek is the lowest one of its principal tributaries, and the distance from the mouth of this creek to the mouth of the canyon is about 9 miles. The total fall in this distance is 850 feet. The topography, however, as shown on the Castle Dale and Wasatch topographic maps suggests as the plan of power development on the stream a low diversion dam just below the mouth of Wright Creek, near the east line of sec. 11, T. 19 S., R. 5 E., Salt Lake base and meridian, and a pipe line along the north side of the canyon to a penstock and power house in the NW. ¼ sec. 3, T. 20 S., R. 6 E. The pipe line would be about 6 miles long, and the head is 575 feet.

A stream-gaging station is maintained on the creek about 2 miles below the proposed power house, and although the flow at this station is in excess of the amount of water available at the dam site the nature of the tributaries below Wright Creek is such that this excess is not very great. Accordingly it is estimated that the Q90 and Q50 flows at the proposed point of diversion are 8 and 18 second-feet respectively. The corresponding power capacities are 368 and 828 horsepower, or 276 and 620 kilowatts.

Storage on Ferron Creek for regulation of the stream for power is not a probability, for the same reason as on Huntington and Cottonwood Creeks. The stream is primarily important for irrigation use, and the only storage that might be developed is that necessary to further irrigation development.

The Black Box Canyon site (9BK 6) is on the San Rafael River at the Black Box Canyon, which heads 75 miles above the mouth of the river. The topography as shown by the above-mentioned river survey of 1925 suggests a dam to hold a water depth of 245 feet at the head of the canyon, which is mile 75 of the survey. The crest length would be about 300 feet, and the storage capacity thus created would be about 510,000 acre-feet. (See pl. 27.) The maximum run-off of the river at this place, as indicated from the records at the gaging station 40 miles farther downstream, may be expected to be about 300,000 acre-feet, and the average would probably be about 200,000 acre-feet. Accordingly about two years or more would be required to fill the reservoir, and thereafter the water 45 feet below the full-stage surface would be dead storage. The stream, however, is subject to wide variations, at flood stages it carries large quantities of silt and débris. For this reason the excess storage capacity would be an advantage to the project in providing storage for the silt, in excess of the capacity necessary to regulate the stream flow completely. A tunnel 3¼ miles long extending westward from the dam would open into the lower end of the canyon, and thence a penstock would lead to a power house. This tunnel would cut off about 8½ miles of the river course and would make usable a head of 575 to 600 feet with a drawdown of 45 feet on the reservoir. The estimated equalized stream flow at the power site is 274 second-feet. The power capacity of the site under a mean head of 575 feet is 12,600 horsepower, or 9,450 kilowatts.

The Mexican Bend power site (9BK 7) is suggested by the topography at Mexican Bend, which is immediately below the Black Box Canyon on the San Rafael River. From the lower end of the canyon the river course for a distance of 9 miles forms a horseshoe which has a spread of 1½ miles at its two ends. The fall in this 9-mile stretch is 220 feet. A dam at the upper end of this horseshoe, at mile 66 of the river survey, and a tunnel 1½ miles long would connect with a power house at the lower point of the horseshoe, just above mile 57. About 25 feet more head could be developed without interfering with the tailrace water of the Black Box Canyon plant if the dam were built to a height of about 30 feet. The stream flow would be the same at each plant, and under these conditions the power capacity of this site would be 5,590 horsepower, or 4,190 kilowatts. Both of these power sites are accessible with difficulty at this time and also remote from market.

SUMMARY

Undeveloped power sites in lower Green River Basin

[Estimate of power based on static head and over-all plant efficiency of 70 per cent]

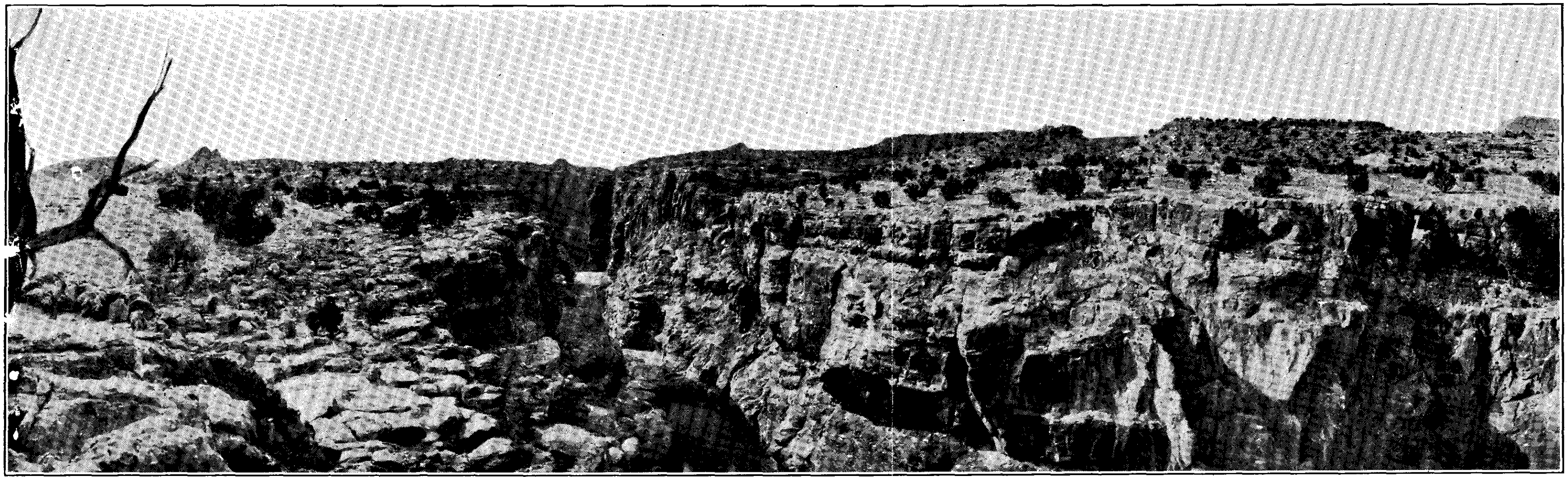
Index No.	Power site	Stream	Static head (H) (feet)	With existing flow				With regulated flow	
				Q90	Q50	Horsepower		Q90	Horsepower (0.8H× Q90)
						0.08H× Q90	0.08H× Q50		
9BJ 1	Kyune	Price River	600	20	35	960	1,680		
9BJ 2	Castlegate	do	450	25	40	900	1 440		
9BK 1	Upper Huntington	Huntington Creek	750	18	30	1,080	1,800		
9BK 2	Lower Huntington	do	600	28	45	1,344	2,160		
9BK 3	Straight Canyon	Cottonwood Creek	525	20	34	840	1,428		
9BK 4	Cottonwood	do	275	20	34	440	748		
9BK 5	Ferron	Ferron Creek	575	8	18	368	828		
9BK 6	Black Box Canyon	San Rafael River	575					274	12,600
9BK 7	Mexican Bend	do	245					274	5,590
						5,932	10,084		18,190

GREEN RIVER CANYONS

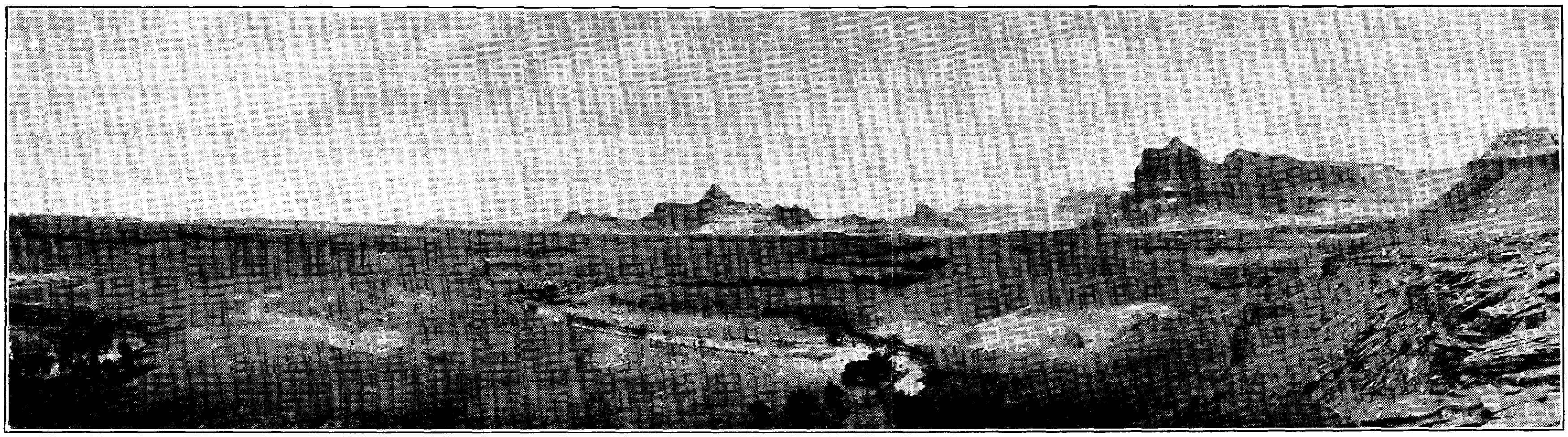
GENERAL FEATURES

The Green River in its course through the Uinta Mountains and the high plateaus to the south flows in alternate stretches of narrow canyons and small valleys called parks. The stream attracted little attention as a great natural resource until recent years. It first became a subject of careful study only as it might affect the regimen of the lower Colorado River.

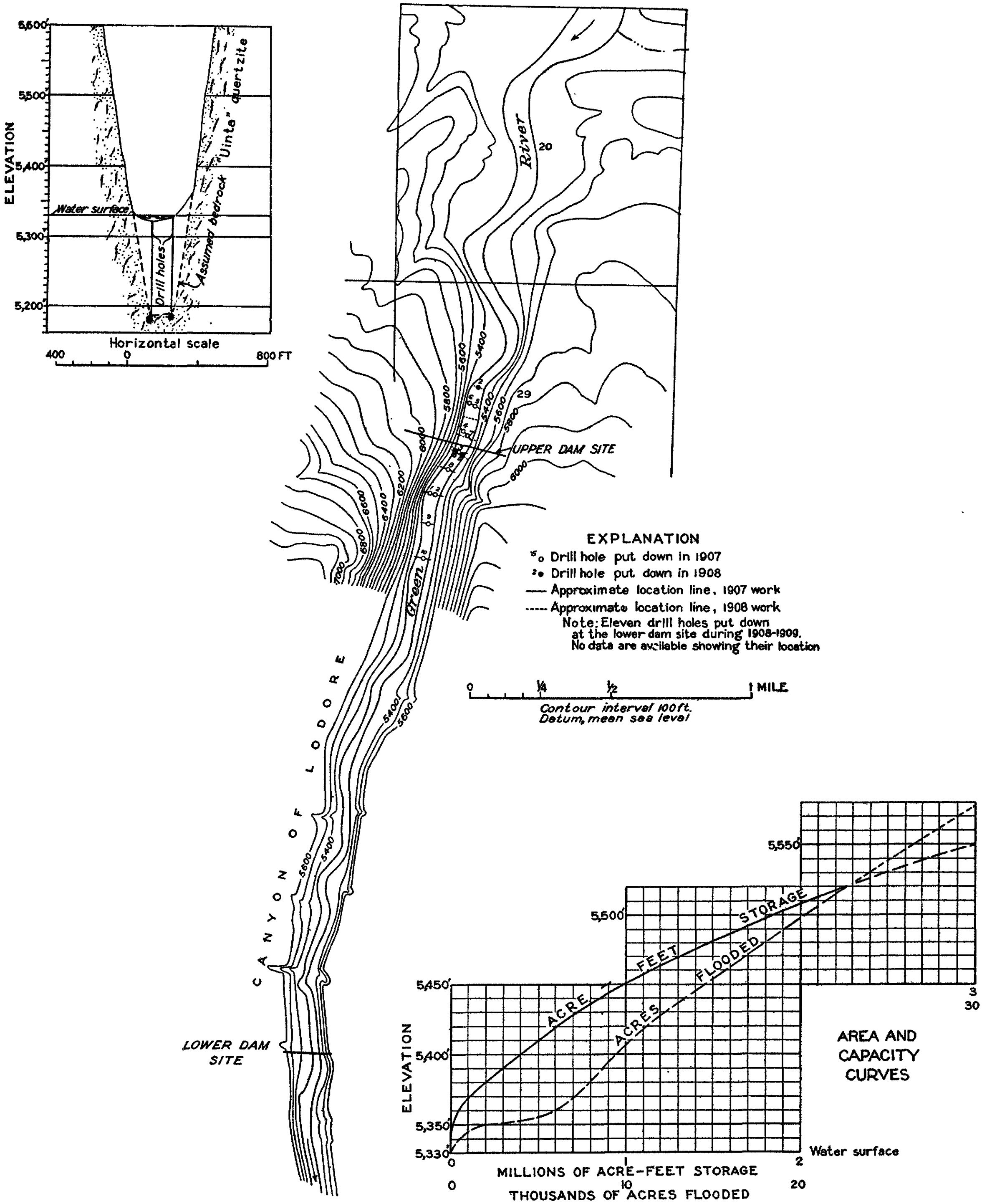
Water was first diverted from the Colorado River into the Imperial Valley for irrigation in 1901, and the use for this purpose grew rapidly thereafter. It was immediately realized, however, that some protection against floods on the lower river should be provided if this



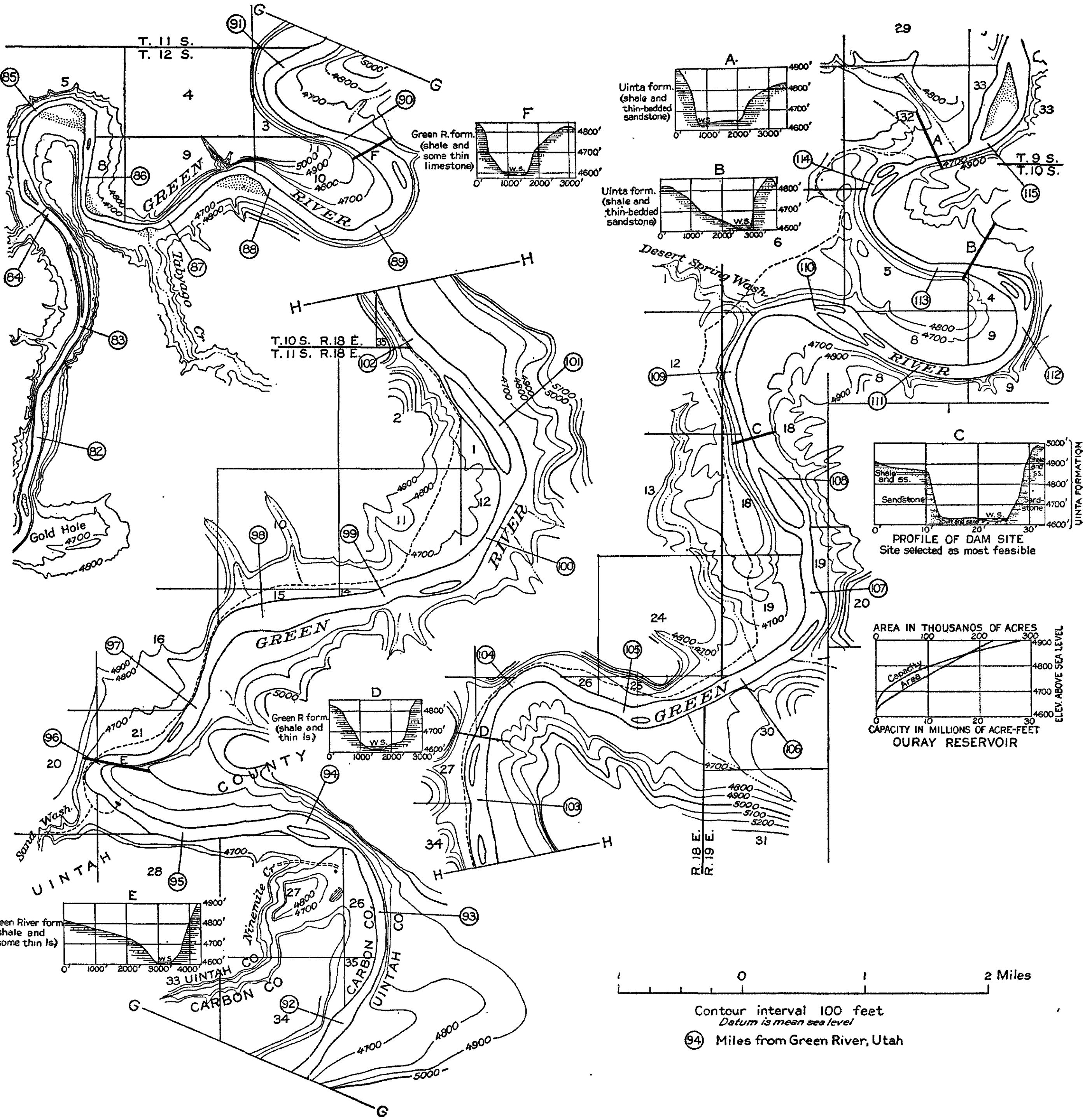
A. VIEW DOWNSTREAM INTO BLACK BOX CANYON FROM ITS UPPER END, SAN RAFAEL RIVER, UTAH



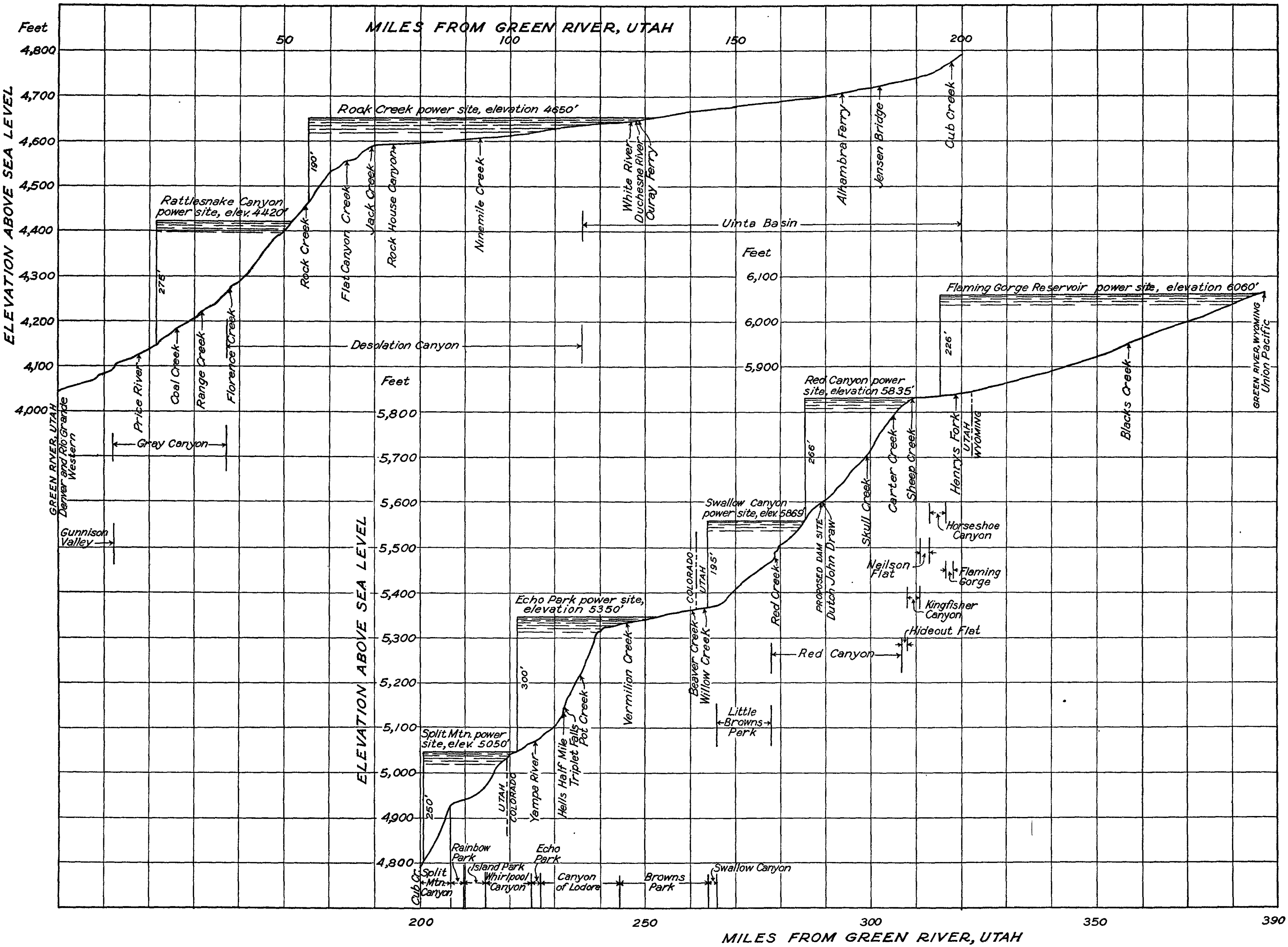
B. VIEW UP THE SAN RAFAEL RIVER VALLEY FROM THE HEAD OF BLACK BOX CANYON



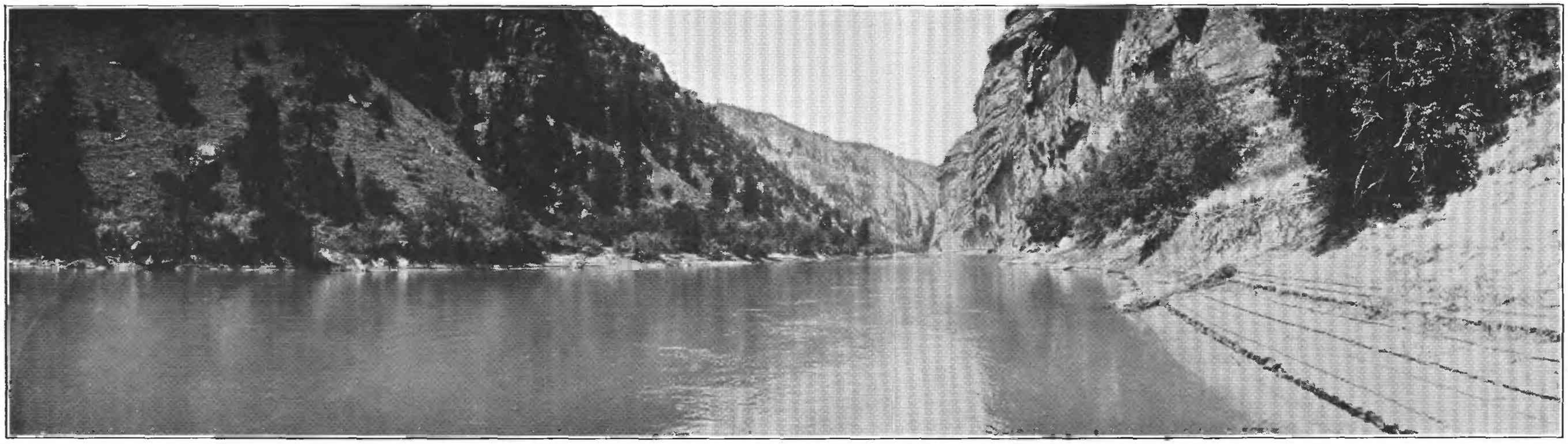
BROWNS PARK DAM SITES



DESOLATION CANYON, GREEN RIVER, UPPER END TO VICINITY OF TABYAGO CANYON, SHOWING TOPOGRAPHY AND SECTIONS AT POSSIBLE DAM SITES



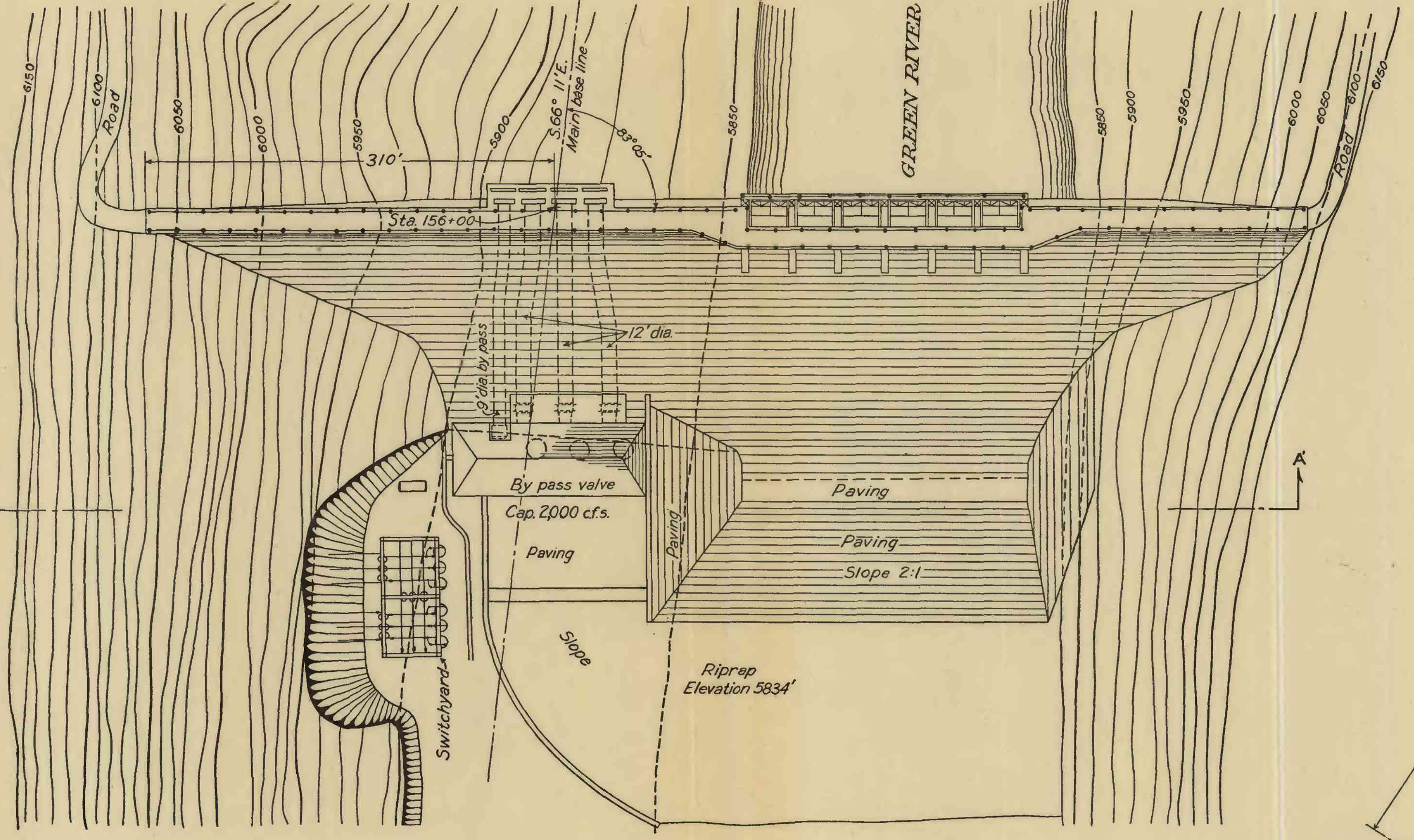
PROFILE OF GREEN RIVER FROM GREEN RIVER, WYO., TO GREEN RIVER, UTAH, SHOWING SUGGESTED PLAN OF POWER DEVELOPMENT AND ALTERNATE DAM SITES



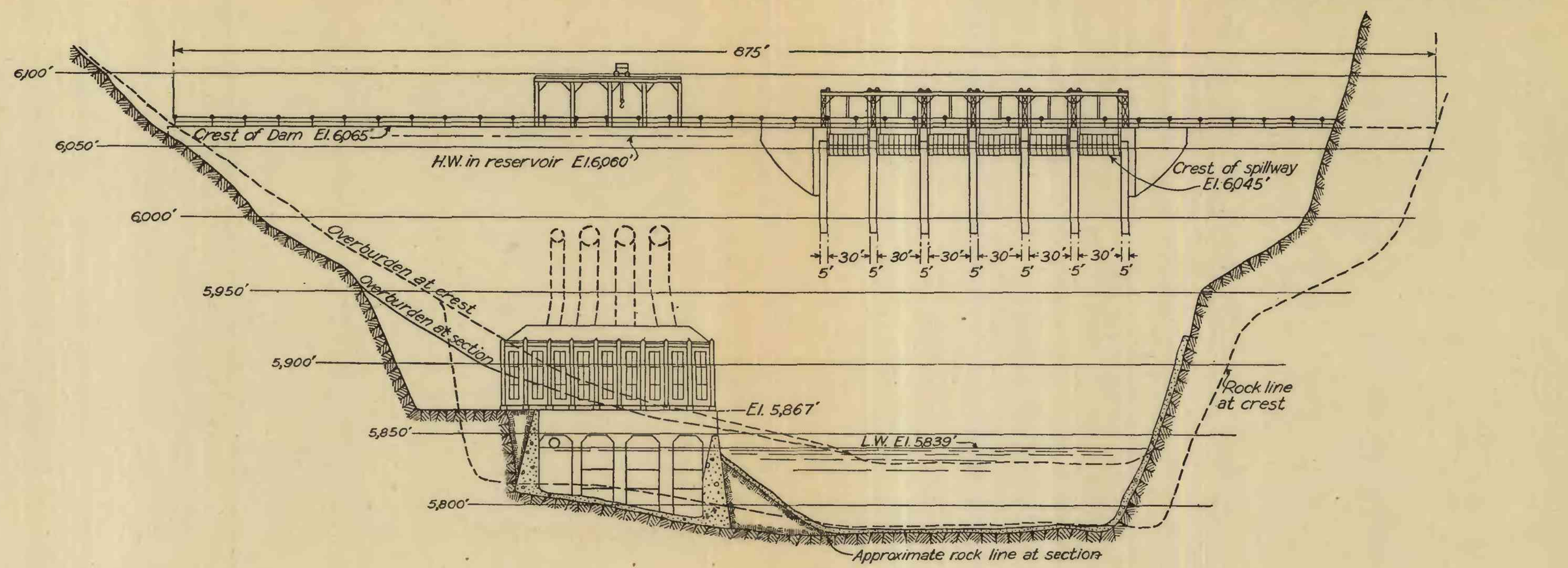
A. VIEW DOWN HORSESHOE CANYON TOWARD DAM SITE DRILLED BY UNITED STATES BUREAU OF RECLAMATION

B. VIEW DOWNSTREAM INTO CANYON OF LODORE FROM ITS UPPER END

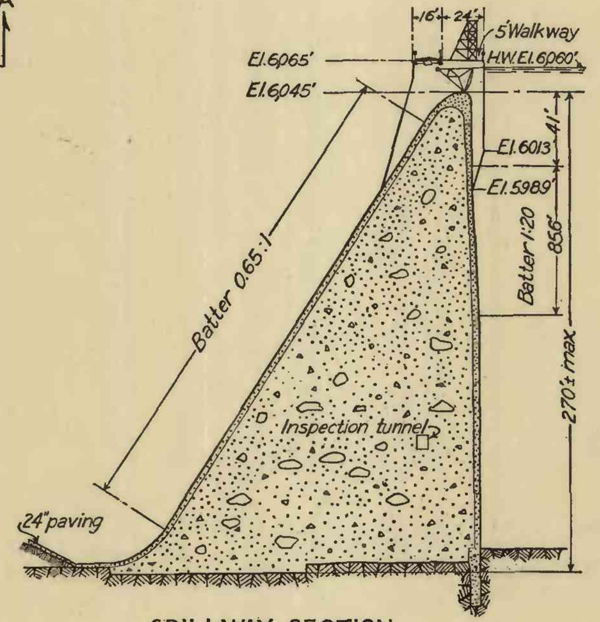
MAP AND CROSS SECTIONS OF DAM SITE AND AUXILIARY DIKE FOR FLAMING GORGE POWER DEVELOPMENT



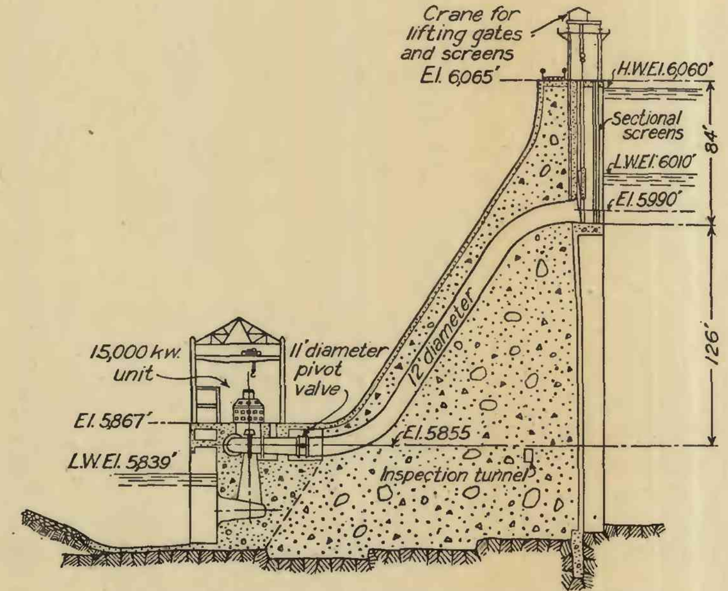
PLAN



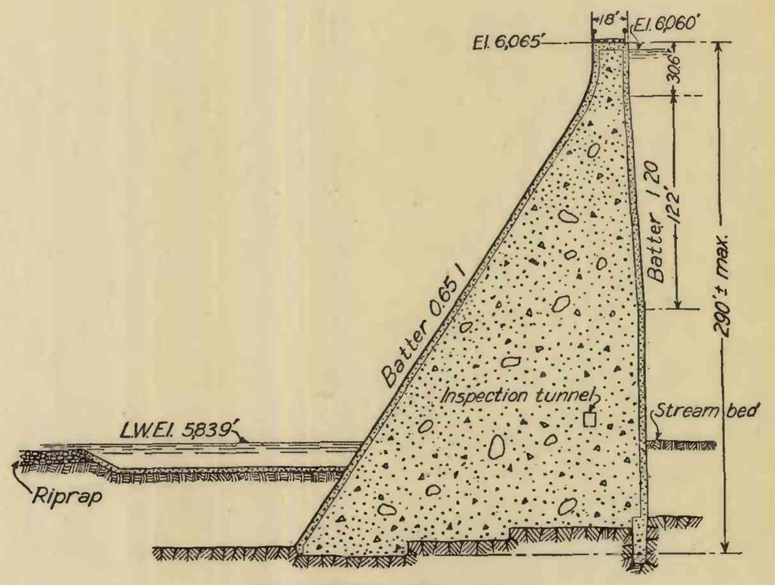
SECTION A-A′



SPILLWAY SECTION



SECTION THROUGH DAM AND POWER HOUSE



BULKHEAD SECTION

50 0 50 100 150 200 250 FEET

DETAILS OF PROPOSED DAM AND POWER HOUSE AT FLAMING GORGE SITE irrigation development were to be preserved. Accordingly searches were instituted for storage sites to control the river, and in 1904 a preliminary report was made to the United States Bureau of Reclamation calling attention to Browns Park, on the Green River, as a possible reservoir site. Immediately after this report was submitted a plane-table survey was made of the park area and its capacity as a reservoir determined. The dam site was located in the head of the Canyon of Lodore, and during 1907–8 more than $43,000 was spent by the Bureau of Reclamation in drilling explorations at two proposed dam sites. (See pl. 28.) The results of these operations were not encouraging, and further investigations were made for other reservoir sites. A survey was made of the Flaming Gorge site in 1914. Soon afterward diamond drilling was done at the proposed dam sites in Horseshoe Canyon. Two sites were drilled, one about 4,000 feet above the mouth of the canyon and the other about 500 feet farther up. At the upper site 15 holes were drilled, at the lower site 6, and on the saddle above the Horseshoe Canyon 4. Further work was done here by the Utah Power & Light Co. in 1923–1926 and is described in detail in the section on the Flaming Gorge power site (p. 235).

After the survey of the Flaming Gorge reservoir site an attempt was made in 1916 to find a suitable dam site in the upper part of Desolation Canyon that could be used to create a huge reservoir of the Green River Valley in Uinta Basin. Several of the most promising cross sections in the canyon were surveyed, and the results of that work are shown on Plate 29. A topographic survey of the reservoir itself had already had been made for private persons by Guy Sterling, an engineer. About this time the stream began to attract so much interest as a source of power as to induce the Utah Power & Light Co. to spend considerable money in making a topographic survey of a stretch of the river extending through part of Desolation and Gray Canyons and reconnaissance investigations of the power possibilities of the canyon stretches between Flaming Gorge and Uinta Basin. In this way there became available several maps of different stretches of the river. They were all independent of one another, and there was no complete map of the river as a whole. Accordingly in 1922 the Geological Survey, in cooperation with the Utah Power & Light Co., made a complete map, correlating the surveys that were available and filling in the stretches for which there were no surveys. The results of this survey are published by the Geological Survey under the title "Plan and profile of Green River, Green River, Utah, to Green River, Wyo.," consisting of 16 sheets—10 plans and 6 profiles. These may be obtained from the Director of the Geological Survey at $1.60 for the set.

When survey data became available for the Colorado River through its lower canyons storage possibilities were found large enough to afford complete regulation of the flow of the river into its lower valley, and the sites on the Green River were abandoned, except the one at Flaming Gorge, which has now been completely investigated as a power site under preliminary permit 165 of the Federal Power Commission.

In discussing the power sites in this report it is not intended to advocate the development of the river as here outlined, but merely to suggest a plan that seems to fit into the general topographic conditions without undue disturbance to agricultural developments along the stream. (See pl. 30.) Obviously, it is impossible to say that suitable foundation conditions for dams will be found at any of these suggested sites where no drilling has been done. Accordingly some of them may prove infeasible after careful investigation, or some others not here suggested may prove to be better fitted into market and economic conditions.

CONDITIONS SUGGESTING PLAN OF DEVELOPMENT

With a dam in Horseshoe Canyon complete regulation of the flow of the river at that place is possible. This is of course a very desirable result, because the regulated flow would then be available at all the power sites down the river.

To develop the fall through Red Canyon a dam is suggested near mile 285 of the river survey, because of the narrow cross section there and the fact that a dam of moderate height could be used to develop the entire fall between that locality and the Flaming Gorge site in Horseshoe Canyon.

The Swallow Canyon site is suggested in place of one near the upper end of the Canyon of Lodore, because the drillings made by the Bureau of Reclamation at the latter site disclose unattractive foundation conditions, which add materially to the engineering difficulties of the project, because the dam site is from 1 to 3 miles down the canyon, a narrow rock gorge with almost vertical walls nearly half a mile high. Furthermore, the reservoir that would be created would not be needed after the Flaming Gorge project is built and would only add to depletion of the stream flow by evaporation as well as inundate additional ranch lands, in Browns Park.

With a dam at the head of Whirlpool Canyon, which is here suggested as the Echo Park site, advantage would be gained of the combined flow of the Green and Yampa Rivers, and it is believed that with the streams already regulated at developments above sufficient additional regulation would be created by this dam to take care of the inflow below the other points of regulation. The Canyon of Lodore would be the reservoir, and no serious inundation of lands in

Browns Park would result. Evaporation losses would be a minimum, because of the narrowness of the canyon, the average width of the proposed reservoir surface being only about 600 feet. However, it would be about 30 miles long and have an estimated capacity of 200,000 acre-feet, about half of which could be used for stream regulation with a drawdown of 50 feet at the dam.

The Split Mountain site is at the lower end of the Green River Canyon through the Uinta Mountains. It contemplates by creating storage in Island Park the use of the total regulated flow of the Green River at this point. Here the river enters the open valley of the Uinta Basin, and for a distance of more than 80 miles it meanders through the valley with an average fall of less than 2 feet to the mile.

It is this valley that would be inundated by the proposed Ouray Reservoir, for which dam-site surveys were made at several sections in the upper end of Desolation Canyon. The building of this reservoir would completely control the Green River at this place, but it would inundate considerable improved agricultural land and serve no material benefit other than contribute to regulation of the lower Colorado River. No suitable dam site was found.

The fall in Desolation and Gray Canyons below Uinta Basin and the topography of the canyon suggest two developments, and these are selected with the view of utilizing the power of the stream with due regard to the agricultural possibilities along it in the Uinta Basin. They are described below.

FLAMING GORGE POWER SITE

Location.—The Flaming Gorge power site (9AK 1) is on the Green River just south of the Wyoming-Utah line. The dam site is in the upper end of Horseshoe Canyon, in the SW. ¼ sec. 31, T. 3 N., R. 21 E., Salt Lake base and meridian. (See pl. 1.)

Physical characteristics.—Horseshoe Canyon is a narrow gorge with massive sandstone walls, in many places almost vertical. (See pl. 31, *A*.) In August, 1923, a preliminary permit was issued to the Utah Power & Light Co. by the Federal Power Commission for the development of this site. Under this permit more than 20 drill holes were sunk in Horseshoe Canyon and 10 in Flaming Gorge. Bedrock was found in Flaming Gorge at depths of 40 to 45 feet and in Horseshoe Canyon at depths ranging from 50 feet at the upper end of the canyon to 73 feet at the lower end. As a result of these investigations and studies of cross sections at many places the dam site above indicated was chosen as best suited for the proposed development. At this section the average altitude of low water is 5,839 feet above sea level and a dam with its crest at 6,065 feet would have a crest length of 875 feet. (See pls. 32 and 33.)

In commenting on the geology of Horseshoe Canyon for dams J. B. Reeside, jr., geologist, who accompanied the Green River survey party, says:

For dam sites in Horseshoe Canyon the Weber sandstone affords strong, tight walls and a good foundation under the fill in the stream. The sandstone is a good building material in blocks or broken for concrete. The only limestone in the neighborhood is in the Park City formation and in the Twin Creek formation of Boars Tusk. Probably neither is of a type to be serviceable for manufacture of cement on the ground. The only natural spillway for a dam site in Horseshoe Canyon is the saddle in the NE. ¼ sec. 36, T. 3 N., R. 20 E. This is not very good, because the rock of the saddle is the soft, easily eroded shale of the Park City formation. Possibly a spillway could be cut in the inclined top of the hard basal part of the Park City formation, which lies beneath these soft layers and would not be easily eroded.

Plans of development.—A gravity-type concrete dam is proposed. Its crest length is 875 feet, at 6,065 feet above sea level. An overflow-type spillway is provided at 6,045 feet. (See pl. 33.) The reservoir formed above the dam will extend up the river for a distance of about 60 miles, and the capacity of the top 50 feet is shown by the following table:

Contour (feet above sea level)	Area (acres)	Total capacity (acre-feet)	Contour (feet above sea level)	Area (acres)	Total capacity (acre-feet)
6,010	25,500	------------	6,040	31,800	854,500
6,020	27,300	264,000	6,050	34,300	1,185,000
6,030	29,500	548,000	6,060	37,200	1,542,500

An earthen dike is proposed across the saddle northwest of the dam. This dike would be built to an altitude of 6,075 feet and be about 1,460 feet long. The details of the dam, power house, and dike are shown on plates 32 and 33. The water is to be passed through intakes in the dam itself to the turbines in the power house on the lower side of the dam. The static head on the plant averages 196 feet and ranges from a maximum of 221 feet to a minimum of 171 feet.

Water supply.—From the stream-flow records of the Green River at Green River, Wyo.; at Bridgeport, about 44 miles below the power site; and at the power site itself for 1924–25, an estimated regulated flow of 2,620 second-feet is available at this site under present conditions. It is believed that this quantity will never be reduced more than 20 per cent by all future irrigation in the basin above, plus the losses that will result from evaporation from the proposed reservoir.

Power capacity.—With a stream flow of 2,620 second-feet and an average static head of 196 feet the power capacity of the site in round numbers is 41,000 horsepower, or 30,750 kilowatts. However, the proposed plan of development as shown on Plate 33 contemplates the installation of three 21,000 horsepower turbines, each direct connected to a 15,000 kilowatt generator, and the plant is designed for a maximum hydraulic capacity of 3,900 second-feet.

Rights of way.—Most of the land involved in this project is in public ownership. Only a small amount of agricultural land would be flooded by the reservoir, and this is in private ownership. Part of the county highway between Linwood, Utah, and Green River, Wyo., would need to be relocated, and a new bridge would be required at the crossing over Blacks Fork.

Accessibility.—The project is easily accessible from Green River, Wyo., over a good earth road. The distance is about 65 miles.

Adaptability of plan.—The proposed plan of development at this site will completely regulate the flow of the river at the dam. It is at the "top of the hill," and the regulation is thus available at all the power sites on the river except the few in the upper basin. It fits admirably into a complete and comprehensive plan of development of the stream. It is not an attractive power project if considered by itself, as the estimated cost of its development is approximately $12,000,000, or about $300 per firm horsepower. Its value to other developments below, however, makes it a site of considerable economic importance.

RED CANYON POWER SITE

Location.—The Red Canyon power site (9AK 2) is on the line between secs. 19 and 20, T. 2 N., R. 23 E., Salt Lake base and meridian, at about mile 285¼ of the river survey made in 1922 by the Geological Survey, 7 miles above the mouth of Red Canyon. (See general location on pl. 1.)

Physical characteristics.—At this site the water surface in July, 1922, was 5,569 feet above sea level. The width of the canyon at the water surface was 150 feet, and a dam 266 feet in height above the water would have a crest length of 700 feet. (See fig. 25.)

Plan of development.—A dam with power house built into it similar to the type for the Flaming Gorge project (pl. 33) is suggested for this site. By raising the water surface to 5,835 feet above sea level as a maximum, it would then not interfere with the Flaming Gorge development above. The full head at the dam could be made available at all times by regulating the stream at the Flaming Gorge plant.

Water supply.—Complete regulation of the stream is contemplated at the Flaming Gorge dam. The Red Canyon site is 31 miles farther down the river, and a few important but small streams enter in this stretch. It is believed that there would be sufficient flexibility in the operation of the Flaming Gorge plant along with the Red Canyon plant to obtain a regulated flow of about 2,720 second-feet at this site. This estimated flow is based on stream-flow records on the Green River at Green River, Wyo., and records obtained at the Flaming Gorge site during the investigations under Federal Power Commission preliminary permit. The reservoir formed in the canyon by this dam would have a surface area of about 1,300 acres, and with an average depth of 80 feet its capacity would be approximately 100,000 acre-feet.

Power capacity.—With a static head of 266 feet and a stream flow of 2,720 second-feet the power capacity of this site is 57,900 horsepower (43,500 kilowatts). Maximum use of the streams above this site for irrigation will probably never reduce this capacity more than 15 or 20 per cent.

Right of way.—Nothing but a narrow canyon would be affected by this project. There is no agricultural area involved, and apparently there would be no flowage damage.

Accessibility.—This site is not now readily accessible, and this fact will have an important effect on the economic feasibility of the project. After the Flaming Gorge site is developed and more power is needed this project or one at some other perhaps more feasible section in Red Canyon will then become attractive.

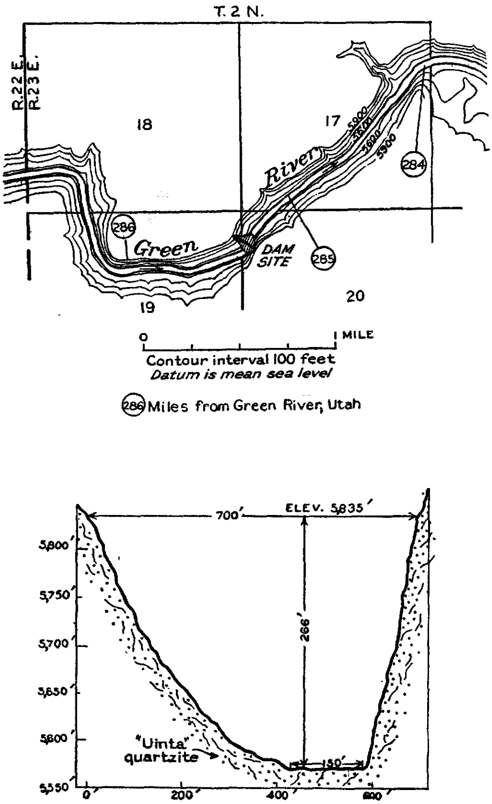


FIGURE 25.—Red Canyon dam site

SWALLOW CANYON POWER SITE

Location.—The Swallow Canyon power site (9AK 3) is at the lower end of the canyon, in sec. 9, T. 1 N., R. 25 E., Salt Lake base and meridian. A map and cross section of the dam site are shown in Figure 26.

Physical characteristics.—Swallow Canyon is a short canyon only about 3 miles long connecting Little Browns Park with Browns Park. In speaking of the geology of this region Mr. Reeside states:

> The greater part of the area is underlain by rather soft, very light colored sandstone which constitutes the Browns Park formation. At some places the river leaves the soft beds and flows again on the hard "Uinta" quartzite. One of these stretches is Swallow Canyon. A dam placed in this canyon would have strong, solid walls and foundation.

Plan of development.—A similar type of development to that proposed at the Flaming Gorge site (pl. 33) is suggested at this site. The water surface behind the dam would be raised from 5,367 to 5,562 feet above sea level, or to a height of 195 feet.

Water supply.—Streamflow records for a number of years are available for a station at Bridgeport, about 8 miles up the river from this site. These records show very closely the amount of water available at the site, and it is estimated that with the regulation afforded by the developments above a flow of 2,740 second-feet can be maintained.

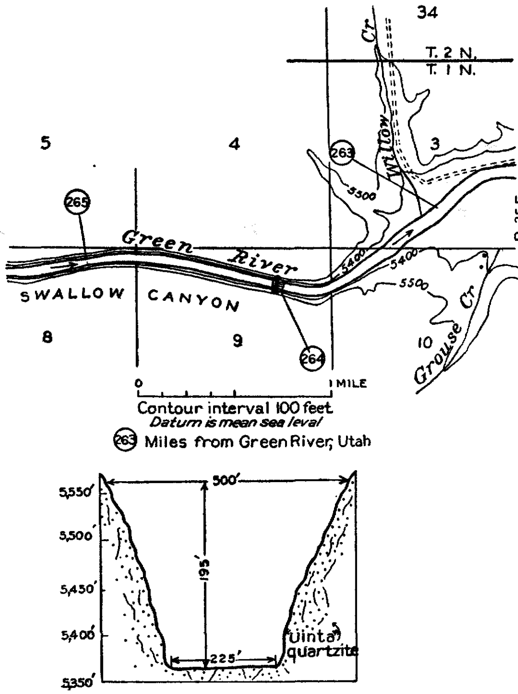


FIGURE 26.—Swallow Canyon dam site

Power capacity.—The static head at this site would be 195 feet, and with a flow of 2,740 second-feet the power capacity of the site would be 34,700 horsepower (26,100 kilowatts). Future irrigation use of the streams above this site will probably never reduce this capacity as much as 15 per cent.

Right of way.—Some privately owned land on ranches in Little Browns Park would be inundated by this project, but most of it is barren waste land.

Accessibility.—This site is accessible with some difficulty. A road leads into Little Browns Park from Vernal, and another one furnishes a means of reaching the railroad towns of Rock Springs and Green River. Neither of these roads, however, is suitable for heavy traffic.

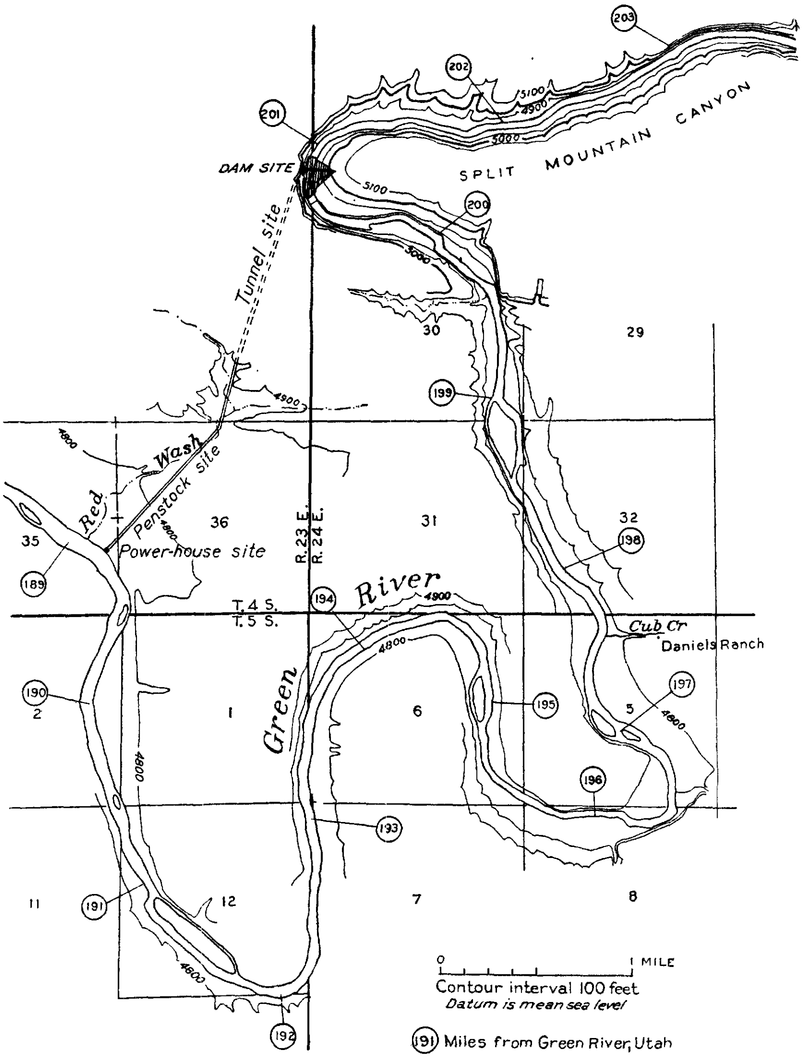
ALTERNATE POWER SITE IN CANYON OF LODORE

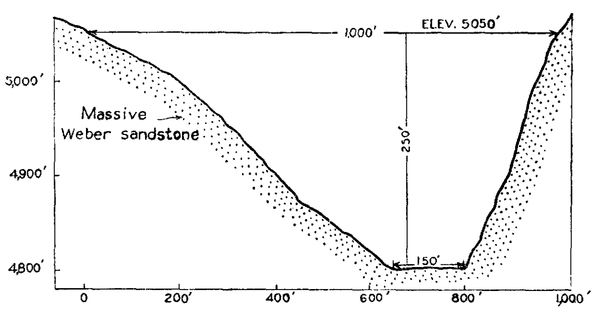
The head of the Canyon of Lodore is 21 miles down the river from the Swallow Canyon site. Some prospecting for bedrock has been done in the upper part of this canyon. A map, cross section, and area and capacity curves for this site are shown on Plate 28 and a view of the upper end of the canyon is shown in Plate 31, *B*. If, however, more work of this kind were to be done at some future time and a suitable dam site were found, it could be used instead of the Swallow Canyon site and might also be used so as to fit into a plan using a different site in Red Canyon. To do this, however, would inundate all of the Browns Park area, flooding what little ranch land is now in use and creating a reservoir much larger than any present necessity requires, thus increasing the cost of development and also increasing the losses by evaporation. The results of the drilling operations of the Bureau of Reclamation in the Canyon of Lodore are shown in the following tables:

Summary of diamond-drill work completed during 1907 and 1908 at upper dam site Browns Park Reservoir

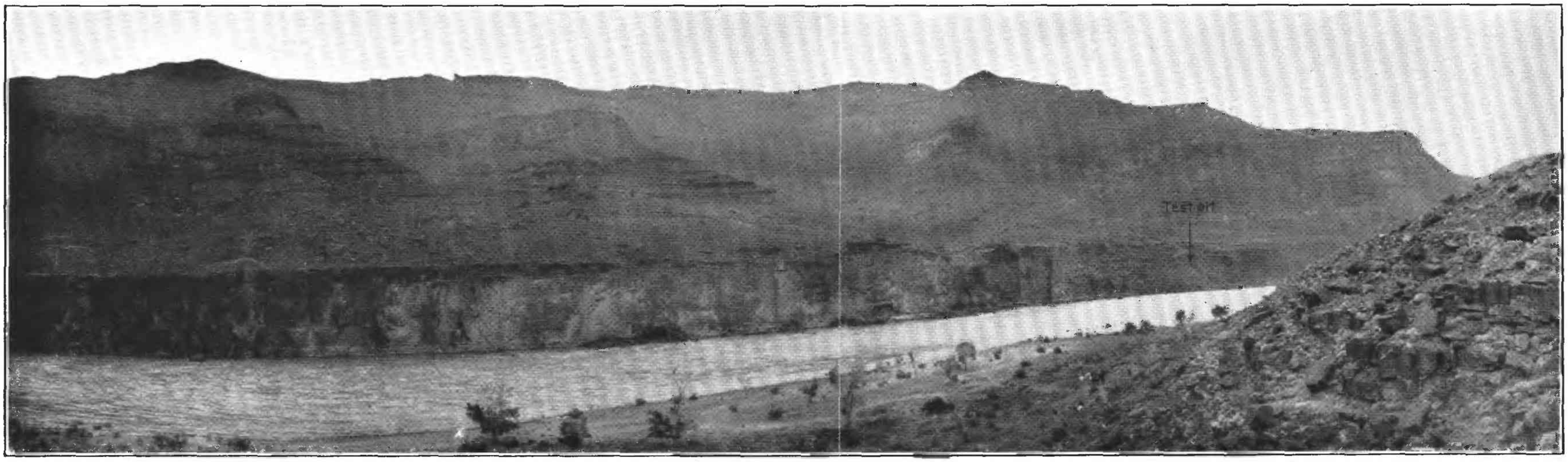
[See pl. 28, showing approximate location of holes]

Hole No.	Distance from east canyon wall (feet)	Depth through sand or gravel (feet)	Depth through gravel or boulder (feet)	Depth to bedrock (feet)	Total depth (feet)	Depth sunk in bedrock (feet)	Remarks
	1907						
1	Center of gorge	111	111–129	No proof	129	0	Work abandoned for winter of 1907.
2	96	86	86–98	do	98	0	No attempt to go deeper. Reconnaissance hole.
3	Near center	60		do	60	0	Do.
4	West quarter	60		do	60	0	Do.
5	East of center	60		do	60	0	Do.
6	West quarter	60		do	60	0	Do.
7	East of center	60		do	60	0	Do.
8	Center of gorge	60		do	60	0	Do.
9	West of center	60		do	60	0	Do.
10	Center of gorge	15		do	15	0	Do.
	1908						
1	Probably on east side of river.	40		do	40	0	Diamond-drill outfit not available. Hole abandoned.
2	Center of stream	80		do	80	0	No attempt to go deeper. Hole ended in sand.
3	Not given	80		do	80	0	Do.
4	do	79		do	79	0	No attempt to go deeper. Hole ended in boulders.
5	do	80		do	80	0	No attempt to go deeper. Hole ended in fine sand.
6	do	80		do	80	0	Do.
7	do	75		do	75	0	No attempt to go deeper. Hole ended in boulders.
8	324	96	96–139. 5	139. 5	150	10. 5	On Sept. 25, 1908, river rose 32 feet, overturning scows.
9	207	123	123–136. 5	136. 5	186. 25	49. 75	Churn drilled from 136.5 to 151 feet. At a depth of 157 feet a crevice was encountered which took 50 per cent of the water pumped into hole. "The rock, being porous, took the rest."
10	Not given	40			40		Hole abandoned at depth of 40 feet to move to lower site.
					1,552.25	60.25	

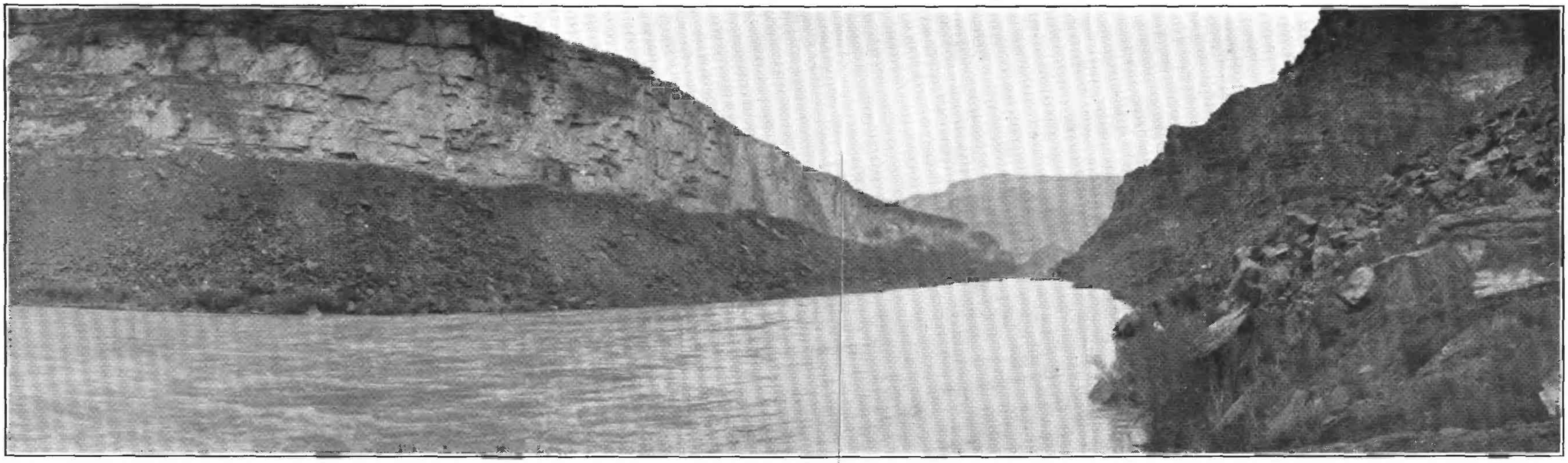




SPLIT MOUNTAIN DAM SITE AND PROPOSED TUNNEL SITE



A. VIEW UP CANYON AT MILE 26



B. VIEW UP CANYON NEAR RATTLESNAKE DAM SITE

TYPICAL SECTIONS OF GRAY CANYON, ON THE GREEN RIVER

Summary of diamond-drill work completed during 1908 and 1909 at lower or Hijo dam site, Browns Park Reservoir

[No topographic map of this site has been prepared]

Hole No.	Distance from east canyon wall (feet)	Depth through sand or gravel (feet)	Depth through gravel or boulder (feet)	Depth to bedrock (feet)	Total depth (feet)	Depth sunk in bedrock (feet)	Remarks
11	Center of gorge	60		No proof	60		Hole abandoned on account of rise in river.
12	395 from left side	96.7	96.7–103.8	do	103.8		Hole ended on either boulder or bedrock.
13	275 from right side.	69	69 - 95	do	95		Bottom of hole in boulders.
14	Center of gorge	96	96 -105.3	do	105.3		Do.
15	do	94	94 - 95.7	do	95.7		Do.
16	do	23		do	23		Bottom of hole in gravel.
17	4 feet from hole 16				15		Bad ground.
18	Not given	95	95 -107.7	107.7	134	26.3	Level taken from 8 feet above low water.
19	Takes place of hole 13.	91	91 - 96.4	96.4	130	33.7	
20	Close to left	65	65 - 77	No proof	77		Hole lost on account of breaking casing.
20A		59	59 -159.6	do	159.6		Casing left in; work abandoned.
					998.4	60.0	

ECHO PARK POWER SITE

Location.—The Echo Park dam site (9BA 1) is at the head of Whirlpool Canyon, just where the river leaves Echo Park. It is about 3 miles down the river from the mouth of the Yampa River. (See pl. 1.)

Physical characteristics.—At this site the river is in a narrow box canyon in the "Uinta" quartzite. The distance between the walls at the water surface is 150 feet, and a dam to raise the water 300 feet would be 600 feet long on the top. (See fig. 27.)

Plan of development.—A development such as that proposed at the Flaming Gorge site (pl. 33) is also suggested at this site.

Water supply.—At this site the flow of the Green River is augmented by that of the Yampa River, and it is estimated that with each of the streams regulated above a flow of 4,950 second-feet would be available here. The Canyon of Ladore and the Blue Mountain Canyon on the Yampa River would form a reservoir. The backwater would extend up each of the streams about 29½ miles and create storage capacity of about 575,000 acre-feet. The Sand Draw and Johnson Draw dam sites, on the Yampa River, would both be flooded.

Power capacity.—The static head at the Echo Park site would probably fluctuate from 280 to 300 feet, allowing the top 20 feet of the reservoir to be used for regulation of the inflow into it below other points of regulation. With an average static head of 290 feet and a stream flow of 4,950 second-feet the power capacity of the site is 114,800 horsepower (86,100 kilowatts). All future irrigation use of the streams above this site will probably never reduce this capacity as much as 15 per cent.

Right of way.—No valuable agricultural lands would be flooded by this project.

Accessibility.—This site is accessible with difficulty. It is remote from any railroad transportation and would require expensive road construction to connect it with any present highway.

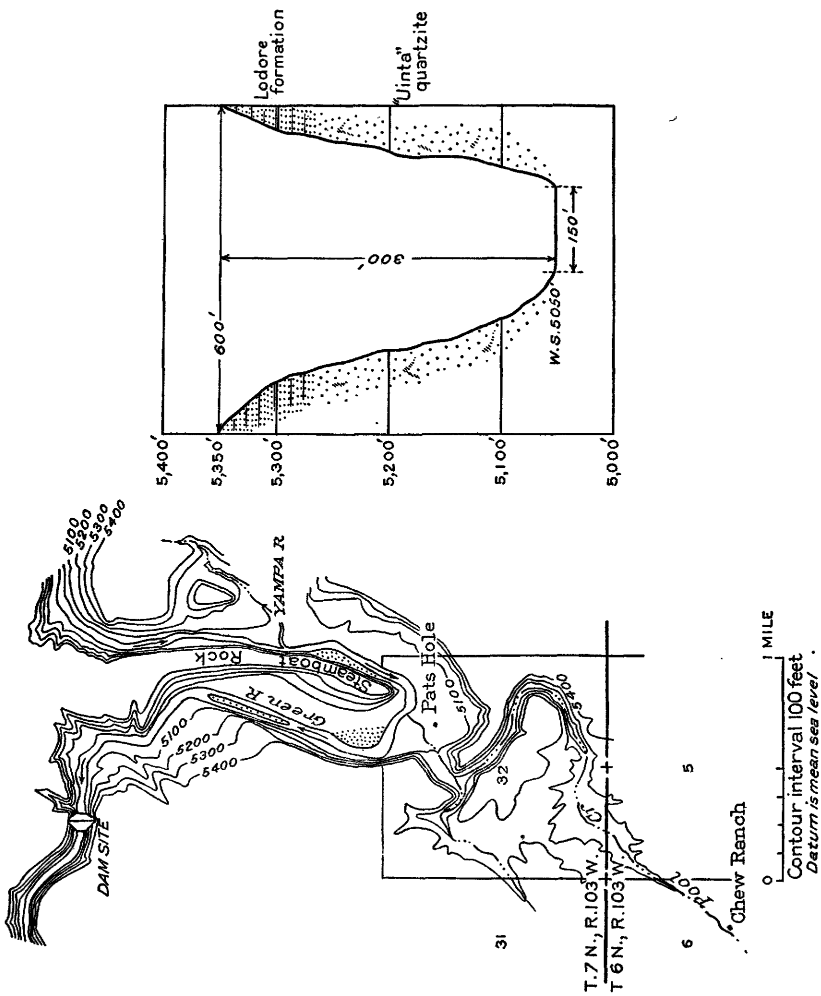


FIGURE 27.—Echo Park dam site.

SPLIT MOUNTAIN POWER SITE

Location.—The Split Mountain Power site (9BA 2) is about 1 mile above the lower end of Split Mountain Canyon, about 9 miles northeast of Jensen, Utah, just below mile 201 of the Green River survey.

Physical characteristics.—The river at this dam site has cut its channel into the Weber sandstone. This rock is hard and dense and is considered satisfactory for the foundation and abutment walls of a dam. (See pl. 34.)

Plan of development.—The same type of development as that proposed at the Flaming Gorge site (pl. 33) is adaptable for this site. The dam here would have a length of 150 feet at the water surface (altitude 4,800 feet) and a crest length of 1,000 feet at a height of 250 feet (altitude 5,050 feet). Another plan has been suggested, however, as a combination irrigation and power development. This plan contemplates a tunnel form a point immediately above the proposed dam extending almost due south to Red Wash. This tunnel, if taken out at an altitude of 4,900 feet, would be about 1 mile long, and a penstock from its outlet to the river near the mouth of Red Wash would be 1½ miles long. This would cut off about 12 miles of the river course and gain an additional head of 65 feet, adding about 25,500 horsepower to the capacity of the site after due allowance is made for irrigating about 12,000 acres of land to the west and south of the tunnel outlet. The large tunnel and pressure pipe necessary to handle 5,100 second-feet of water would add considerably to the cost of the development, but the irrigation feature may add to the attractiveness of the project when further irrigation development is needed in that locality. A small tunnel for the irrigation project might be more feasible. It has also been proposed that water be diverted from the Green River here to supply the Deadmans Bench irrigation project, which lies on both sides of the Colorado-Utah line to the southeast. This plan, however, was investigated by the Bureau of Reclamation and determined to be economically infeasible.

Water supply.—From an analysis of the stream-flow records on the Green River at Little Valley, Ouray, Jensen, and Bridgeport, it is estimated that an equalized flow at the Split Mountain power site of about 5,100 second-feet is possible with the regulation provided by the other developments above and the storage that would be created behind this dam.

Power capacity.—If the top 50 feet of the storage behind the dam is allowed for regulation the average static head would be 225 feet. With a flow of 5,100 second-feet the power capacity would be 91,800 horsepower (68,850 kilowatts). Ultimate irrigation use of the streams above this site will probably not decrease this capacity in excess of 15 per cent.

Right of way.—Development as here suggested would inundate Island Park, a part of which is used for ranching.

Accessibility.—The dam site is not difficultly accessible from towns in the Uinta Basin, but it is remote from railroad transportation.

ROCK CREEK POWER SITE

Location.—The Rock Creek power site (9BJ 3) is in Desolation Canyon about 73 miles downstream from Ouray and a little less than a mile above the mouth of Rock Creek, just below mile 55 of the Green River survey.

Physical characteristics.—The canyon walls at this place consist of alternating layers of shale and sandstone of the Wasatch formation. The material is compact, however, and would furnish fairly good

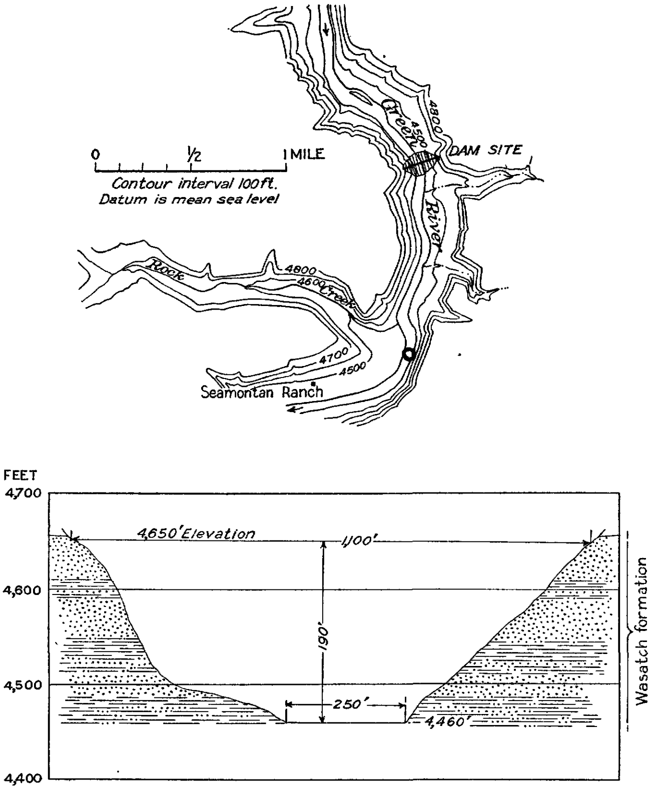


FIGURE 28.—Rock Creek dam site

walls and foundation for a dam. A map and cross section of the site are shown in Figure 28.

Plan of development.—A dam to raise the water 190 feet, or to an altitude of 4,650 feet, is suggested at this site. This would do a negligible amount of flood damage to lands in the Uinta Basin above and would at the same time create approximately 300,000 acre-feet of storage capacity in the upper 20 feet of the reservoir, to be used for stream regulation. The dam and power house suggested for this site are similar to those proposed for the Flaming Gorge site. (See pl. 33.)

Water supply.—The amount of water available here is somewhat uncertain. Stream-flow records for a few years are available for a gaging station at Ouray, but this station is above the mouths of both the Duchesne and White Rivers. These records, however, indicate that about 5,000,000 acre-feet passes Ouray each year except in years of abnormally low run-off, such as 1919. The records for the Little Valley station below Green River, Utah, are very complete and cover many years. In determining the stream flow at this power site it is assumed that the flow of the river at Split Mountain will be equalized by the developments there and farther upstream. Accordingly, there will be about 5,100 second-feet available at the Rock Creek site plus the inflow between the two power sites that can be regulated by the available storage capacity. Thus from the records of flow at Little Valley and Ouray, on the Green River, and those on the Duchesne and White Rivers it is estimated that by using the upper 15 to 20 feet of the reservoir that would be created by raising the water 190 feet at the dam site, enough storage capacity would be available to regulate the stream flow at about 7,000 second-feet.

Power capacity.—With a depth of water at the dam of 190 feet and a drawdown of the top 20 feet of the reservoir the minimum static head would be 170 feet and the average head would be 180 feet. Under these conditions the power capacity of the site with a stream flow of 7,000 second-feet is, in round numbers, 100,000 horsepower (75,000 kilowatts). It is believed that ultimate use of the streams for irrigation above this power site will diminish its capacity less than 15 per cent.

Right of way.—Damage from flooding of agricultural or improved lands would be slight with the plan of development here proposed. Most of the area that would be inundated is barren waste land and canyon bottoms that are already subject to flooding during high-water stages of the river.

Accessibility.—This site is not readily accessible. It is 55 miles up the river from Green River station on the Denver & Rio Grande Western Railroad and is 73 miles downstream from Ouray, an Indian trading post in the Uinta Basin where highway connections are available to towns in the basin and beyond.

Alternate plans of development.—By building the Rock Creek dam high enough to raise the water behind it to an altitude of 4,740 feet the water depth at the dam would be 280 feet and the reservoir created would have a capacity of about 5,000,000 acre-feet. This would flood the Green River Valley to a point within 10 miles by river of the Split Mountain site and would inundate a considerable number of ranches as well as the towns of Jensen and Ouray. The surface area of the reservoir would be about 90,000 acres. The crest length of this dam would be about 1,300 feet, and it is estimated that the storage capacity in the upper 110 feet of the reservoir would be sufficient to regulate the stream flow at about 7,000 second-feet. This would permit complete power development in the canyons below the Uinta Basin without depending on the developments on the Yampa and upper Green for stream regulation. The average static head under this plan would be about 230 feet and the power capacity of the site with a stream flow of 7,000 second-feet would be 129,000 horsepower (96,600 kilowatts).

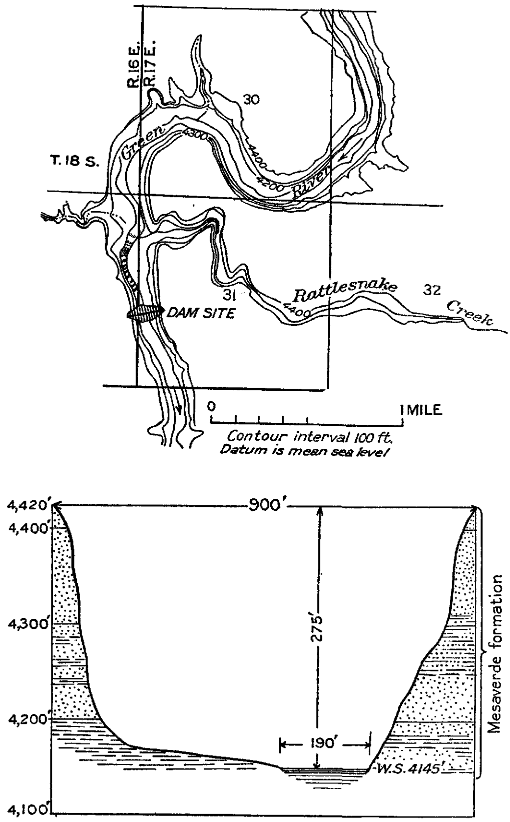


FIGURE 29.—Rattlesnake dam site

If the Ouray dam site of the Bureau of Reclamation, 53 miles up the river, just below mile 109 of the Green River survey, were used a water surface 4,790 feet above sea level is suggested. This would make the water depth at the dam 160 feet, and in the upper 50 feet of the reservoir about 5,000,000 acre-feet storage capacity would be available. A detail cross section of this dam site and area and capacity curves of the reservoir are shown on Plate 29. The total capacity of the reservoir would be 9,000,000 acre-feet, or nearly twice the yearly run-off at the dam site. About 4,000 acres more land would be flooded also. The average static head at the plant, if the top 50 feet of the reservoir were used for regulation and the rest as dead storage, would be 135 feet, and with a stream flow of 7,000 second-feet the power capacity of the site would be 75,600 horsepower (56,700 kilowatts).

RATTLESNAKE POWER SITE

Location.—The Rattlesnake power site (9BJ 4) is in Gray Canyon about 22 miles upstream from the town of Green River, Utah, on the east line of sec. 36, T. 18 S., R. 16 E., Salt Lake base and meridian.

Physical characteristics.—The walls of Gray Canyon are composed of a succession of hard, cliff-making brown sandstone, soft gray shale, brown carbonaceous shale, and coal. These rocks are classified as the Mesaverde formation; they lie immediately beneath the Wasatch formation and rest upon the Mancos shale. A map and cross section of the dam site are shown in Figure 29, and views of Gray Canyon in Plate 35.

Plan of development.—A combination dam and power house similar to the one proposed at the Flaming Gorge site is suggested at this site. (See pl. 33.) A dam to raise the water 275 feet, or from 4,145 to 4,420 feet above sea level, would have a crest length of 900 feet. (See fig. 29.)

Water supply.—The stream flow would be slightly greater than that at the Rock Creek site, because of the inflow from several small streams, but it would not be great enough to have any material effect on the power capacity of the site based on a flow of 7,000 second-feet.

Power capacity.—The static head at this site with the water surface raised from 4,145 to 4,420 feet would be 275 feet. Accordingly the power capacity of the site with a stream flow of 7,000 second-feet would be 154,000 horsepower (115,500 kilowatts).

Right of way.—All of the flooded area would be canyon bottom lands and canyon walls, none of it of agricultural value except the McPherson ranch, which comprises a small area near the mouth of Florence Creek.

Accessibility.—This site is not difficultly accessible. It is only 22 miles from the railroad at Green River, Utah, and for about half of this distance a good earth road is now in use.

CONDITIONS BELOW GREEN RIVER, UTAH

The fall of the Green River in the 117.3 mile stretch from Green River, Utah, to its mouth is 504.3 feet, or 4.33 feet to the mile. There are no attractive dam sites in this stretch, and the topographic conditions suggest that it be utilized for pondage by building a dam on the main Colorado River below the mouth of the Green, at the Junction or Dark Canyon Dam site. A description of these sites may be found on pages 47–51 of Water-Supply Paper 556, by E. C. LaRue, who regards the Dark Canyon site as the better one of the two.

SUMMARY

Water power sites on Green River between Green River, Wyo., and Green River, Utah [a]

Index No.	Name of power site	Static head (feet)	Estimated regulated stream flow (second-feet)	Power capacity (horse-power)
9AK 1	Flaming Gorge	[b] 196	2,620	41,000
9AK 2	Red Canyon	266	2,720	57,900
9AK 3	Swallow Canyon	195	2,740	34,700
9BA 1	Echo Park [c]	[b] 290	4,950	114,800
9BA 2	Split Mountain	[b] 225	5,100	91,800
9BJ 3	Rock Creek	[b] 180	7,000	100,000
9BJ 4	Rattlesnake	275	7,000	154,000
				594,200

[a] Backwater from either the Dark Canyon or the Junction power developments as described in Water-Supply Paper 556, pp. 47–49, would extend to the town of Green River, Utah. For this reason the utilization of that stretch of the river below the town is not considered in detail in this report.
[b] Average head.
[c] Development of the Echo Park site would flood the Sand Draw and Johnson Draw dam sites on the Yampa River.

RECAPITULATION

Water powers of Green River Basin

Minor drainage basin	Number of power sites	Horsepower			
		With existing flow		With regulated flow	
		0.08H×Q90	0.08H×Q50	0.08H×Q90	0.08H×Q50
Upper Green River Basin	9	1,530	1,933	11,100	
Yampa and White River Basins	9	[a] 7,150	[a] 17,460	[b] 86,500	
Uinta Basin exclusive of Green River	16	37,170	59,088	49,622	78,334
Lower Green River Basin	9	5,930	10,084	18,190	
Green River canyons	7			594,200	
	50	51,780	88,565	759,612	78,344

[a] Includes Cross Mountain site and sites on small streams. Other sites on main stream considered only with stream regulation.
[b] Does not include Sand Draw and Johnson Draw sites, as these would be flooded by development of Echo Park site on Green River.

RELATIVE VALUE OF STREAMS FOR POWER AND IRRIGATION

In the arid region the question how the streams may be used to best advantage is one that becomes more serious as the use of the water increases. One of the fundamental conditions involved in the question is the accepted principle that the different uses to which the water may be put are classified in order of their importance as (1) domestic, (2) irrigation, and (3) power and other industrial uses. In the early stages of development along the streams there is usually plenty of water and no difficulty attendant upon its use, but as the number of users increases and communities become dependent upon the streams for their water supply the problem becomes more and more complicated.

It is, of course, obvious that domestic use should have a preferred right, and it is also obvious that in communities where local irrigation is of primary importance in the production of the community's food supplies that, too, should have a preferred right. But there are few communities now that are solely dependent upon their own products for food. Only a little more than half of the food supply for the farms in the intermontane region is now produced on the farms, and in many places it is even cheaper to obtain foodstuffs by parcel post or freight than it is to produce them there. This condition has greatly changed the economic aspect of farming in the arid region where irrigation is necessary, and it has likewise affected, in some localities at least, the economic value of water rights for irrigation.

Throughout the arid region the cheaply constructed irrigation projects in climates adapted for general farming are all built, and the time when the more expensive ones will become economically feasible has been pushed farther into the future by increased transportation facilities and more efficient farming methods. Agriculture, including irrigation, was the basis upon which practically all the permanent communities of the arid West have been built, and some of these are still solely dependent upon this industry for their existence, but others have added different forms of industry such as mining and manufacturing.

The communities supported by irrigated lands are beyond doubt more stable than those subject to the ups and downs of prosperity that are not uncommon to other industries, and for this reason public opinion in the West places irrigation use of the streams superior to all other uses except domestic.

It is a somewhat common practice to measure the future growth of the arid West in terms of the total run-off of the streams and the area of undeveloped land, without any regard to the economic factor involved in the problem. However, the fallacy of such a criterion is very rapidly becoming apparent. The fact is now recognized that new problems must be solved in irrigation development to meet the profound changes that are reshaping our economic and social structure. Further irrigation development should be made only as economic needs demand, if it is to become permanently successful. This fact, however, seems to be entirely overlooked by those who wish to see every arable acre developed, and the result is that other uses of streams, such as power, are regarded as subject for all time to any proposed future demands for irrigation development, regardless of economic feasibility and without consideration of the relative economic value of the two uses. This attitude may preclude the use of a stream for power, as it may involve the water rights for that use in so much uncertainty as to make the power capacity too small to be attractive and also add to the difficulties of financing the project. In view of these conditions, each stream should be considered as an individual problem, and its utilization might properly be worked out according to the most comprehensive plan, based upon the weighted economic values of the various uses. Power now has a place in modern agriculture. Electricity has become the servant of the farmer and is the means by which he is enabled to do several times the work that he could do a few years ago. With these conditions in mind the following discussion of the relative value of the streams in the Green River Basin for irrigation and power has been prepared.

In the upper Green River Basin there are neither irrigation nor power resources that are attractive at this time. The region, because of its altitude and climate, is best adapted for stock raising, although there are vast areas of land that could be irrigated. The average value of improved farm land in this basin is not much greater than $25 an acre. This indicates that the lands do not produce high-priced crops and accordingly could not carry the burden of costs involved in building adequate irrigation works. Surveys show that there are literally hundreds of thousands of acres of arable land in this part of the basin, and much of it is irrigable, but the economic factor involved is well determined in the public mind, and the result is that the irrigation possibilities are unattractive to the prospective farmer or homeseeker. Accordingly there is much unused water in the streams, although on some of the smaller ones the entire natural summer flow is now used. In view of these conditions the value of these streams in the upper Green River Basin for irrigation is not now apparent, beyond the limit of the present use, and in all probability for many years to come the flow of the Green River as it now leaves the upper basin will be very little changed by further irrigation. The value of the streams above the Flaming Gorge project for power is perhaps comparable to that for irrigation. The power sites are not attractive because they are all too small to develop for an outside market, and the local market is too small to justify very extensive development. Ice would be troublesome at the power sites for about five months each year, and stream regulation would be necessary to eliminate the wide fluctuations in stream flow. In brief, the agricultural possibilities and the topographic conditions of the upper Green River Basin indicate that any conflict in the use of the streams for irrigation and power will never be serious, and the two uses may properly be considered compatible.

In the Yampa and White River Basins the use of the streams for irrigation is similar to that in the upper Green River Basin. Extension of the present irrigated areas in these two river basins would be expensive, and the acre value of the crops that can be produced there is small, as indicated by the fact that the average value of improved land in these basins ranges from $25 to $50 an acre. Obviously, such values would not justify very high irrigation costs. The White River Valley is somewhat different from the others in that it is narrow and most of its agricultural areas are improved. The irrigated areas fringe the river, and in its lower reaches the valley bottoms consist of alkaline and unproductive soil. Water might be taken from either the Yampa or the White River or both onto the Deadmans Bench, lying on both sides of the Utah-Colorado line north of the White River, but estimates made by the Bureau of Reclamation indicate that the cost of this diversion would be more than $200 an acre. The power value of the streams in the White River Basin is negligible, and the same is true of the streams in the upper part of the Yampa River Basin in view of the ice conditions in the winter, the small power capacity of the sites, and the fact that coal is so handy and cheap for steam-power development. On the Yampa River from Juniper Canyon down, however, the stream is valuable principally for power, because there are no available irrigable lands to which the water could be taken except on the Deadmans Bench. The power capacity of the stream is large enough to be considered favorably in connection with a large interconnected system, and this capacity is not likely to be appreciably diminished by irrigation use of the water in the upper valley, because of the questionable economic feasibility of the remaining irrigation possibilities in that region.

In the Uinta Basin the agricultural industry is more directly dependent upon irrigation, because it is more diversified. All of the natural summer flow of the streams is taxed to capacity and often beyond, to supply the irrigation demands. Storage is badly needed to carry the farmers through a year of subnormal run-off and also to care for the gradually increasing irrigated area. Accordingly each of the dozens of small lakes at the headwaters of the streams is a potential reservoir, and regardless of the fact that many of them have a capacity of only a few acre-feet they are all needed, and work is being done on some of them each year to increase the stored water supply. Thus the streams in this basin are beyond question valuable principally for irrigation, but it is also a fact that they have considerable value for power. Topographic conditions provide the power value of the streams in the canyons above the diversion points of the irrigation canals, and thus the streams may be used for both power and irrigation. The capacity of most of the power sites is large enough to make development economically feasible when the market for the power becomes available. Conditions in this basin are such that the maximum use possible may be made of the streams for irrigation. Irrigation possibilities are still more or less attractive here, and it is therefore reasonable to assume that irrigation development will become more intensive as time goes on. The market for power will grow with the irrigation growth, and thus the power value of the streams will be enhanced. Here again, because of the topographic conditions, power and irrigation use of the streams need not be in conflict. This is especially true as long as the power demand does not exceed the capacity of the feasible power sites when operated by the streams as regulated for irrigation. When the demand passes that point there is likely to be some conflict, but the market will then no doubt be large enough to make connection into the Utah Power & Light Co.'s system feasible and thus obviate any difficulty.

In the lower Green River Basin the streams at one time had some value for power development, but this has now virtually gone. One hydroelectric plant was operated on the Price River for several years, and others were contemplated at different times. The cheap coal in the Price River Valley, where coal-mining camps furnished the greater part of the power market, was also used for generation of electric power, and this furnished keen competition to the one isolated hydroelectric plant. Accordingly when this plant was washed out by a flood on the river it was not rebuilt, and its load was absorbed by the steam plants. Then a transmission line of the Utah Power & Light Co.'s system was built into the territory and it has now taken over practically all the load, so that the power value of the Price River under present conditions is negligible and is not in any way comparable with its value for irrigation. This same condition exists on the tributaries of the San Rafael River—Huntington, Cottonwood, and Ferron Creeks. Power projects were carefully planned on each of these streams during the period from 1910 to 1915, and for several years electric energy was generated at a flour mill on Cottonwood Creek to supply some of the settlements in the valley. Now these power sites are of negligible value, and the plant on Cottonwood Creek has been abandoned because the market in the valley is being better served by the Utah Power & Light Co. Thus the value of small isolated power sites which only a few years ago were considered a very desirable asset to a community fades into insignificance before the onward march of the centralized service of the superpower system. Irrigation use of the Price River and the tributaries of the San Rafael above mentioned may be expanded to a minor extent at some future time, but at present there is no economic demand for it.

The principal value of the Green River itself is for power. Topographic conditions are such that very little of the water can be used for irrigation, and even where it would be physically possible the expense of getting the water onto the available lands is too high to make the projects economically attractive. The principal power sites on the river are in the canyon stretches between Flaming Gorge, near the Utah-Wyoming line, and the mouth of Gray Canyon, about miles north of Green River, Utah. Most of the sites are not easily accessible, and this adds engineering difficulties to their development and increases the cost of development. The Flaming Gorge site is one of the most easily accessible sites, and it is about 65 miles from a railroad. The Split Mountain site is accessible by wagon road, but it is even farther from rail transportation than Flaming Gorge, and all construction materials and equipment would have to be carried to it by trucks. The sites in Gray Canyon above Green River, Utah, are not very far from the railroad at Green River, but to reach them it would be necessary to build a wagon road through several miles of narrow rugged canyon. As these three localities are the most easily accessible, it is obvious that none of the Green River sites are free from the rather expensive construction feature of transportation. Inaccessibility not only adds to the cost of constructing the dam and power house, but it adds tremendously to the cost of constructing and maintaining transmission lines. These physical conditions naturally detract from the value of the power sites, especially in view of the fact that hydroelectric equipment has about reached the limit of efficiency and steam plants are making advanced progress in fuel economy. In other words, the economy of hydroelectric plants generally has reached a maximum, whereas that of steam plants is still increasing. In the meantime capital costs of hydroelectric power projects are trending upward, because of such physical conditions as those above mentioned, which are found on many streams the country over, but capital costs of the steam plants are trending downward. The result is obviously in favor of the steam plants, and hydroelectric power projects should be encouraged in every way possible so that they may successfully compete economically with steam projects, for obviously it is good sense to develop as much of our electric energy as possible by our inexhaustible water power and thus restrain too great a demand upon our exhaustible coal supplies.

With the conditions above set forth in mind the States in the arid region might very properly consider carefully whether restrictions and obligations placed upon proposed power use of the streams to protect remote irrigation possibilities are justifiable. It might easily be that the development of a large hydroelectric project would be estopped indefinitely, and a steam plant built in its stead, by a simple requirement that such power development must be subject to all possible future irrigation use of the water above the project, regardless of the economic feasibility of the irrigation use. It is unwise to impose such restrictions on power projects without a proper analysis of the whole problem.

It is the opinion of the writer that water power really has an important place in the utilization of our western streams. It may be a by-product of irrigation, coordinate with irrigation, or even superior to irrigation. Those seeking to develop power would be shortsighted if they did not foster all possible development of the region through irrigation development; those seeking to develop irrigation would be shortsighted if they put every obstacle possible in the way of developing water power.

MARKET CONDITIONS

A market for power is the one thing that gives value to a power site, and this value, generally speaking, is directly proportional to the constancy of the market demand. The cost of producing power rises as the load factor lowers; in other words, when the demand fluctuates considerably the full production capacity of a plant can be realized for only a comparatively short period of maximum demand. If generating facilities sufficient to meet this maximum demand are installed the result is that during many hours of a year the investment in the plant is only partly productive. On the other hand, if the demand were constant and sufficient flow were available throughout the year, each kilowatt of generator capacity could turn out 8,760 kilowatt-hours of energy, and the unit cost would then be less than for any other condition of operation. The ideal load factor on a power plant is therefore 100 per cent.

In water-power development regulation of stream flow by reservoirs is usually necessary in order to utilize the power possibilities completely, and this regulation of course adds to the cost of the development. Furthermore, few water-power sites are near load centers, and therefore relatively long transmission lines are involved in their development. These are the conditions in the Green River Basin. The population is sparse throughout the basin, and the principal demand for power is for coal mining, an industry which has wide variations in its power demands and operates on an average load factor of about 20 per cent. These conditions of a low load factor and cheap fuel make steam-plant development the more practicable, and at this time more than 20,000 kilowatts of electric power is being generated by steam and used in the upper Green River Basin and the Yampa River Basin. Steam power was also used in the lower Green River Basin until a few years ago, when the Utah Power & Light Co. extended its lines into that region, and now the coal-mining companies are able to purchase power from that company with less capital outlay than would be required to generate it in their individual plants.

Thus far industrial development in the Green River Basin has been confined principally to agriculture and coal mining. Small amounts of manufactured products are turned out, but they require little power. There are more than 7,000 farms within the basin, and the value of farm buildings is in excess of $63,000,000. The annual output of dairy products amounts to about $1,000,000, and the value of livestock is approximately $30,000,000.

More than 10,000,000 tons of coal is mined within the basin each year—about 5,000,000 tons in the upper basin, 1,000,000 tons in the Yampa River Basin, and 4,000,000 tons in the lower basin. The estimated average consumption of power in this industry in the Green River Basin has been a little more than 7 kilowatt-hours for each ton of coal mined. Some of the principal coal-producing fields of the West are within the Green River Basin. Besides these coal-mining operations some mining of hydrocarbon compounds is done in the Uinta Basin near the Utah-Colorado line. There are no other mining operations of consequence.

Results of geologic investigations that have been conducted in different parts of the basin indicate that there are 1,000,000 acres or more of phosphate lands in Wyoming and Utah in the Uinta Mountains north and east of Vernal. These lands have been considered on several occasions as a source of phosphate fertilizer, and in the event of such development power would be needed in the process of manufacture. These studies show also that an abundance of building stone exists at different places in this region, and some of the sandstone of the Frontier formation near Kemmerer, Wyo., has been quarried and shipped for building. Clay deposits that will supply clay of good quality suitable for both ordinary brick and fire brick have also been found.

Vast deposits of oil shale lie within the Green River Basin, and it is quite possible that these deposits will at some future time form the basis of an oil-shale industry of no mean importance. This industry will support a population that will furnish a market for electric power, although the industry itself may not be a large power user. The same thing is true of oil-well development, but the wells that are now producing in the Wyoming and Colorado portions of the basin are beyond the economical transmission range of any present power development.

Another industry that promises to be of some importance in this region is the carbonization of coal and the manufacture of gas and oils from the distilled volatiles obtained in that process. One plant of this kind is now being projected in the coal district near Kemmerer, Wyo., and another one is proposed, to be located near Salt Lake City, to treat the coals from the Utah fields.

Some of the coal in the lower Green River Basin is coking coal of excellent quality, and more than 200,000 tons of coke is made yearly from it, for use in the smelter industry in Utah, Montana, California, and Idaho. More than 800 coke ovens are operated at Sunnyside, Utah, and the by-products from these ovens give opportunity for an industry that would also supply much gas and oil for commercial uses.

Although the Green River Basin has thus a number of valuable natural resources, their development from all present indications will be rather slow, and to attempt to supply the present power market from a single power system or even from two or three systems would require many miles of transmission lines through unproductive territory, which would not be economically justified by the present power demand. In view of this condition the assumption is warranted that the power needs of the Green River Basin are being satisfied in the most feasible way. In the upper basin and in the Yampa River Basin coal is plentiful and cheap, and the major part of the load is concentrated near the coal mines, so that short transmission lines are adequate. In the isolated parts of the basin where coal is not cheaply available small hydroelectric plants are serving the needs of the surrounding communities. In the lower basin it has become economically feasible for a central station to extend one of its numerous lines into the region to pick up the available load, and it is not unreasonable to suppose that at some future time what has happened in the lower basin will happen in the other parts of the basin.

Power markets outside of the Green River Basin are concentrated largely in the Salt Lake City district, to the west, and the Denver district, to the east. Each one of these centers is served by an interconnected power system, which is continually expanding to meet the growing market. The air-line distance between these two cities is a little less than 400 miles, and the water-power resources of the Green River Basin lie almost midway between the two. Denver is already getting power from its Shoshone hydroelectric plant, on the upper Colorado River about 135 miles west of the city, and this plant is only about 75 miles southeast of the Juniper power site, on the Yampa River. The Flaming Gorge power site, on the Green River at the Wyoming-Utah line, is about 135 miles east of Salt Lake City practically the same distance as plants on the Bear River, to the north, from which power is now being brought into the city. The distance from the Flaming Gorge site to the Juniper site is about 75 miles.

The Utah Power & Light Co. now serving the Salt Lake City district, has made application to the Federal Power Commission for a license to develop the Flaming Gorge site, so that it is not unreasonable to assume that this site will be utilized at some future time. With this development tied into the present system by a transmission line extending northward to the town of Green River, Wyo., and westward roughly paralleling the main line of the Union Pacific Railroad, it would then be possible to pick up the present power load at the town of Green River and other places along the way to the west, and it might also be economically feasible to extend a line eastward to serve at least a part of the 128,000-kilowatt load that is now used along the Union Pacific Railroad between Ogden, Utah, and Cheyenne, Wyo.

Then if the Juniper power site were developed and tied into the Shoshone plant the present coal-mining load in the Yampa River Valley could be served from that plant, and the excess power could be utilized to advantage eventually in the Denver district. In this way the low load factor power market now available in these parts of the Green River Basin could be absorbed without serious disturbance to the general load factor of the large systems.

The Flaming Gorge power site, on the Green River, and the Juniper site, on the Yampa River, are both what might be called key sites, in that each is located, so to speak, at the "top of the hill." Each of them will be of benefit to other developments farther downstream because of the stream-flow regulation made possible by the storage reservoirs behind the dams. Continued power development of these two streams will eventually furnish easy interconnection between the two systems that are serving Salt Lake City and Denver, and with the present tendency toward such interconnections it is not improbable that a superpower system will extend from Denver to the Pacific Northwest and southward through California.

In the lower Green River Basin a hydroelectric development has been proposed on the Green River in the canyon above the town of Green River, Utah. This would be easily connected with the transmission line of the Utah Power & Light Co. now tapping this basin. Such a connection would furnish additional power to the general system and also amply take care of any further industrial development of the region, as well as furnish a connecting link between the system of the Utah Power & Light Co. and that of the Western Colorado Power Co., to the east. It would also place a transmission line roughly parallel with the main line of the Denver & Rio Grande Western Railroad Co., which could then electrify its line between Salt Lake City, Utah, and Grand Junction, Colo. Along this stretch of line an average of about 35,000 horsepower and a maximum of about 55,000 horsepower, are now being used. By a plan of this kind the large power sites in the Green River Basin could be developed, primarily to extend the present systems that are supplying the power market in the industrial centers outside of the basin, and incidentally to serve the power demand within a great part of the basin itself.

This plan does not, however, take care of the Uinta Basin, the northern part of the Green River Basin above Green River, Wyo., or the White River Basin. In the Uinta Basin the type of development required is quite different from that in any other parts of the Green River Basin already considered. Here the population depends largely on agriculture rather than mining. Coal is not cheap in the Uinta Basin, and electric power is now supplied to the population centers from water-power plants. Several water-power sites are available along the south slopes of the Uinta Mountains, and they are not beyond economical transmission distance to the centers of possible development in this basin. Accordingly, as the market for power grows these sites may be developed and interconnected with those already there. When the demand for power becomes so great that it would be more economical to bring power in from the Utah Power & Light Co.'s system than it would be to develop additional sites within the basin itself it would be a simple matter to connect the two systems. This same plan is also applicable to the present steam-electric power load in the vicinity of Kemmerer, Wyo. If a transmission line were built from the Flaming Gorge project to Salt Lake City, a tap line extending northward from it would no doubt at some time be economically feasible, to pick up the load in that region.

In that part of the upper basin north of the town of Green River, Wyo., stock raising is now the principal industry, and there are no industrial centers or other centers of population that offer an attractive power market. Accordingly, until this condition is changed the small water-power sites near the towns can supply all the power demand.

In the White River Basin the demand for power is in many respects similar to that in the upper Green River Basin, but here if the power sites on the Yampa River were developed a transmission line of 50 miles or less would connect the two basins, and this distance would not be serious if a good concentrated power load were to become available.

The normal annual rate of growth of the power load in the Salt Lake City and Denver districts is about 10,000 horsepower, and this figure of course does not take into consideration the possibility of a large industry springing up that may require several times that much. It is also quite possible that the two transcontinental railroads now crossing the Green River Basin, the Union Pacific on the north, and the Denver & Rio Grande Western on the south, may within a reasonably short time be obliged to increase their facilities for handling their freight traffic, and this might be done by electrifying those stretches of their lines that now slow up the movement of trains. Each of these stretches is within easy reach of the Green River power sites, and this demand may therefore furnish an impetus to the development of these sites.

The present-day tendency in the development of electric power is toward large generator units, especially where it is possible to connect these into a well-developed system. This condition is available in connection with the development of the sites in the Green River Basin. If the Flaming Gorge site were developed and tied into the Utah Power & Light Co.'s system it would now be only one of about 40 hydroelectric plants that are already interconnected, as the Idaho

Power Co.'s system is now connected with that of the Utah Power & Light Co. More than 200,000 kilowatts of hydrogenerator capacity are represented by this combined system, and this is supplemented by 41,000 kilowatts of steam-generator capacity. This superpower system now serves the territory from the coal fields in the lower Green River Basin on the south through practically all of the Great Salt Lake Basin and practically all of the Snake River Valley in Idaho as far north as Oxbow, on the Oregon-Idaho boundary. The transmission-line distance from one end of this territory to the other is about 600 miles, and all of the area that can be reached from this system is virtually a potential power market for the Green River power projects.

A system of this sort makes it possible to develop many power sites which if considered individually would be economically infeasible. The flexibility of such a system permits balancing of the load of the different localities and makes it possible to shift surplus energy from one district to another to meet peak or abnormal conditions. The efficiency of the system is increased because of increased diversity of load and a resulting rise in the load factor. Idle time for generator equipment is minimized, small and inefficient plants are eliminated, and the service is subject to fewer interruptions because it is supplied from a number of sources. Accordingly, greater economy is possible in the production and distribution of electric power, and the result is greater satisfaction to both the producing company and the power user. In view of these conditions it seems reasonable to assume that the demand for power which will eventually impel the development of the larger power sites of the Green River Basin will come from the industrial centers outside of the basin.

RECORDS OF STREAM FLOW

The United States Geological Survey, in cooperation with the States of Utah and Wyoming, has maintained gaging stations in the Green River Basin within those States, and the State of Colorado has maintained similar stations in the Yampa and White River Basins in northwestern Colorado.

Most of these stations are represented by the accompanying records and in the following list. The stations are arranged in downstream order, and the tributaries are indicated by indention.

- Green River near Kendall, Wyo.,
- Green River near Daniel, Wyo.,
- Green River at Green River, Wyo.
- Green River at Bridgeport, Utah.
- Green River at Jensen, Utah.
- Green River at Ouray, Utah.
- Green River at Green River,[1] Utah.
  - Horse Creek at Daniel, Wyo.
  - Cottonwood Creek near Big Piney, Wyo.
  - East Fork at East Fork Canal, Wyo.
  - East Fork at New Fork, Wyo.
    - New Fork River near Cora, Wyo.
    - New Fork River near Boulder, Wyo.
      - Pine Creek at Pinedale, Wyo.
      - Pole Creek at Fayette, Wyo.
        - Fall Creek near Fayette, Wyo.
      - Boulder Creek near Boulder, Wyo.
  - North Piney Creek near Marbleton, Wyo.
  - Middle Piney Creek near Big Piney, Wyo.
  - Labarge Creek near Labarge, Wyo.
  - Fontenelle Creek near Fontenelle, Wyo.
  - Big Sandy Creek near Big Sandy, Wyo.
  - Big Sandy Creek near Eden, Wyo.
  - Big Sandy Creek near Farson, Wyo.
    - Squaw Creek near Big Sandy, Wyo.
    - Little Sandy Creek near Eden, Wyo.
  - Blacks Fork near Urie, Wyo.
  - Blacks Fork at Granger, Wyo.
    - Hams Fork at Diamondville, Wyo.
  - Beaver Creek near Lodore, Colo.
  - Vermilion Creek near Lodore, Colo.
  - Yampa River at Yampa, Colo.
  - Yampa River at Steamboat Springs, Colo.
  - Yampa River at Craig, Colo.
  - Yampa River near Maybell, Colo.
    - Walton Creek near Steamboat Springs, Colo.
    - Soda Creek at Steamboat Springs, Colo.
    - Elk River at Hinman Park, Colo.

[1] Described in earlier reports as near Blake or Elgin; records at Little Valley included in this report.

Green River—Continued.
Yampa River—Continued.
Elk River near Clark, Colo.
Elk River near Trull, Colo.
Big Creek near Steamboat Springs, Colo.
Mad Creek near Steamboat Springs, Colo.
Trout Creek at Pinnacle, Colo.
Fish Creek at Dunkley, Colo.
Fish Creek near Steamboat Springs, Colo
Elkhead Creek near Craig, Colo.
Fortification Creek at Craig, Colo.
Williams Fork near Pyramid, Colo.
Williams Fork at Hamilton, Colo.
Milk Creek near Axial, Colo.
Little Snake River (Middle Fork) near Battle Creek, Colo.
Little Snake River near Dixon, Wyo.
Little Snake River near Lily (formerly Maybell), Colo.
South Fork of Little Snake River near Battle Creek, Colo.
Slater Fork at Baxter ranch, near Slater, Colo.
Slater Fork near Slater, Colo.
Savery Creek at Savery, Wyo.
Willow Creek near Baggs, Wyo.
Muddy Creek near Baggs, Wyo.
Fourmile Creek near Baggs, Wyo.
Ashley Creek near Vernal, Utah.
Utah Power & Light Co.'s tailrace (formerly Vernal Milling Co.) near Vernal, Utah.
Duchesne River, North Fork (head of Duchesne River), near Hanna, Utah.
Duchesne River near Tabiona, Utah
Duchesne River at Duchesne, Utah
Duchesne River at Myton, Utah.
West Fork of Duchesne River near Hanna, Utah.
Wolf Creek near Hanna, Utah.
Strawberry River above mouth of Indian Creek in Strawberry Valley, Utah.
Strawberry River below mouth of Indian Creek in Strawberry Valley, Utah.
Strawberry River at Duchesne, Utah.
Indian Creek in Strawberry Valley, Utah.
Trail Hollow Creek in Strawberry Valley, Utah.
Currant Creek:
Red Creek near Fruitland, Utah.
Antelope Creek near Myton, Utah.
Lake Fork (West Fork) near Mountain Home, Utah.[2]
Lake Fork near Altonah, Utah.
Lake Fork below forks, near Whiterocks, Utah.
Lake Fork near Myton, Utah.
Uinta River near Neola, Utah.[2]
Uinta River near Whiterocks, Utah.
Uinta River near Fort Duchesne, Utah.
Uinta River at Ouray School, Utah.
Whiterocks River near Whiterocks, Utah.

[2] Fragmentary records for years ending Sept. 30, 1921-1925, in Water-Supply Papers 529, 549, 569, 589, 609.

Green River—Continued.
- White River, North Fork (head of White River), near Buford, Colo.
- White River near Meeker, Colo.
- White River near Rangely, Colo.
  - Marvine Creek near Buford, Colo.
  - South Fork of White River near Buford, Colo.
- Fish Creek (head of Price River) at Scofield, Utah.
- Price River near Helper, Utah.
- Price River at Woodside, Utah.
- Huntington Creek (head of San Rafael River) near Huntington, Utah.
- Huntington Creek near Castle Dale, Utah.
- San Rafael River near Green River, Utah.
  - Cottonwood Creek near Orangeville, Utah.
  - Ferron Creek (upper station) near Ferron, Utah.
  - Ferron Creek near Ferron, Utah.
  - Ferron Creek near Castle Dale, Utah.

GREEN RIVER NEAR KENDALL, WYO.

LOCATION.—In sec. 23, T. 38 N., R. 110 W., at Kendall ranger station, 6 miles north of Kendall post office, Sublette County. Nearest tributary, Rock Creek, enters a short distance below.

DRAINAGE AREA.—271 square miles (measured on topographic map).

RECORDS AVAILABLE.—August 2, 1910, to June 30, 1912; May 15 to September 30, 1918.

GAGE.—Chain gage at left bank 1,000 feet below ranger station; read by forest ranger.

EXTREMES OF DISCHARGE.—1910–1912, 1918: Maximum stage recorded, 6.8 feet at 8 a. m. June 15 and 16, 1918 (discharge, 5,090 second-feet). Minimum discharge occurs during winter.

DIVERSIONS.—Prior to December 31, 1916, no adjudicated diversions from Green River above station.

ACCURACY.—Gage read twice daily. Rating curve well defined prior to July 31, 1918. Records good except for periods of shifting control and days of missing gage heights, for which they are fair.

Monthly discharge of Green River near Kendall, Wyo., for 1910–1912 and 1918

Month	Discharge in second-feet			Run-off in acre-feet
	Maximum	Minimum	Mean	
1910				
August 2-31	720	300	486	29,900
September	280	130	187	11,100
1910-11				
October	176	60	111	6,820
April 26-30	160	135	150	1,490
May	740	181	438	26,900
June	3,010	900	1,880	112,000
July	1,660	660	1,210	74,400
August	624	260	406	25,000
September	320	160	224	13,300
1911-12				
October 1-14	210	160	199	5,530
June 8-30	2,900	750	1,910	87,100
1918				
May 15-31	534	331	443	14,900
June	5,030	503	2,900	173,000
July	1,550	550	972	59,800
August	670	293	422	25,900
September	370	205	268	15,900
October 8-17	370	215	272	5,400
The period				295,000

GREEN RIVER NEAR DANIEL, WYO.

Location.—Near line between Tps. 32 and 33 N., R. 110 W., at highway bridge 6 miles southwest of Daniel, Sublette County. No important tributary within several miles.

Drainage area.—932 square miles (measured on base map of Wyoming).

Records available.—April 20, 1913, to September 30, 1926. State engineer maintained station at this point during 1913 and 1914.

Gage.—Chain on downstream side of bridge.

Extremes of discharge.—1913–1926: Maximum stage recorded, 7.0 feet at 10 a. m. June 16, 1918 (discharge, 8,750 second-feet). Minimum discharge apparently occurs during winter. (Minimum discharge recorded November 8 and 9, 1922, 175 second-feet.)

Diversions.—Prior to July 1, 1921, adjudicated diversions of 241 second-feet from Green River above station near Daniel.

Accuracy.—Records good to excellent.

Monthly discharge of Green River near Daniel, Wyo., for 1913–1926

Month	Discharge in second-feet			Run-off in acre-feet
	Maximum	Minimum	Mean	
1913				
April 20–30	3,430	1,120	2,120	46,300
May	5,000	975	2,530	156,000
June	4,900	2,490	3,370	201,000
July	4,000	1,280	2,060	127,000
August	1,600	510	943	58,000
September	1,440	330	546	32,500
The period				621,000
1913–14				
October	360	275	317	19,500
April 14–30	2,130	840	1,410	47,400
May	3,720	975	2,120	130,000
June	4,400	1,440	2,880	171,000
July	2,490	840	1,660	102,000
August	1,520	300	751	46,200
September	300	230	258	15,400
1914–15				
October 1–10	275	250	252	5,000
April	1,000	465	716	42,600
May	1,000	356	607	37,300
June	1,590	640	1,070	63,700
July	2,180	1,000	1,360	83,600
August	1,000	465	609	37,400
September	1,140	272	611	36,400
1915–16				
October	695	250	354	21,800
November	340	206	252	15,000
December 1–4	246	246	246	1,950
March 21–31	1,670	690	1,260	27,500
April	2,390	385	956	56,900
May	2,750	1,190	1,840	113,000
June	4,620	1,670	2,700	161,000
July	1,890	1,280	1,720	106,000
August	1,500	480	1,050	64,600
September	515	190	333	19,800
1917				
April 27–30	1,730	670	1,010	8,010
May	3,670	500	2,240	138,000
June	4,810	1,810	3,400	202,000
July	4,050	1,810	2,880	177,000
August	1,810	500	936	57,600
September	720	430	498	29,600
The period				612,000

Note.—Records for 1913 and 1914 revised.

Monthly discharge of Green River near Daniel, Wyo., for 1913–1926—Continued

Month	Discharge in second-feet			Run-off in acre-feet
	Maximum	Minimum	Mean	
1917–18				
October	394	245	301	18,500
November	245	245	245	14,600
March 28–31	1,640	1,140	1,430	11,400
April	1,140	498	656	39,000
May	2,030	1,080	1,470	90,400
June	8,210	1,310	4,740	282,000
July	2,980	930	1,600	98,400
August	930	454	634	39,000
September	454	330	389	23,100
1918–19				
October	530	310	387	23,800
November 1–23	310	136	218	9,950
April	1,250	300	734	43,700
May	2,280	385	929	57,100
June	2,620	400	771	45,900
July	478	238	316	19,400
August	498	254	361	22,200
September	530	254	406	24,200
1919–20				
October	491	200	311	19,100
May	2,980	465	1,870	115,000
June	2,980	1,640	2,320	138,000
July	2,280	1,500	1,990	122,000
August	1,500	530	1,020	62,700
September	530	320	419	24,900
1920–21				
October	310	254	268	16,500
November	390	254	292	17,400
December 1–9	294	254	270	4,820
April 9–30	1,040	336	717	31,300
May	2,710	800	1,640	101,000
June	5,710	1,460	3,250	193,000
July	2,180	720	1,090	67,000
August	720	575	661	40,600
September	610	395	475	28,300
1921–22				
October	385	213	272	16,700
November 1–19	219	175	196	7,380
April 24–30	707	528	625	8,680
May	3,050	626	2,050	126,000
June	4,010	2,380	3,090	184,000
July		725	1,240	76,200
August	1,080	635	807	49,600
September			470	28,000
1922–23				
October	260	232	247	15,200
November	293	254	274	16,300
December 1–9		210	226	4,030
April 16–30	1,820	490	1,020	30,300
May	3,430	1,200	2,120	130,000
June	3,330	1,330	2,090	124,000
July	2,420	1,210	1,850	114,000
August	1,140	465	696	42,800
September	450	270	340	20,200
1923–24				
October	404	232	323	19,900
November 1–15	304	238	276	8,210
April 14–30	1,440	442	718	24,200
May	1,760	820	1,310	80,600
June	1,500	635	987	58,700
July	1,660	376	837	51,500
August	520	244	361	22,200
September	340	216	272	16,200
1924–25				
October	388	203	255	15,700
May	2,420	700	1,410	86,700
June	2,960	1,070	1,880	112,000
July	3,410	953	1,920	118,000
August	910	449	685	42,100
September	592	399	481	28,600
1925–26				
October	528	278	368	22,600
November	345	238	285	17,000
April	1,670	282	932	55,500
May	1,670	710	1,160	71,300
June	1,800	417	1,030	61,300
July	1,320	463	874	53,800
August	940	445	621	38,200
September	628	236	362	21,500

GREEN RIVER AT GREEN RIVER, WYO.

LOCATION.—In sec. 22, T. 18 N., R. 107 W., at Union Pacific Railroad pumping station, 100 feet below railroad bridge, at Green River, Sweetwater County, Wyo. No tributary within several miles.

DRAINAGE AREA.—7,670 square miles (measured on base map of Wyoming).

RECORDS AVAILABLE.—May 2, 1895, to October 31, 1906; October 1, 1914, to September 30, 1926.

GAGE.—Chain on left bank at pumping station. From March 1, 1915, to September 29, 1920, chain at highway bridge a third of a mile downstream. Gage used from 1895 to 1906 vertical staff on submerged cribbing near present site. No determined relation between gages.

EXTREMES OF DISCHARGE.—1895–1906; 1915–1926: Maximum stage recorded, 12.3 feet at 5 p. m. June 19, 1918 (discharge, 22,200 second-feet); minimum mean daily discharge recorded, 160 second-feet on November 17, 1898.

DIVERSIONS.—Prior to July 1, 1921, adjudicated diversions of 223 second-feet from Green River between Daniel and Green River stations.

ACCURACY.—Records good 1895 to 1906; excellent 1915 to 1926, except during winter, for which they are fair.

Monthly discharge of Green River at Green River, Wyo., for 1895–1906 and 1914–1926

Month	Discharge in second-feet			Run-off in acre-feet
	Maximum	Minimum	Mean	
1895				
May 2-31	6,120	2,560	4,060	242,000
June	6,780	3,730	4,600	274,000
July	6,900	2,730	4,200	258,000
August	2,910	1,200	1,880	116,000
September	1,170	530	749	44,600
The period				935,000
1895-96				
October	718	355	517	31,800
November	355	220	265	15,800
December			[a] 260	[a] 16,000
January			[a] 250	[a] 15,400
February			[a] 250	[a] 14,400
March			[a] 300	[a] 18,400
April	1,480	910	975	58,000
May	6,980	1,380	2,200	135,000
June	15,500	6,820	11,800	702,000
July	6,230	2,440	4,190	258,000
August	2,530	1,390	1,880	116,000
September	1,520	800	1,120	66,600
The year	15,500		2,000	1,450,000
1896-97				
October	960	640	740	45,500
November			[a] 600	[a] 35,700
December			[a] 500	[a] 30,700
January			[a] 450	[a] 27,700
February			[a] 400	[a] 22,200
March			[a] 400	[a] 24,600
April	3,200	1,200	1,960	117,000
May	17,900	2,720	9,770	601,000
June	14,400	4,400	7,550	449,000
July	4,400	1,760	2,790	172,000
August	2,500	640	1,600	98,400
September	640	400	465	27,700
The year	17,900		2,270	1,650,000

[a] Estimated.

NOTE.—Records for 1895 and 1896 revised.

Monthly discharge of Green River at Green River, Wyo., for 1895–1906 and 1914–1926—Continued

Month	Discharge in second-feet			Run-off in acre-feet
	Maximum	Minimum	Mean	
1897–98				
October	1,760	500	1,010	62,100
November			[a] 760	[a] 45,200
December			[a] 550	[a] 33,800
January			[a] 500	[a] 30,700
February			[a] 400	[a] 22,200
March			[a] 450	[a] 27,700
April	5,520	800	2,660	158,000
May	7,680	2,320	4,060	250,000
June	15,100	4,200	9,060	539,000
July	9,120	2,160	4,620	284,000
August	2,080	720	1,420	87,300
September	1,200	260	646	38,400
The year	15,100		2,180	1,580,000
1898–99				
October	400	300	347	21,300
November	1,280	160	400	23,800
December			[a] 300	[a] 18,400
January			[a] 300	[a] 18,400
February			[a] 400	[a] 22,200
March			[a] 450	[a] 27,700
April	2,390	990	1,600	95,200
May	5,690	1,530	3,270	201,000
June	21,400	5,480	12,500	744,000
July	20,700	8,880	14,500	892,000
August	8,650	2,460	5,170	318,000
September	2,460	1,700	2,060	123,000
The year	21,400		3,440	2,500,000
1899				
October	1,990	1,640	1,820	112,000
1900–1901				
October			[a] 600	[a] 36,900
November			[a] 600	[a] 35,700
December			[a] 500	[a] 30,700
January			[a] 500	[a] 30,700
February			[a] 400	[a] 22,200
March			[a] 500	[a] 30,700
April	2,880	500	1,320	78,600
May	12,400	1,780	6,750	415,000
June	10,200	3,400	5,420	323,000
July	4,200	1,840	2,750	169,000
August	2,460	905	1,410	86,700
September	905	500	632	37,600
The year	12,400		1,780	1,300,000
1901–2				
October			[a] 500	[a] 30,700
November			[a] 450	[a] 26,800
December			[a] 400	[a] 24,600
January			[a] 300	[a] 18,400
February			[a] 300	[a] 16,700
March			[a] 300	[a] 18,400
April	1,380	285	844	50,200
May	7,920	845	2,260	139,000
June	10,800	4,380	7,100	422,000
July	4,550	1,720	2,670	164,000
August	2,260	950	1,390	85,500
September	950	380	656	39,000
The year	10,800		1,430	1,040,000

[a] Estimated.

Monthly discharge of Green River at Green River, Wyo., for 1895–1906 and 1914–1926—Continued

Month	Discharge in second-feet			Run-off in acre-feet
	Maximum	Minimum	Mean	
1902–3				
October	380	285	329	20,200
November			[a] 300	[a] 17,900
December			[a] 300	[a] 18,400
January			[a] 300	[a] 18,400
February			[a] 250	[a] 13,900
March			600	36,900
April	1,740	582	1,200	71,400
May	2,660	1,300	1,840	113,000
June	13,000	2,020	9,570	569,000
July	8,010	2,400	3,990	245,000
August	2,160	1,110	1,460	89,800
September	3,320	792	1,550	92,200
The year	13,000		1,810	1,310,000
1903–4				
October	1,160	845	1,010	62,100
November			[a] 800	[a] 47,600
December			[a] 600	[a] 36,900
January			[a] 500	[a] 30,700
February			[a] 700	[a] 40,300
March			[a] 900	[a] 55,300
April	3,660	1,160	1,960	117,000
May	13,100	2,690	6,130	377,000
June	12,200	7,160	10,300	607,000
July	8,010	3,470	5,260	323,000
August	3,540	1,220	2,040	125,000
September	1,400	620	890	53,000
The year	13,100		2,580	1,870,000
1904–5				
October	838	597	698	42,900
November			[a] 550	[a] 32,700
December			[a] 500	[a] 30,700
January			[a] 400	[a] 24,600
February			[a] 400	[a] 22,200
March			[a] 550	[a] 33,800
April	1,260	600	883	52,500
May	3,600	820	1,580	97,200
June	8,540	3,320	5,950	354,000
July	5,590	1,820	3,460	213,000
August	1,740	860	1,120	68,900
September	964	420	639	38,000
The year	8,540		1,390	1,010,000
1905–6				
October	600	420	486	29,900
November			[a] 400	[a] 23,800
December			[a] 300	[a] 18,400
January			[a] 300	[a] 18,400
February			[a] 300	[a] 16,700
March			[a] 500	[a] 30,700
April	3,360	893	2,040	121,000
May	8,700	2,060	5,030	309,000
June	12,200	4,510	6,830	406,000
July	6,210	2,740	4,860	299,000
August	4,060	1,390	2,240	138,000
September	1,990	790	1,260	75,000
The year	12,200		2,050	1,490,000
1906				
October	790	560	660	40,600
1914–15				
October			[a] 550	[a] 33,800
November			[a] 500	[a] 29,800
December			[a] 400	[a] 24,600
January			[a] 325	[a] 20,000
February			[a] 325	[a] 18,000
March			[a] 800	[a] 49,200
April	2,140	910	1,420	84,500
May	2,560	1,140	1,620	99,600
June	3,960	2,010	2,820	168,000
July	3,770	1,580	2,650	163,000
August	1,580	840	1,110	68,200
September	3,600	738	1,270	75,600
The year	3,960		1,150	834,000

[a] Estimated.

Monthly discharge of Green River at Green River, Wyo., for 1895–1906 and 1914–1926—Continued

Month	Discharge in second-feet			Run-off in acre-feet
	Maximum	Minimum	Mean	
1915–16				
October	1,620	910	1,170	71,900
November	910	625	816	48,600
December	910	345	624	38,400
January	565	295	416	25,600
February	798	422	569	32,700
March	6,280	595	1,970	121,000
April	4,390	1,670	2,640	157,000
May	5,780	2,670	3,880	239,000
June	13,800	2,530	8,330	496,000
July	9,040	2,820	5,460	336,000
August	3,290	1,290	2,150	132,000
September	1,290	660	898	53,400
The year	13,800	295	2,410	1,750,000
1916–17				
October	990	692	874	53,700
November	950	250	518	30,800
December	448	340	405	24,900
January	448	315	374	23,000
February	392	340	364	20,200
March	1,030	420	529	32,500
April	5,170	1,030	2,260	134,000
May	8,400	1,890	4,760	293,000
June	18,400	4,560	10,100	601,000
July	17,300	5,170	10,400	640,000
August	5,170	1,470	2,400	148,000
September	1,570	1,030	1,340	79,700
The year	18,400	250	2,870	2,080,000
1917–18				
October	1,120	795	930	57,200
November	1,030	475	790	47,000
December			[a] 550	[a] 33,800
January			[a] 375	[a] 23,100
February			[a] 400	[a] 24,600
March			[a] 890	[a] 54,700
April	2,890	1,320	1,800	107,000
May	3,880	1,660	3,050	188,000
June	21,800	3,020	13,400	797,000
July	7,770	2,260	4,280	263,000
August		1,000	1,570	96,500
September	1,160	825	901	53,600
The year	21,800		2,410	1,750,000
1918–19				
October			[a] 900	[a] 55,300
November	1,130	410	749	44,600
December			[a] 449	[a] 27,600
January			[a] 358	[a] 22,000
February			[a] 346	[a] 19,200
March	1,640	350	655	40,300
April	2,120	890	1,600	95,200
May	5,100	1,420	2,580	159,000
June	8,050	890	2,140	127,000
July	890	350	542	33,300
August	715	330	523	32,200
September	750	330	499	29,700
The year	8,050		946	685,000
1919–20				
October	925	460	724	44,500
November	960		[a] 575	[a] 34,200
December			[a] 375	[a] 23,100
January			[a] 350	[a] 21,500
February			[a] 375	[a] 21,600
March	1,420	680	935	57,500
April	4,030	820	1,710	102,000
May	9,190	1,220	4,390	270,000
June	12,300	4,720	8,730	519,000
July	6,200	2,250	4,050	249,000
August	2,200	890	1,430	87,900
September	890	820	881	52,400
The year	12,300		2,040	1,480,000

[a] Estimated.

Monthly discharge of Green River at Green River, Wyo., for 1895–1906 and 1914–1926—Continued

Month	Discharge in second-feet			Run-off in acre-feet
	Maximum	Minimum	Mean	
1920–21				
October	980	760	827	50, 800
November	900	650	766	45, 600
December			[a] 500	[a] 30, 700
January			[a] 450	[a] 27, 700
February			[a] 500	[a] 27, 800
March	2, 280	860	1, 530	94, 100
April	4, 170	1, 340	2, 310	137, 000
May	10, 100	1, 610	4, 150	255, 000
June	21, 200	7, 350	13, 000	774, 000
July	6, 050	1, 610	2, 950	181, 000
August	1, 760	1, 130	1, 380	84, 800
September	1, 130	770	939	55, 900
The year	21, 200		2, 440	1, 760, 000
1921–22				
October	770	690	743	45, 700
November	770	620	736	43, 800
March 18–31	3, 650	1, 930	2, 740	76, 100
April	4, 090	730	1, 820	108, 000
May	8, 980	2, 980	5, 410	333, 000
June	13, 000	8, 570	11, 000	655, 000
July	9, 820	1, 850	3, 570	220, 000
August	2, 140	1, 560	1, 860	114, 000
September	1, 560	770	1, 130	67, 200
1922–23				
October	770	690	735	45, 200
November	850		673	40, 000
March 28–31	810	730	760	6, 030
April	3, 650	850	2, 020	120, 000
May	10, 700	2, 980	5, 590	344, 000
June	12, 100	4, 730	7, 660	456, 000
July	10, 700	3, 650	6, 000	369, 000
August	3, 380	1, 180	2, 020	124, 000
September	1, 640	950	1, 080	64, 300
1923–24				
October	1, 570	1, 040	1, 220	75, 000
November	1, 120	733	941	56, 000
March	1, 860	601	941	57, 900
April	8, 120	670	2, 820	168, 000
May	6, 970	1, 740	3, 950	243, 000
June	4, 770	2, 240	3, 150	187, 000
July	2, 850	796	1, 730	106, 000
August	858	640	754	46, 400
September	678	608	638	38, 000
1924–25				
October	883	610	687	42, 200
November	769	482	649	38, 600
March	2, 800	800	1, 190	73, 200
April	2, 800	1, 060	1, 910	114, 000
May	7, 370	1, 000	3, 390	208, 000
June	8, 590	3, 330	5, 790	345, 000
July	10, 300	2, 700	5, 250	323, 000
August	2, 500	1, 240	1, 910	117, 000
September	1, 520	1, 060	1, 230	73, 200
1925–26				
October	1, 600	1, 060	1, 260	77, 500
November	1, 240	1, 240	911	54, 200
March	2, 700	780	1, 340	82, 400
April	3, 120	755	2, 330	139, 000
May	4, 980	1, 930	3, 560	219, 000
June	4, 460	1, 060	2, 860	170, 000
July	4, 980	1, 180	2, 060	127, 000
August	1, 930	802	1, 200	73, 800
September	950	570	739	44, 000

[a] Estimated.

GREEN RIVER AT BRIDGEPORT, UTAH

LOCATION.—In sec. 31, T. 2 N., R. 25 E., half a mile below Sears Creek and ferry at Bridgeport post office and 40 miles northeast of Vernal.

DRAINAGE AREA.—15,700 square miles (measured on special map of Colorado River Basin).

RECORDS AVAILABLE.—October 1, 1914, to September 30, 1915. Records were obtained October 12, 1911, to September 30, 1914, at station 5 miles below; flow practically the same at both points.

GAGE.—Gurley printing water-stage recorder on right bank. From October 12, 1911, to September 30, 1914, records were obtained from a staff gage at Park Livestock Co.'s ferry near the headquarters ranch, about 5 miles below present gage.

DISCHARGE MEASUREMENTS.—Made from car on ferry cable or by wading.

CHANNEL AND CONTROL.—Bed for 300 or 400 feet above and below gage is of solid rock overlain in places with clean gravel. Current swift above and below gage; control should be fairly permanent.

EXTREMES OF DISCHARGE.—Maximum stage recorded (at old gage) 13.4 feet June 13 and 14, 1912 (discharge, 16,900 second-feet); minimum stage recorded, 3.0 feet during January and February, 1912; stage-discharge relation affected by ice.

DIVERSIONS.—The amount of water diverted above is not definitely known.

REGULATION.—None.

ACCURACY.—Open-water records considered good; winter records fair.

Monthly discharge of Green River at Bridgeport, Utah, for 1911–1915

Month	Discharge in second-feet			Run-off in acre-feet
	Maximum	Minimum	Mean	
1911–12				
October 12–31	1,020	880	[a] 915	36,300
November	950		[a] 822	[a] 48,900
December			[a] 580	[a] 35,700
January			[a] 550	[a] 33,800
February			[a] 590	[a] 33,900
March			[a] 774	[a] 47,600
April			[a] 1,630	[a] 97,000
May	6,640	1,660	4,020	247,000
June	16,900	6,640	11,900	708,000
July	13,200	4,820	7,700	473,000
August	4,820	2,000	3,390	208,000
September	2,340	1,270	1,540	91,600
The year				2,060,000
1912–13				
October	1,710	1,190	1,330	81,800
November			[a] 1,100	[a] 65,500
December			[a] 700	[a] 43,000
January			[a] 850	[a] 52,300
February			[a] 800	[a] 44,400
March			[a] 1,800	[a] 111,000
April	6,800		[a] 5,070	[a] 302,000
May	10,900	3,750	6,330	389,000
June	14,000	8,080	10,900	649,000
July	12,000	4,030	6,720	413,000
August	4,600		[a] 2,720	[a] 167,000
September			[a] 1,850	[a] 110,000
The year				2,430,000

[a] Estimated.

Monthly discharge of Green River at Bridgeport, Utah, for 1911–1915—Continued

Month	Discharge in second-feet			Run-off in acre-feet
	Maximum	Minimum	Mean	
1913–14				
October	2,220	1,270	1,860	114,000
November	1,530		[a] 1,150	[a] 68,400
December			[a] 750	[a] 46,100
January			[a] 780	[a] 48,000
February			[a] 1,020	[a] 56,600
March	3,750		[a] 1,970	[a] 121,000
April	6,800	3,100	5,130	305,000
May	14,400	4,750	8,870	545,000
June	16,700	8,580	11,800	702,000
July	9,300	2,840	5,980	368,000
August	4,350	1,160	2,480	152,000
September	1,160	790	903	53,700
The year	16,700		3,560	2,580,000
1914–15				
October			[a] 1,260	[a] 77,500
November			[a] 841	[a] 50,000
December			[a] 479	[a] 29,500
January			[a] 480	[a] 29,500
February			[a] 494	[a] 27,400
March	1,850	500	950	58,400
April	2,970	1,580	2,240	133,000
May	3,540	2,140	2,990	184,000
June	6,330	3,200	4,750	283,000
July	4,420	2,030	3,210	197,000
August	2,320	900	1,350	83,000
September	5,010	846	1,790	107,000
The year	6,330		1,740	1,260,000

[a] Estimated.

GREEN RIVER AT JENSEN, UTAH

LOCATION.—In sec. 21, T. 5 S., R. 23 E., at steel highway bridge at Jensen, 3 miles below mouth of Brush Creek and 2½ miles above Ashley Creek.

DRAINAGE AREA.—26,100 square miles (measured on special map of Colorado River Basin).

RECORDS AVAILABLE.—November 7, 1903, to December 24, 1904; March 13 to September 30, 1906; June 30 to October 17, 1914; August 1 to December 15, 1915, when station was discontinued.

GAGE.—Chain gage on downstream rail of highway bridge, near right bank; read twice daily by H. W. Chatwin. The gage used November 7, 1903, to September 30, 1906, was a vertical staff about 300 feet below the old Billings ferry.

DISCHARGE MEASUREMENTS.—Made from highway bridge. Conditions only fair.

CHANNEL AND CONTROL.—Stream bed of sand and mud; shifting. Right bank high; not subject to overflow; left bank is occasionally overflowed at extremely high water. Channel straight for several hundred feet above and below bridge.

EXTREMES OF DISCHARGE.—1903–1915: Maximum stage recorded, 11.80 feet May 29, 1904 (discharge, 32,100 second-feet); minimum stage recorded, 0.93 foot December 6, 1904 (discharge, 36 second-feet). Gage used in 1904 was not referred to same datum as later chain gage but must have been approximately the same.

DIVERSIONS.—Considerable water diverted above this station in Wyoming and Utah, but amount is not definitely known.

REGULATION.—None.

ACCURACY.—Records only fair owing to unstable conditions in channel.

Monthly discharge of Green River at Jensen, Utah, for 1903–4, 1906, and 1914–15

Month	Discharge in second-feet			Run-off in acre-feet
	Maximum	Minimum	Mean	
1903-4				
October				
November 7-30	1,560	852	1,290	61,400
December	2,830	1,390	1,730	106,000
January			[a] 1,800	111,000
February	4,990	2,270	[a] 2,000	115,000
March	6,290	2,820	3,550	218,000
April	12,200	12,400	7,580	451,000
May	32,100	13,700	20,400	1,250,000
June	26,200	5,400	23,000	1,370,000
July	13,200	2,240	9,480	583,000
August	4,850	670	3,100	191,000
September	2,350		1,210	72,000
The period				4,530,000
1904				
October	1,800	670	1,040	64,000
November	1,080	586	745	44,300
December 1-24	980	236	639	31,700
The period				140,000
1906				
March 13-31	16,200	1,990	7,340	277,000
April	14,700	3,970	8,070	480,000
May	29,600	8,850	19,400	1,190,000
June	30,200	9,670	20,400	1,210,000
July	12,300	5,160	9,230	568,000
August	5,870	2,520	3,850	237,000
September	4,420	2,240	3,080	183,000
The period				4,140,000
1914				
July	11,200	4,570	7,730	475,000
August	5,330	1,930	3,350	206,000
September	1,930	1,280	1,460	86,900
October 1-17	3,350	1,280	2,360	79,600
The period				848,000
1915				
August	2,580	1,120	1,550	95,300
September	6,780	1,080	2,150	128,000
October	4,020	1,420	2,040	125,000
November	1,690	749	1,280	76,200
December 1-15	1,400	910	1,150	34,200
The period				459,000

[a] Estimated.

GREEN RIVER AT OURAY, UTAH

LOCATION.—500 feet below ferry maintained by the Government at Ouray, Utah. Nearest town is Vernal, Utah, 35 miles distant, and nearest railroad station is Dragon, 35 miles distant.

RECORDS AVAILABLE.—March 23, 1904, to July 8, 1905. Gage heights only published in Water-Supply Papers 133 and 175.

GAGE.—Staff gage securely driven into the river bottom and spiked to a large cottonwood tree that overhangs the right bank.

DISCHARGE MEASUREMENTS.—Made from the Government ferry cable, which is suspended across the river about 500 feet above gage.

CHANNEL AND CONTROL.—Bed of stream is composed of clean sand and is shifting. Stream is usually confined to one channel, changing only as sand bars are formed during high water.

46050—30——19

GREEN RIVER AT GREEN RIVER, UTAH

LOCATION.—In NW. ¼ SW. ¼ sec. 15, T. 21 S., R. 16 E., at highway bridge, 1 mile southeast of Green River, Emery County. San Rafael River enters from right 22 miles downstream.

DRAINAGE AREA.—40,600 square miles (measured in 1927 on base maps).

RECORDS AVAILABLE.—October 21, 1894, to October 15, 1899; March 1, 1905, to September 30, 1926. Described in earlier reports as near Blake or Elgin. Records obtained at Little Valley, 7 miles downstream, December 18, 1910, to June 20, 1924, give practically the same flow as the additional 470 square miles of drainage area are practically all desert. Records for years 1898–99, published in Twentieth and Twenty-first Annual Reports and reproduced in this report, should be used with considerable care as their accuracy is questionable.

EQUIPMENT.—Stevens continuous water-stage recorder on downstream side of right bank.

DISCHARGE MEASUREMENTS.—Made from cable at old ferry site, 8 miles downstream.

CHANNEL AND CONTROL.—Bed composed of gravel and sand. One channel at all stages. Left bank high and not subject to overflow; right bank lower and may be overflowed at extreme stages above and below the highway and Denver & Rio Grande Western Railroad bridges. There is a well-defined break in slope three-quarters of a mile downstream, but the stage-discharge relation seems to be affected at times by sand carried into river channel by Saleratus Wash that enters a short distance above that point.

EXTREMES OF DISCHARGE.—1894–1899; 1905–1926: Maximum discharge recorded, 68,800 second-feet May 29, 1897. Minimum stage recorded, 0.95 foot on December 1, 1919 (discharge, 510 second-feet).

DIVERSIONS.—Below practically all diversions.

REGULATION.—Slight regulation by diversion from tributaries.

ACCURACY.—Records good.

COOPERATION.—Since December 16, 1917, station has been maintained in cooperation with Utah Power & Light Co.

Monthly discharge of Green River near Green River, Utah, for 1894–1899 and 1905–1926

Month	Discharge in second-feet			Run-off in acre-feet
	Maximum	Minimum	Mean	
1894–95				
October 21-31	3,250	3,100	3,170	69,200
November	3,250	2,440	2.930	174,000
December	2 440	1,700	2,240	138,000
January	2,440	2,010	2,170	133,000
February	2,320	2,010	2,140	119,000
March	6,470	2,320	3,780	232,000
April	16,700	4,720	8,280	493,000
May	26,300	13,900	21,400	1,320,000
June	21,000	10,600	14,600	869,000
July	15,000	4,740	9,430	580,000
August	4,860	2,150	3,340	205,000
September	2,790	1,450	1,770	105,000
The period	26,300	1,450	6,250	4,440,000

Monthly discharge of Green River near Green River, Utah, for 1894–1899 and 1905–1926—Continued

Month	Discharge in second-feet			Run-off in acre-feet
	Maximum	Minimum	Mean	
1895–96				
October	2,620	1,650	2,020	124,000
November	1,880	900	1,590	94,600
December	1,450	950	1,300	79,900
January	1,500	1,160	1,330	81,800
February	1,550	1,200	1,390	80,000
March	4,540	1,450	2,460	151,000
April	13,100	2,960	4,930	293,000
May	29,800	7,330	13,500	830,000
June	43,500	12,300	27,400	1,630,000
July	11,300	5,140	6,720	413,000
August	5,650	1,870	3,240	199,000
September	9,430	1,740	3,060	182,000
The year	43,500	900	5,730	4,160,000
1896–97				
October	2,990	1,740	2,110	130,000
November	2,160	1,390	1,720	102,000
December			[a] 1,300	79,900
January			[a] 1,000	61,500
February			[a] 1,200	66,600
March			[a] 2,000	123,000
April	13,100	3,550	6,430	383,000
May	67,300	15,700	43,500	2,670 000
June	55,200	11,400	26,600	1,580,000
July	10,500	3,900	6,320	389,000
August	4,110	2,150	3,260	200,000
September	9,450	1,880	3,230	192,000
The year	67,300		8,260	5,980,000
1897–98				
October	8,300	4,120	5,770	355,000
November	4,120	3,070	3 460	206,000
December	2,860	1,040	1,460	89,600
January	6,010	1,140	4,690	288,000
February	6,010	4,860	5,500	305,000
March	6,430	2,910	4,660	286,000
April	20,400	3,490	10,500	623,000
May	23,200	18,500	20,700	1,270,000
June	35,600	20,400	26,600	1,580,000
July	27,000	3,810	10,300	635,000
August	3,500	2,020	2,570	158,000
September	3,070	1,160	1,840	110,000
The year	35,600	1,040	8,170	5,910,000
1898–1899				
October	1,600	1,200	1,460	89,800
November	2,020	1,080	1,410	84,000
December	1,400	1,120	1,270	78,200
January	2,020	1,400	1,590	97,500
February	2,020	1,600	1,740	96,400
March	6,330	1,600	3,110	191,000
April	17,500	4,120	6,810	405,000
May	34,100	8,330	23,200	1,430,000
June	58,400	28,400	44,100	2,620,000
July	51,200	12,300	30,600	1,880,000
August	23,200	4,330	10,700	655,000
September	4,230	2,650	3,300	199,000
The year	58,400	1,080	10,780	7,830,000
1899				
October 1–14	2,650	2,440	2,460	151,000
1905				
January				
February				
March	3,840	1,760	2,990	184,000
April	6,360	2,720	4,070	242,000
May	24,200	6,360	12,900	793,000
June	33,900	14,000	24,300	1,450,000
July	13,400	4,180	7,640	470,000
August	3,840	1,870	2,730	168,000
September	6,030	1,870	2,510	149,000
The period				3,460,000

[a] Estimated.

Monthly discharge of Green River near Green River, Utah, for 1894–1899 and 1905–1926—Continued

Month	Discharge in second-feet			Run-off in acre-feet
	Maximum	Minimum	Mean	
1905–6				
October	6,190	1,870	2,480	152,000
November	2,560	1,820	2,050	122,000
December	1,870		1,320	81,200
January			[a] 1,400	[a] 86,100
February			[a] 1,620	[a] 90,000
March	21,800	1,870	6,110	376,000
April	16,900	5,400	9,580	570,000
May	36,500	12,400	24,800	1,520,000
June	42,100	24,500	31,300	1,860,000
July	15,700	8,040	6,170	824,000
August	8,260	4,430	5,080	379,000
September	7,440	3,720		302,000
The year	42,100		8,780	6,360,000
1906–7				
October	3,720	2,560	3,020	186,000
November	5,870	1,760	3,260	194,000
December	3,280	1,700	2,430	149,000
January	2,900	1,820	2,440	150,000
February	7,840	2,560	4,010	273,000
March	13,400	3,720	6,760	416,000
April	24,900	6,030	14,000	833,000
May	42,900	13,100	24,700	1,520,000
June	48,100	29,800	38,800	2,310,000
July	42,900	19,000	31,600	1,940,000
August	19,300	7,100	11,200	689,000
September	7,940	3,220	4,820	287,000
The year	48,100	1,700	12,300	8,950,000
1907–8				
October	5,260	3,000	3,670	226,000
November	3,000	1,890	2,560	152,000
December	1,890	1,240	1,470	90,400
January	1,820	1,350	1,300	79,900
February	1,890	1,600	1,530	88,000
March	5,940	1,740	3,570	220,000
April	12,800	3,450	6,590	392,000
May	14,600	8,160	11,600	713,000
June	25,000	11,400	18,100	1,080,000
July	14,400	4,820	10,300	633,000
August	8,890	4,820	6,810	419,000
September	5,300	1,900	3,380	201,000
The year	25,000	1,240	5,910	4,290,000
1908–9				
October	6,120	2,700	3,580	220,000
November	3,220	830	2,160	129,000
December	1,460	750	801	49,300
January	3,510	930	1,980	122,000
February	2,580	1,330	1,720	95,500
March	33,000	1,460	8,120	499,000
April	16,200	4,820	9,290	553,000
May	32,700	11,000	22,400	1,380,000
June	62,200	32,700	46,300	2,760,000
July	42,600	12,800	25,200	1,550,000
August	14,100	8,000	10,300	633,000
September	18,000	5,170	9,960	593,000
The year	62,200	750	11,800	8,580,000
1909–10				
October	4,820	3,220	3,930	242,000
November	3,510	2,470	2,980	177,000
December	4,820	800	1,290	79,300
January			[a] 1,000	[a] 61,500
February	7,500	1,200	2,500	139,000
March	22,400	2,700	11,400	701,000
April	24,800	7,560	12,500	744,000
May	28,800	13,000	21,200	1,300,000
June	21,300	6,310	13,700	815,000
July	6,500	1,640	3,230	199,000
August	4,650	1,100	2,160	133,000
September	6,500	1,100	2,040	121,000
The year	28,800		6,490	4,710,000

[a] Estimated.

Monthly discharge of Green River near Green River, Utah, for 1894–1899 and 1905–1926—Continued

Month	Discharge in second-feet			Run-off in acre-feet
	Maximum	Minimum	Mean	
1910–11				
October	5,940	1,300	3,280	202,000
November	3,450	2,000	2,270	135,000
December	2,000	770	1,520	93,500
January	4,380		2,330	143,000
February	8,640	1,630	3,440	191,000
March	13,500	1,500	6,280	386,000
April	7,440	4,050	5,480	326,000
May	16,100	7,770	11,700	719,000
June	27,600	11,300	19,400	1,150,000
July	16,400	4,950	8,460	520,000
August	4,480	2,130	2,930	180,000
September	4,390	1,520	1,970	117,000
The year	27,600	770	5,760	4,160,000
1911–12				
October	6,120	2,440	3,800	234,000
November	2,640	1,740	2,240	133,000
December	1,910	1,450	1,640	101,000
January	2,280	1,430	1,720	106,000
February	2,070	1,480	1,800	104,000
March	6,050	1,530	3,690	227,000
April	9,850	4,870	6,550	390,000
May	30,600	5,330	16,100	990,000
June	54,600	22,600	37,600	2,240,000
July	28,800	9,500	16,300	1,000,000
August	10,900	3,860	6,860	422,000
September	4,440	2,810	3,620	215,000
The year	54,600	1,430	8,490	6,160,000
1912–13				
October	7,790	2,810	3,660	225,000
November	4,240	2,210	3,510	209,000
December	1,810	1,290	1,520	93,500
January	2,400		[a] 2,300	[a] 141,000
February	2,400		[a] 2,230	[a] 124,000
March	6,040		[a] 4,160	[a] 256,000
April	19,100	7,800	12,800	762,000
May	24,500	9,100	16,500	1,010,000
June	26,700	12,800	19,400	1,150,000
July	18,200	8,760	14,700	904,000
August	8,100	2,240	4,330	266,000
September	8,760	2,240	3,830	228,000
The year	26,700		7,410	5,370,000
1913–14				
October	4,540	2,880	3,560	219,000
November	3,770	2,720	3,250	193,000
December	2,720		[a] 1,680	[a] 103,000
January			[a] 1,950	[a] 120,000
February	7,200		[a] 2,640	[a] 147,000
March	12,800	3,300	6,430	395,000
April	19,600	6,300	12,600	750,000
May	45,900	15,800	28,500	1,750,000
June	50,800	24,000	35,700	2,120,000
July	23,000	6,600	13,600	836,000
August	6,300	3,040	4,620	284,000
September	3,580	2,320	2,620	156,000
The year	50,800		9,780	7,070,000
1914–15				
October	5,710	2,720	3,960	243,000
November	3,680	1,660	2,720	162,000
December	2,260	1,100	1,530	94,100
January			[a] 1,500	[a] 92,200
February			[a] 1,770	[a] 98,300
March	4,540		3,030	186,000
April	11,200	4,690	7,440	443,000
May	14,700	7,260	11,000	676,000
June	19,200	11,700	15,600	928,000
July	11,100	2,740	6,160	379,000
August	3,050	1,500	2,080	128,000
September	8,800	1,460	3,120	186,000
The year	19,200	1,100	4,990	3,620,000

[a] Estimated.

Monthly discharge of Green River near Green River, Utah, for 1894–1899 and 1905–1926—Continued

Month	Discharge in second-feet			Run-off in acre-feet
	Maximum	Minimum	Mean	
1915–16				
October	8,440	2,800	3,940	242,000
November	3,910	2,380	2,830	168,000
December	2,460	875	1,880	116,000
January			[a]1,720	[a]106,000
February	2,720		[a]2,240	[a]129,000
March	17,600	2,630	9,080	558,000
April	18,500	7,340	10,500	625,000
May	30,300	15,800	21,000	1,290,000
June	26,200	15,800	23,000	1,370,000
July	15,400	6,420	10,300	633,000
August	8,520	3,150	5,750	354,000
September	2,970	1,990	2,570	153,000
The year	30,300	875	7,930	5,740,000
1916–17				
October	11,300	2,570	4,990	307,000
November	3,620	1,070	2,560	152,000
December	3,060	1,140	2,060	127,000
January			[a]1,290	[a]79,300
February			[a]2,090	[a]116,000
March	4,540	2,800	3,350	206,000
April	24,100	5,360	11,900	708,000
May	44,500	10,900	26,200	1,610,000
June	66,700	31,800	46,300	2,760,000
July	59,400	10,900	28,000	1,720,000
August	12,600	3,810	6,660	410,000
September	5,000	3,420	4,010	239,000
The year	66,700		11,700	8,430,000
1917–18				
October	3,810	2,970	3,260	200,000
November	3,240	2,800	3,100	184,000
December	3,330	1,800	2,720	167,000
January	3,330	1,200	2,350	144,000
February	3,060	2,090	2,450	136,000
March	5,730	2,970	4,080	251,000
April	9,390	5,120	6,470	385,000
May	18,400	5,980	13,000	848,000
June	43,300	13,500	29,000	1,730,000
July	23,600	5,240	11,500	707,000
August	4,880	1,920	3,280	202,000
September	4,430	1,830	2,570	153,000
The year	43,300	1,200	7,050	5,110,000
1918–19				
October	4,650	2,800	3,680	226,000
November	3,520	1,420	3,010	179,000
December	2,970	1,310	2,120	130,000
January			[a]1,420	[a]87,300
February			[a]1,750	[a]97,200
March	10,900		4,500	277,000
April	15,400	4,880	7,970	474,000
May	19,900	10,500	14,900	916,000
June	19,900	3,620	9,290	553,000
July	3,420	850	1,750	108,000
August	1,700	838	1,200	73,800
September	2,460	834	1,790	107,000
The year	19,900	834	4,460	3,230,000
1919–20				
October	2,240	1,600	1,990	122,000
November	2,450	710	2,100	125,000
December		510	1,470	90,400
January			[a]1,750	[a]108,000
February	3,040		2,430	140,000
March	5,250	2,800	3,970	244,000
April	12,300	3,130	6,530	389,000
May	48,100	4,580	26,700	1,640,000
June	49,100	20,800	34,100	2,030,000
July	19,700	5,810	10,200	627,000
August	6,370	3,230	4,530	279,000
September	3,110	2,050	2,540	151,000
The year	49,100	510	8,190	5,950,000

[a] Estimated.

NOTE.—Discharge figures for December, 1915, have been revised. Above figures supersede those published in Water-Supply Paper 439, p. 21.

Monthly discharge of Green River near Green River, Utah, for 1894–1899 and 1905–1926—Continued

Month	Discharge in second-feet			Run-off in acre-feet
	Maximum	Minimum	Mean	
1920–21				
October	3,760	2,220	2,610	160,000
November	4,120	2,600	3,310	197,000
December	2,420	1,100	1,900	117,000
January			[a] 1,970	[a] 121,000
February	4,670	2,170	3,040	169,000
March	11,400	5,460	7,670	472,000
April	10,300	5,060	7,450	443,000
May	39,200	8,390	25,200	1,550,000
June	64,100	24,000	46,700	2,780,000
July	22,800	5,610	10,800	664,000
August	7,040	4,220	5,500	338,000
September	4,670	2,310	3,430	204,000
The year	64,100	1,100	9,950	7,220,000
1921–22				
October	2,760	2,180	2,350	144,000
November	2,780	2,280	2,460	146,000
December	3,360	1,260	2,180	134,000
January	2,580	955	1,750	108,000
February	3,720	1,800	2,470	137,000
March	19,000	2,210	6,420	395,000
April	10,600	4,290	6,050	360,000
May	44,000	11,500	26,800	1,650,000
June	45,800	23,100	37,400	2,230,000
July	21,700	3,830	8,600	529,000
August	8,680	2,920	4,070	250,000
September	4,650	1,960	2,890	172,000
The year	45,800	955	8,630	6,250,000
1922–23				
October	2,580	1,960	2,060	127,000
November	2,830	2,340	2,590	154,000
December	2,740	1,540	2,130	131,000
January	2,610	1,810	2,200	135,000
February	2,520	1,670	2,120	118,000
March	10,000	2,560	3,670	226,000
April	16,400	8,570	11,500	682,000
May	42,000	13,400	25,800	1,590,000
June	41,500	18,400	30,800	1,830,000
July		9,210	12,900	796,000
August	9,750	3,570	5,780	356,000
September	4,410	2,710	3,300	196,000
The year	42,000	1,540	8,760	6,340,000
1923–24				
October		3,550	3,890	239,000
November	3,790		[a] 3,380	[a] 201,000
December	2,900		[a] 2,070	[a] 127,000
January			[a] 1,440	[a] 88,500
February			[a] 2,870	[a] 165,000
March	5,200		[a] 3,310	[a] 204,000
April	21,600	2,780	11,300	672,000
May	24,300	7,670	15,900	978,000
June	16,800	5,970	12,600	750,000
July	5,730	1,910	3,630	223,000
August	1,940	1,180	1,470	90,400
September	6,140	1,090	1,500	89,300
The year	24,300		5,270	3,830,000
1924–25				
October	2,270	1,250	1,710	105,000
November	2,270	1,760	2,050	122,000
December	1,990		1,180	72,600
January			[a] 1,450	[a] 89,200
February	2,800		[a] 2,330	[a] 129,000
March	9,700	2,360	4,480	275,000
April	12,200	5,290	7,890	469,000
May	20,100	6,080	13,700	842,000
June	20,100	9,450	14,100	839,000
July	15,400	4,260	9,270	570,000
August	7,810	3,320	4,370	269,000
September	9,800	2,960	4,480	267,000
The year	20,100		5,590	4,050,000

[a] Estimated.

Monthly discharge of Green River near Green River, Utah, for 1894–1899 and 1905–1926—Continued

Month	Discharge in second-feet			Run-off in acre-feet
	Maximum	Minimum	Mean	
1925–26				
October	9,990	3,540	4,850	298,000
November	3,760	2,600	3,220	192,000
December	3,260	1,240	2,370	146,000
January	2,200	1,640	1,900	117,000
February	2,540	1,760	2,270	126,000
March	8,940	2,500	5,600	344,000
April	18,300	3,760	10,300	613,000
May	24,000	9,710	18,200	1,120,000
June	23,700	4,890	13,100	780,000
July	16,100	2,770	5,770	355,000
August	6,240	1,860	3,230	199,000
September	2,280	1,260	1,580	94,000
The year	24,000	1,240	6,050	4,380,000

HORSE CREEK AT DANIEL, WYO.

Location.—About sec. 2, T. 33 N., R. 111 W., at highway bridge three-fourths mile south of Daniel, in Sublette County. No tributary between station and mouth.

Drainage area.—193 square miles (measured on base map of Wyoming).

Records available.—April 20, 1913, to November 18, 1918. State engineer maintained station during 1913 and 1914.

Gage.—Vertical staff on upstream side of left bridge abutment.

Extremes of discharge.—1913–1918: Maximum stage recorded, 5.7 feet at 10 a.m. June 16, 1918 (discharge, 1,530 second-feet); minimum stage recorded, 0.7 foot August 29–30, 1915 (discharge, 1 second-foot).

Diversions.—Prior to December 31, 1916, adjudicated diversions of 161 second-feet from Horse Creek, all above station.

Accuracy.—Gage read once daily. Rating curves well defined except for 1913–14, for which they were only fairly well defined. Records considered only fair, as gage is read but once daily, and they are uncertain at several periods.

Monthly discharge of Horse Creek at Daniel, Wyo., for 1913–1918

Month	Discharge in second-feet			Run-off in acre-feet
	Maximum	Minimum	Mean	
1913				
April 20–30	665	199	360	7,850
May	1,260	448	838	51,500
June	1,240	380	771	45,900
July	380	50	133	8,180
August	76	11	41.3	2,540
September	161	22	44.4	2,640
The period				119,000
1913–14				
October	44	24	33.1	2,040
April 19–30	335	199	273	6,500
May	1,020	212	575	35,000
June	1,100	225	606	36,100
July	225	51	126	7,750
August	51	18	36.6	2,250
September	22	8	16.1	958

Note.—Records revised for 1913 and 1914.

Monthly discharge of Horse Creek at Daniel, Wyo., for 1913–1918—Continued

Month	Discharge in second-feet			Run-off in acre-feet
	Maximum	Minimum	Mean	
1914–15				
October	76	4	20.6	1,270
April	275	25	112	6,660
May	275	15	132	8,120
June	275	7	128	7,620
July	25	7	8.16	502
August	15	1	5.06	311
1916				
April 25–30	720	237	424	5,050
May	530	224	345	21,200
June	1,080	237	607	36,100
July	408	45	180	11,100
August	84	11	44.4	2,730
September	11	11	11.0	655
The period				76,800
1916–17				
October	21	13	18.9	1,160
November 1–22	21	15	16.4	716
May	715	102	406	25,000
June	1,160	273	820	48,800
July	940	37	336	20,700
August	95	16	33.7	2,070
September	44	13	20.9	1,270
1917–18				
October	33	11	18.5	1,140
November 1–19	51	37	49.4	1,860
April 22–30	132	108	116	2,070
May	368	114	267	16,400
June	1,330	185	794	47,200
July	260	39	113	6,950
August	39	24	33.8	2,080
September	23	14	19.9	1,180
1918				
October	38	14	20.7	1,270
November 1–18	30	22	25.4	907

COTTONWOOD CREEK NEAR BIG PINEY, WYO.

LOCATION.—About sec. 21, T. 32 N., R. 111 W., at highway bridge near Hayden ranch, 16 miles north of Big Piney, in Sublette County.

DRAINAGE AREA.—241 square miles (measured on base map of Wyoming).

RECORDS AVAILABLE.—April 25, 1916, to September 30, 1919.

GAGE.—Creek flows in two channels 1 mile apart; vertical staff on North Channel and Stevens water-stage recorder on South Channel at highway bridge.

EXTREMES OF DISCHARGE.—North Channel, 1916–1919: Maximum stage recorded, 4.2 feet at 8 p. m. June 16, 1918, affected by backwater. Maximum discharge of 590 second-feet occurred at 5 p. m. June 23 and 24, 1917; minimum discharge, channel dry during August and September, 1919.

South Channel, 1916–1919: Maximum stage recorded, 5.0 feet from 8 a. m. to 2 p. m. June 17, 1918 (discharge, 355 second-feet); minimum discharge, channel dry during periods in summer of 1919.

DIVERSIONS.—Prior to July 1, 1919, adjudicated diversions of 48 second-feet from Cottonwood Creek above station and 52 second-feet below.

ACCURACY.—North Channel: Gage read twice daily during high water and once daily at other times. Rating curve well defined except during June, 1918, when drift lodged on fence below gage and caused backwater. Records fair.

South Channel: Gage read once daily during 1916–1917; continuous record from recording gage during 1918 and 1919. Rating curve well defined except during high water of 1917. Records good except for 1917, for which they are fair.

Monthly discharge of North Channel of Cottonwood Creek near Big Piney, Wyo., for 1916–1919

Month	Discharge in second-feet			Run-off in acre-feet
	Maximum	Minimum	Mean	
1916				
April 25-30	288	89	196	2,330
May	184	33	69.7	4,290
June	248	53	116	6,900
July	170	36	77.8	4,780
August	124	36	54.7	3,360
September	40	30	33.2	1,980
The period				23,600
1916-17				
October 1-21	30	15	25	1,040
May 20-31	492	276	365	8,690
June	590	152	329	19,600
July	396	78	191	11,700
August	86	28	51.1	3,140
September	30	20	25.3	1,510
1917-18				
October	20	16	18.4	1,130
November	40	16	28.0	1,670
April 7-30	142	52	86.8	4,130
May	220	42	116	7,130
June	586	54	309	18,400
July	156	39	79.5	4,890
August	46	19	27.6	1,700
September	27	20	24.1	1,430
1918-19				
October	32	19	28.5	1,750
November 1-13	32	23	29.1	751
April	244	42	121	7,200
May	39	5	20.2	1,240
June	42	1.5	12.6	750
July	42	.5	18.6	1,140
August	10	0	1.86	114
September	0	0	0	0

Monthly discharge of South Channel of Cottonwood Creek near Big Piney, Wyo., for 1916–1919

Month	Discharge in second-feet			Run-off in acre-feet
	Maximum	Minimum	Mean	
1916				
April 25-30	166	84	115	1,370
May	130	13	58.2	3,580
June	166	42	84.3	5,020
July	67	5	26.6	1,640
August	56	5	12.3	756
September	5	3	4.28	255
The period				12,600
1916-17				
October	11	4	6.8	418
November 1-18	4	.2	1.68	60
May 11-31	214	132	189	7,870
June	266	64	164	9,760
July	201	23	74.8	4,600
August	29	12	20.2	1,240
September	14	12	13.2	786

Monthly discharge of South Channel of Cottonwood Creek near Big Piney, Wyo., for 1916–1919—Continued

Month	Discharge in second-feet			Run-off in acre-feet
	Maximum	Minimum	Mean	
1917–18				
October	14	12	13.6	836
November	13	4	6.1	363
April	54	8	36.3	1,730
May	106	49	69.2	4,250
June	354	46	193	11,500
July	87	20	44.0	2,710
August	23	16	17.9	1,100
September	20	13	16.4	976
1918–19				
October	23	15	18.6	1,140
November 1–3	24	18	20.4	526
April 14–30	62	45	51.6	1,740
May	44	17	24.8	590
June	18	1.0	9.34	556
July	7.5	0	2.50	154
August	2.6	0	.88	54
September 1–9	2.2	0	1.02	18

EAST FORK AT EAST FORK CANAL, WYO.

LOCATION.—In sec. 10, T. 31 N., R. 106 W., 300 feet above intake of East Fork Canal and 18 miles southeast of Boulder, Sublette County. No tributary within several miles.

DRAINAGE AREA.—106 square miles (measured on base map of Wyoming).

RECORDS AVAILABLE.—May 14, 1916, to September 30, 1917; May 15 to September 30, 1921; irrigation seasons of 1922 and 1923, when station was discontinued.

GAGE.—Vertical staff at left bank.

EXTREMES OF DISCHARGE. Maximum discharge recorded, 1,400 second-feet during June, 1917. Minimum stage occurred during winter.

DIVERSIONS.—Prior to July 1, 1921, adjudicated diversions of 26 second-feet from East Fork above station.

ACCURACY.—Records fair.

Monthly discharge of East Fork at East Fork Canal, Wyo., for 1916, 1917, and 1921–1923

Month	Discharge in second-feet			Run-off in acre-feet
	Maximum	Minimum	Mean	
1916				
May 14–31	315	139	204	7,280
June	1,260	315	675	40,200
July	455	97	227	14,000
August	97	12	37.5	2,310
September	18	8	12.9	768
The period				64,600
1917				
May 15–31	205	135	178	6,000
June	1,400	155	731	43,500
July	900	135	441	27,100
August	115	27	46.6	2,870
September	65	18	34.2	2,040
The period				81,500

Monthly discharge of East Fork at East Fork Canal, Wyo., for 1916, 1917, and 1921–1923—Continued

Month	Discharge in second-feet			Run-off in acre-feet
	Maximum	Minimum	Mean	
1921				
May 15-31	1,110	230	523	17,600
June	1,180	285	651	38,700
July	315	38	120	7,380
August	51	8	17.6	1,080
September	27	12	14.3	851
The period				65,600
1922				
June	1,180	285	763	45,400
July	285	51	139	8,550
August	97	15	38.4	2,360
September	22	4	9.3	553
The period				56,900
1922-23				
October 1-14	5.0	4.0	4.7	131
May 13-31	1,040	192	491	18,500
June	900	242	501	29,800
July	500	108	248	15,200
August	101	10	32.2	1,980
September	54	6	14.8	881
1923				
October	46	11	28.9	1,760
November 1-15	29	18	22.5	669

EAST FORK AT NEW FORK, WYO.

Location.—About sec. 33, T. 32 N., R. 108 W., at highway bridge a quarter of a mile south of New Fork, Sublette County. No tributary between station and mouth, 1 mile below.

Drainage area.—348 square miles (measured on base map of Wyoming).

Records available.—April 1, 1905, to October 31, 1906; May 11, 1915, to September 30, 1924.

Gage.—Vertical staff on downstream side of left abutment. Gage used during 1905 was a quarter of a mile upstream; during 1906, gage was at bridge, and referred to datum 0.27 foot higher than present gage.

Extremes of discharge.—Maximum discharge recorded, 2,940 second-feet at 6.30 a. m. on June 19, 1917; minimum discharge, 25 second-feet at 6 p. m. April 4, 1920.

Diversions.—Prior to July 1, 1921, adjudicated diversions of 141 second-feet from East Fork, all above station.

Accuracy.—Gage read twice daily except during 1905–6, when it was read once daily. Rating curve fairly well defined 1905–6 and well defined 1915–1921. Records good for 1905–6, and excellent for remainder of period, except during winter, for which they are fair.

Monthly discharge of East Fork at New Fork, Wyo., for 1905–6 and 1915–1921

Month	Discharge in second-feet			Run-off in acre-feet
	Maximum	Minimum	Mean	
1905				
April	58	43	52.9	3,150
May	820	58	286	17,600
June	2,550	370	1,230	73,400
July	338	58	147	9,040
August	58	43	47.8	2,940
September	43	30	33.5	1,990
The period				108,000
1905–6				
October	133	30	35.8	2,200
November			[a] 30	[a] 1,790
December			[a] 30	[a] 1,840
January			[a] 25	[a] 1,540
February			[a] 25	[a] 1,390
March			[a] 30	[a] 1,840
April			[a] 75	[a] 4,460
May	1,480	100	713	43,800
June	2,380	306	887	52,800
July	600	109	321	19,700
August	299	59	120	7,380
September	90	47	61.6	3,670
The year	2,380		196	142,000
1906				
October	59	47	50.1	3,080
1915				
May 11–31	595	190	356	14,800
June	1,020	268	499	29,700
July	338	48	160	9,840
August	109	38	50.5	3,110
September	181	38	81.3	4,840
The period				62,300
1915–16				
October	148	73	99.2	6,100
November			[a] 70	[a] 4,170
December			[a] 65	[a] 4,000
January			[a] 60	[a] 3,690
February			[a] 55	[a] 3,160
March			[a] 60	[a] 3,690
April	370		[a] 178	[a] 10,600
May	799	216	412	25,300
June	2,120	582	1,330	79,100
July	655	100	268	16,500
August	104	59	75.0	4,610
September	64	48	54.1	3,220
The year	2,120		226	164,000
1916–17				
October	89	48	72.5	4,460
November	72		[a] 63	[a] 3,750
December			[a] 55	[a] 3,380
January			[a] 50	[a] 3,070
February			[a] 50	[a] 2,780
March			[a] 55	[a] 3,380
April	410		[a] 125	[a] 7,440
May	370	74	225	13,800
June	2,940	202	1,520	90,400
July	2,100	150	716	44,000
August	134	69	83.9	5,160
September	87	57	68.9	4,100
The year	2,940		257	186,000
1917–18				
October	73	59	65.2	4,010
November	77	66	69.2	4,120
December			[a] 60	[a] 3,690
January			[a] 50	[a] 3,070
February			[a] 50	[a] 2,780
March			[a] 50	[a] 3,070
April	138		[a] 90	[a] 5,360
May	432	100	308	18,900
June	2,540	231	1,530	91,000
July	174	68	102	6,270
August	68	60	62.6	3,850
September	60	54	56.9	3,390
The year	2,540		207	150,000

[a] Estimated.

Monthly discharge of East Fork at New Fork, Wyo., for 1905–6 and 1915–1921—Continued

Month	Discharge in second-feet			Run-off in acre-feet
	Maximum	Minimum	Mean	
1818–19				
October	82	58	68.5	4,210
November	75	40	61.4	3,650
September 11–30	46	36	37.6	1,490
1919–20				
October	53	40	45.9	2,820
November	49		[a] 35	[a] 2,080
December			[a] 30	[a] 1,840
January			[a] 30	[a] 1,840
February			[a] 30	[a] 1,730
March			[a] 35	[a] 2,150
April	400	25	95.8	5,700
May	2,130	63	583	35,800
June	2,320	262	1,050	62,500
July	351	57	120	7,380
August	66	57	58.4	3,590
September	57	54	55.1	3,280
The year	2,320		181	131,000
1920–21				
October	59	52	57.0	3,500
November			[a] 57.0	[a] 3,390
December			[a] 55	[a] 3,380
January			[a] 50	[a] 3,070
February			[a] 50	[a] 2,780
March			[a] 95	[a] 5,840
April	102	56	64.8	3,860
May	2,340	52	518	31,900
June	2,800	308	1,370	81,500
July	290	59	94.0	5,780
August	64	52	56.3	3,460
September	52	50	50.8	3,020
The year	2,800		209	151,000
1921–22				
October	52	48	48.5	2,980
November	52	48	48.7	2,900
April	198	46	63.8	3,800
May	1,820	128	615	37,800
June	2,380	312	1,290	76,800
July	226	65	103	6,330
August	84	61	67.5	4,150
September	72	51	56.9	3,390
1922–23				
October	52	49	51.0	3,140
November	56	45	49.1	2,920
April	153	54	91.5	5,440
May	2,310	109	669	41,100
June	1,920	194	858	51,100
July	580	118	284	17,500
August	113	57	74.0	4,550
September	63	47	54.6	3,250
1923–24				
October	68	56	60.6	3,730
November 1–15	74	56	62.7	1,870
April	388	38	104	6,190
May	1,420	67	533	32,800
June	875	158	402	23,900
July	155	47	84.1	5,170
August	47	39	41.0	2,520
September	49	39	41.4	2,460

[a] Estimated.

NEW FORK RIVER NEAR CORA, WYO.

Location.—In sec. 29, T. 36 N., R. 110 W., 3½ miles below outlet of New Fork Lake and 10 miles northwest of Cora post office, in Sublette County.

Drainage area.—Not measured.

Records available.—August 1 to November 30, 1910.

GAGE.—Vertical staff; read by Eugene Alexander.

DIVERSIONS.—Only one small ditch above station.

ACCURACY.—Gage read once daily, except during high water when it is read twice daily. Rating curve well defined below 100 second-feet and uncertain above. Records good below 100 second-feet.

Monthly discharge of New Fork River near Cora, Wyo., for 1910

Month	Discharge in second-feet			Run-off in acre-feet
	Maximum	Minimum	Mean	
August	42	9	23.1	1,420
September	9	2	6.5	387
October	7	7	7.0	430
November	7	7	7.0	417
The period				2,650

NEW FORK RIVER NEAR BOULDER, WYO.

LOCATION.—About sec. 8, T. 32 N., R. 108 W., at highway bridge 1 mile west of Boulder, Sublette County. Nearest tributary, Boulder Creek, enters one-eighth of a mile below.

DRAINAGE AREA.—578 square miles (measured on base map of Wyoming).

RECORDS AVAILABLE.—May 11, 1915, to September 30, 1926.

GAGE.—Vertical staff at downstream side of left abutment.

EXTREMES OF DISCHARGE.—Maximum stage recorded, 8.7 feet at 6 a. m. on June 17, 1918 (discharge, 12,300 second-feet); minimum discharge, 22 second-feet from December 15 to December 17, 1915.

DIVERSIONS.—Prior to July 1, 1921, adjudicated diversions of 191 second-feet from New Fork River above station.

ACCURACY.—Gage read twice daily. Rating curves fairly well defined. Records good except during winter, for which they are fair.

Monthly discharge of New Fork River near Boulder, Wyo., for 1915–1926

Month	Discharge in second-feet			Run-off in acre-feet
	Maximum	Minimum	Mean	
1915				
May 11-31	468	270	377	15,700
June	1,040	520	833	49,600
July	1,070	486	826	50,800
August	486	154	298	17,800
September	486	144	259	15,400
The period				149,000
1915-16				
October	385	189	293	18,000
November	189	144	166	9,880
December	118	42	79.3	4,880
January	206	61	139	8,550
February	260	82	187	10,800
March	223	105	180	11,100
April	832	91	387	23,000
May	832	430	562	34,600
June	3,200	475	1,860	111,000
July	2,520	800	1,560	95,900
August	865	299	553	34,000
September	299	120	174	10,400
The year	3,200	42	512	372,000

Monthly discharge of New Fork River near Boulder, Wyo., for 1915–1926—Continued

Month	Discharge in second-feet			Run-off in acre-feet
	Maximum	Minimum	Mean	
1916–17				
October	199	128	169	10, 400
November	170	87	140	8, 330
December			[a] 110	[a] 6, 760
January			[a] 90	[a] 5, 530
February			[a] 80	[a] 4, 440
March			[a] 80	[a] 4, 920
April			[a] 175	[a] 10, 400
May	1, 090	300	596	36, 600
June	3, 100	495	1, 490	88, 700
July	3, 180	1, 410	2, 300	141, 000
August	1, 340	340	650	40, 000
September	400	280	339	20, 200
The year	3, 180		521	377, 000
1917–18				
October	300	177	239	14, 700
November	256	140	172	10, 200
December			[a] 130	[a] 7, 990
January			[a] 120	[a] 7, 380
February			[a] 120	[a] 6, 660
March			[a] 150	[a] 9, 220
April	588	176	307	18, 300
May	588	238	433	26, 600
June	11, 800	461	4, 120	245, 000
July	2, 000	506	1, 130	69, 500
August	461	163	297	18, 300
September	176	126	143	8, 510
The year	11, 800		611	442, 000
1918–19				
October	290	145	236	14, 500
November	212	103	152	9, 040
April	145	110	119	7, 080
May	2. 320	145	682	41, 900
June	2, 000	212	619	36, 800
July	187	69	104	6, 400
August	101	66	79. 5	4, 910
September	101	66	89. 3	5, 310
1919–20				
October	157	116	128	7, 870
November	140	95	123	7, 320
May 20-31	1, 190	535	897	21, 400
June	2 950	980	2, 260	134, 000
July	2, 100	680	1, 320	81, 200
August	680	242	432	26, 600
September	231	151	200	11, 900
1920–21				
October	183	135	158	9, 720
March 25-31	145	130	139	1, 930
April	360	130	232	13 800
May	1, 350	220	476	29, 300
June	4, 740	1, 430	2, 720	162, 000
July	1, 840	470	900	55, 300
August	470	207	316	19, 400
September	224	122	176	10, 500
1921–22				
October	118	80	92. 8	5, 710
November 1-8	92	67	82. 1	2, 930
April 20-30	400	122	212	4, 630
May	1, 420	379	704	43, 300
June	3, 420	1, 420	2, 670	159, 000
July	2, 210	495	1, 010	62, 100
August	470	358	417	25, 600
September	358	188	292	17, 400

[a] Estimated.

NOTE.—Records of monthly discharge for the years ending Sept. 30, 1919 and 1920, supersede those published in Water-Supply Paper 469.

Monthly discharge of New Fork River near Boulder, Wyo., for 1915–1926—Continued

Month	Discharge in second-feet			Run-off in acre-feet
	Maximum	Minimum	Mean	
1922–23				
October	194	109	136	8,360
November	142	84	110	6,550
April	470	175	253	15,100
May	1,600	318	709	43,600
June	2,890	1,330	1,900	113,000
July	2,320	1,160	1,740	107,000
August	1,080	260	492	30,300
September	260	122	164	9,760
1923–24				
October	181	106	155	9,530
November 1–16	130	96	114	3,620
April	1,480	94	492	29,300
May	1,480	100	682	41,900
June	1,300	640	895	53,300
July	840	224	549	33,800
August	205	109	150	9,220
September	104	75	83	4,940
1924–25				
October	202	75	105	6,460
May	1,980	300	736	45,300
June	2,830	772	1,580	94,000
July	3,200	752	1,600	98,400
August	720	297	513	31,500
September	367	257	305	18,100
1925–26				
October	376	250	311	19,100
November	297	191	247	14,700
December 1–15	195	135	157	4,670
April	585	103	317	18,900
May	1,310	406	829	51,000
June	1,450	392	930	55,300
July	755	338	537	33,000
August	406	207	320	19,700
September	224	125	170	10,100

PINE CREEK AT PINEDALE, WYO.

Location.—In sec. 4, T. 33 N., R. 109 W., at highway bridge at Pinedale, Sublette County. No important tributary between station and mouth, 3 miles below.

Drainage area.—128 square miles (measured on base map of Wyoming).

Records available.—May 1, 1904, to October 31, 1906; October 1, 1910, to June 30, 1912; May 8, 1915, to September 30, 1926.

Gage.—Gurley water-stage recorder installed May 1, 1926, at left bank. Vertical staff on downstream side of bridge pier used 1917 to 1926; read by United States Forest Service. During 1904 vertical staff was a quarter of a mile west of Pinedale, and during 1905–6 at a point 1 mile above Pinedale. From April 1, 1911, to June 30, 1912, chain at outlet of Fremont Lake 4 miles upstream. From May 8, 1915, to August 16, 1917, vertical staff a quarter of a mile below bridge on left bank was used. Flow at different sites practically comparable.

Extremes of discharge.—1904–1906; 1910–1912; 1915–1926: Maximum stage recorded, 5.0 feet on June 17, 1918 (discharge, 2,310 second-feet). Minimum discharge recorded, 4 second-feet November, 1921.

Diversions.—Prior to July 1, 1921, adjudicated diversions of 78 second-feet from Pine Creek above Pinedale and 4 second-feet below.

Accuracy.—Records good except during winter, for which they are fair.

Monthly discharge of Pine Creek at Pinedale, Wyo., for 1904–1906

Month	Discharge in second-feet			Run-off in acre-feet
	Maximum	Minimum	Mean	
1904				
May	610	90	240	14,800
June	1,340	530	906	53,900
July	975	490	663	40,800
August	450	168	239	14,700
September	168	99	123	7,320
The period				132,000
1904–5				
October	99	24	42.4	2,610
November			[a] 22	[a] 1,310
December			[a] 20	[a] 1,230
January			[a] 20	[a] 1,230
February			[a] 20	[a] 1,110
March			[a] 22	[a] 1,350
April	35	26	29.6	1,760
May	258	43	95.8	5,890
June	1,310	258	932	55,500
July	1,200	451	904	55,600
August	451	159	236	14,500
September	138	54	96.9	5,770
The year	1,310		205	148,000
1905–6				
October	67	35	45.1	2,770
November			[a] 30	[a] 1,790
December			[a] 25	[a] 1,540
January			[a] 20	[a] 1,230
February			[a] 20	[a] 1,110
March			[a] 25	[a] 1,540
April	34	26	32.9	1,960
May	594	55	228	14,000
June	1,320	378	745	44,300
July	1,200	479	859	52,800
August	554	202	359	22,100
September	378	18	118	7,020
The year	1,320		210	152,000
1906				
October	34	18	20.8	1,280

[a] Estimated.

Monthly discharge of Pine Creek at Pinedale, Wyo., for 1910–1912 and 1915–1926

Month	Discharge in second-feet			Run-off in acre-feet
	Maximum	Minimum	Mean	
1910–11				
October			[a] 50	[a] 3,070
November			[a] 40	[a] 2,380
December			[a] 30	[a] 1,840
January			[a] 25	[a] 1,540
February			[a] 25	[a] 1,390
March			[a] 25	[a] 1,540
April	42	29	29.9	1,780
May	247	29	88.0	5,410
June	1,620	266	965	57,400
July	1,150	325	818	50,300
August	306	97	165	10,100
September	97	42	54.6	3,250
The year	1,620		193	140,000

[a] Estimated.

Monthly discharge of Pine Creek at Pinedale, Wyo., for 1910–1912 and 1915–1926—Continued

Month	Discharge in second-feet			Run-off in acre-feet
	Maximum	Minimum	Mean	
1911–12				
October	76	45	59.6	3,660
November			[a] 40	[a] 2,380
December			[a] 30	[a] 1,840
January			[a] 25	[a] 1,540
February			[a] 25	[a] 1,440
March			[a] 25	[a] 1,540
April	42	29	32.2	1,920
May	188	42	81.4	5,010
June	1,280	188	851	50,000
The period				69,900
1915				
May 8–31	144	72	108	5,130
June	460	168	291	17,300
July	500	221	394	24,200
August	216	74	127	7,810
September	123	74	99.3	5,910
The period				60,400
1915–16				
October	123	54	91.6	5,630
November	51	14	34.2	2,040
December	31	10	19.0	1,170
January	38	6	19.6	1,210
February	50	20	33.3	1,920
March	50	28	35.9	2,210
April	77	38	50	2,980
May	165	80	125	7,690
June	1,750	114	752	44,700
July	1,560	384	981	60,300
August	410	114	243	14,900
September	104	28	56.7	3,370
The year	1,750	6	204	148,000
1916–17				
October	50	31	40.2	2,470
November	44	19	27.6	1,640
December			[a] 20	[a] 1,230
January			[a] 20	[a] 1,230
February			[a] 18	[a] 1,000
March			[a] 20	[a] 1,230
April	37	22	25.9	1,540
May	196	27	87.5	5,380
June	1,710	140	551	32,800
July	1,800	806	1,360	83,600
August	769	128	296	18,200
September	141	95	118	7,020
The year	1,800		217	157,000
1917–18				
October	95	43	70.6	4,340
November	42	26	33	1,960
December			[a] 25	[a] 1,540
January			[a] 25	[a] 1,540
February			[a] 20	[a] 1,110
March			[a] 25	[a] 1,540
April	40	28	36.7	2,180
May	112	33	78.1	4,800
June	2,170	100	1,240	73,800
July	1,200	314	712	43,800
August	301	83	178	10,900
September	82	49	60.8	3,620
The year	2,170		208	151,000
1918–19				
October	100	46	77.7	4,780
November	67	37	49.8	2,960
December 1–9	40	29	[a] 32.9	587
April	29	18	20.5	1,220
May	1,110	19	272	16,700
June	970	96	329	19,600
July	84	19	32.7	2,010
August	42	25	30.7	1,890
September	55	29	46.3	2,760

[a] Estimated.

Note.—Above figures for 1918–19 supersede those published in Water-Supply Paper 469.

Monthly discharge of Pine Creek at Pinedale, Wyo., for 1910–1912 and 1915–1926—Continued

Month	Discharge in second-feet			Run-off in acre-feet
	Maximum	Minimum	Mean	
1919–20				
October	57	46	52.8	3,250
November			[a] 47	[a] 2,800
December			[a] 44	[a] 2,710
January			[a] 37.2	[a] 2,290
February	50	25	34.3	1,970
March	26	25	25.2	1,550
April	37	25	32.1	1,910
May	270	37	101	6,210
June	1,040	320	788	46,900
July	900	320	663	40,800
August	320	85	161	9,900
September	991	45	66.4	3,950
The year	1,040		171	124,000
1920–21				
October	45	40	42.2	2,590
November	43	38	39.7	2,360
December			[a] 28	[a] 1,720
January			[a] 25	[a] 1,540
February			[a] 20	[a] 1,230
March			[a] 22	[a] 1,350
April	40	28	34.5	2,050
May	295	32	79.7	4,900
June	1,640	345	1,040	61,900
July	910	275	506	31,100
August	275	85	146	8,980
September	100	28	65.6	3,900
The year	1,640		171	124,000
1921–22				
October	24	6	11.8	726
November 1–17	6	4	4.9	165
April 21–30	17	17	17	337
May	471	18	154	9,470
June	1,500	534	1,110	66,000
July	1,090	266	548	33,700
August	262	131	186	11,400
September	244	48	147	8,750
1922–23				
October	50	24	33.4	2,050
November 1–11	24	22	23.3	508
April	30	20	24.4	1,450
May	520	32	138	8,480
June	1,070	454	686	40,800
July	1,030	265	706	43,400
August	550	90	208	12,800
September	90	35	50.6	3,010
1923–24				
October	38	27	34.2	2,100
April	60	10	21.6	1,290
May	410	6	188	11,600
June	465	273	372	22,100
July	400	29	204	12,500
August	59	29	36.2	2,230
September	31	11	19.4	1,150
1924–25				
October	35	18	20.6	1,270
May	670	50	200	12,300
June	1,900	278	770	45,800
July	1,400		717	44,100
August			215	13,200
September	142	100	126	7,500
1925–26				
October	119	73	91.1	5,600
November	87	60	71.5	4,250
December 1–15	60	40	47.9	1,430
April	52	16	29	1,730
May	535	66	283	17,400
June	625	162	410	24,400
July	224	118	166	10,200
August	178	76	136	8,360
September	76	25	51.3	3,050

[a] Estimated.

NOTE.—Records of monthly discharge for the years ending Sept. 30, 1919 and 1920, supersede those published in Water-Supply Paper 469.

POLE CREEK AT FAYETTE, WYO.

Location.—In sec. 9, T. 33 N., R. 108 W., about 300 yards from Fayette post office.

Drainage area.—126 square miles (measured on General Land Office map).

Records available.—May 1, 1904, to September 30, 1906.

Gage.—Vertical staff set in bed of stream and braced to left bank; read by G. N. Stadin.

Extremes of discharge.—1904–1906: Maximum stage recorded, 3.5 feet on May 24–27 and June 19–20, 1904 (discharge, 1, 220 second-feet). Minimum discharge occurs during winter.

Diversions.—Prior to May 1, 1904, adjudicated diversions of 28.6 second-feet above station.

Accuracy.—Gage read once daily. Rating curve well defined. Because of only one daily gage reading, records good, except during winter, for which they are fair.

Measurement for April 24, 1904, published in Water-Supply Paper 133.

Monthly discharge of Pole Creek at Fayette, Wyo., for 1904–1906

Month	Discharge in second-feet			Run-off in acre-feet
	Maximum	Minimum	Mean	
1904				
May	1, 220	64	419	25, 800
June	1, 220	445	800	47, 600
July	615	205	371	22, 800
August	205	64	116	7, 130
September	64	22	48. 8	2, 900
The period				106, 000
1904–5				
October	22	16	21. 5	1, 320
November			[a] 12	[a] 714
December			[a] 10	[a] 615
January			[a] 10	[a] 615
February			[a] 10	[a] 555
March			[a] 15	[a] 922
April	36	16	23. 8	1, 420
May	359	42	132	8, 120
June	1, 080	221	669	39, 800
July	635	137	319	19, 600
August	150	54	91. 5	5, 630
September	47	19	32. 8	1, 950
The year	1, 080		112	81, 300
1905–6				
October	19	16	17. 3	1, 060
November			[a] 12	[a] 714
December			[a] 10	[a] 615
January			[a] 10	[a] 615
February			[a] 10	[a] 555
March			[a] 15	[a] 922
April	85	25	35. 5	2, 110
May	600	85	313	19, 200
June	980	255	476	28, 300
July	470	190	328	20, 200
August	359	76	168	10, 300
September	635	60	264	15, 700
The year	980		138	100, 000

[a] Estimated.

FALL CREEK NEAR FAYETTE, WYO.

LOCATION.—In sec. 10, T. 33 N., R. 108 W., 1 mile southeast of Fayette post office, at crossing of upper Boulder road.

DRAINAGE AREA.—46 square miles.

RECORDS AVAILABLE.—May 1, 1904, to October 31, 1905.

GAGE.—Vertical staff set in bed of stream and braced to left bank; read by G. N. Stadin.

EXTREMES OF DISCHARGE.—1904–5: Maximum stage recorded, 3.0 feet June 19–21, 1904 (discharge, 480 second-feet); minimum stage recorded, 1.10 feet September 26–30, October 8–14, 1905 (discharge, 2 second-feet).

DIVERSIONS.—Prior to April 1, 1904, adjudicated diversions of 15.9 second-feet from Fall Creek above station.

ACCURACY.—Gage read once daily. Rating curve well defined. Records good except during winter, for which they are fair.

Measurement for April 24, 1904, published in Water-Supply Paper 133.

Monthly discharge of Fall Creek near Fayette, Wyo., for 1904–5

Month	Discharge in second-feet			Run-off in acre-feet
	Maximum	Minimum	Mean	
1904				
May	480	25	189	11,600
June	480	138	302	18,000
July	180	51	99.3	6,110
August	70	16	31.0	1,910
September	16	7	8.0	476
The period				38,100
1904-5				
October	7	7	7	430
November			[a] 5	[a] 298
December			[a] 4	[a] 246
January			[a] 3	[a] 184
February			[a] 3	[a] 167
March			[a] 4	[a] 246
April			[a] 10	[a] 595
May	157	18	50.4	3,100
June	380	157	252	15,000
July	365	46	130	7,990
August	46	10	23.5	1,440
September	10	2	5.33	317
The year	380		41.5	30,000
1905				
October	3	2	2.77	170

[a] Estimated.

BOULDER CREEK NEAR BOULDER, WYO.

LOCATION.—In sec. 4, T. 32 N., R. 108 W., at Sandlin ranch 2 miles northwest of Boulder, in Sublette County. No tributary between station and mouth, 2 miles below.

DRAINAGE AREA.—112 square miles (measured on base map of Wyoming).

RECORDS AVAILABLE.—May 1, 1904, to October 31, 1906; May 10, 1915, to September 30, 1924.

GAGE.—Chain installed May 19, 1920, 50 feet upstream from vertical staff used prior to that date and referred to same datum. Gage used 1904–1906 a short distance upstream.

Extremes of discharge.—1904–1906; 1915–1924: Maximum stage recorded, 6.8 feet at 7 a. m. June 14, 1918 (discharge, 3,240 second-feet); minimum stage recorded, 0.20 foot at 7 p. m. August 25 and 7 a. m. August 26, 1917 (discharge, 1 second-foot).

Diversions.—Prior to July 1, 1921, adjudicated diversions of 83 second-feet from Boulder Creek, all above station.

Accuracy.—Records good except during winter, for which they are fair.

Measurement for April 23, 1904, published in Water-Supply Paper 133.

Monthly discharge of Boulder Creek near Boulder, Wyo., for 1904–1906 and 1915–1924

Month	Discharge in second-feet			Run-off in acre-feet
	Maximum	Minimum	Mean	
1904				
May	1,720	127	594	36,500
June	2,060	888	1,550	92,200
July	1,280	308	620	38,100
August	271	77	134	8,240
September	77	24	43.6	2,590
The period				178,000
1904–5				
October	24	18	18.8	1,160
November			[a] 18	[a] 1,070
December			[a] 20	[a] 1,230
January			[a] 20	[a] 1,230
February			[a] 20	[a] 1,110
March			[a] 20	[a] 1,230
April			[a] 35	[a] 2,080
May	544	42	188	11,600
June	1,940	913	1,350	80,300
July	1,160	157	543	33,400
August	133	35	64.5	3,970
September	35	9	23.6	1,400
The year	1,940		193	140,000
1905–6				
October	9	9	9	553
May	1,030	100	532	32,700
June	2,620	429	1,040	61,900
July	970	206	614	37,800
August	345	77	155	9,530
September	157	29	69.2	4,120
1906				
October	42	18	29.0	1,780
1915				
May 10–31	378	88	218	9,500
June	765	360	551	32,800
July	515	34	226	16,400
August	37	1	12.7	781
September	184	3	42.6	2,530
The period				62,000
1915–16				
October	190	30	101	6,210
November			[a] 30	[a] 1,790
December			[a] 30	[a] 1,840
January			[a] 35	[a] 2,150
February			[a] 35	[a] 2,010
March			[a] 33	[a] 2,030
April	144	33	65	3,870
May	488	130	241	14,800
June	2,340	334	1,270	75,600
July	1,100	102	510	31,400
August	144	12	56.5	3,470
September	12	7.4	8.79	523
The year	2,340		202	146,000

[a] Estimated.

Note.—Records revised for 1904.

Monthly discharge of Boulder Creek near Boulder, Wyo., for 1904–1906 and 1915–1924—Continued

Month	Discharge in second-feet			Run-off in acre-feet
	Maximum	Minimum	Mean	
1916–17				
October	41	7	18.7	1,150
November			[a] 20	[a] 1,190
December			[a] 20	[a] 1,230
January			[a] 25	[a] 1,540
February			[a] 25	[a] 1,390
March			[a] 20	[a] 1,230
April			[a] 20	[a] 1,190
May	230	18	118	7,260
June	2,710	141	1,150	68,400
July	2,480	288	1,140	70,100
August	237	1	70.4	4,330
September	118	23	64.5	3,880
The year	2,710		225	163,000
1917–18				
October	47	3	14.9	916
November	31	14	26.0	1,550
December			[a] 25	[a] 1,540
January			[a] 25	[a] 1,540
February			[a] 25	[a] 1,390
March			[a] 35	[a] 2,150
April	66	12	48.7	2,900
May	215	14	123	7,560
June	3,160	178	1,700	101,000
July	450	43	213	13,100
August	35	7	16.5	1,010
September	8	6	6.6	393
The year	3,160		186	135,000
1918–19				
October	63	5	27.5	1,690
November	51	22	[a] 35	[a] 2,080
December			[a] 25	[a] 1,540
January			[a] 20	[a] 1,230
February			[a] 20	[a] 1,110
March	21		[a] 18	[a] 1,110
April	82	4	32.7	1,950
May	1,900	54	551	33,900
June	700	25	178	10,600
July	25	6	9.4	578
August	6	3	3.7	228
September	3	3	3.0	179
The year	1,900		77.6	56,200
1919–20				
October	69	4	49.8	3,060
November	68	40	55.0	3,270
April 14–30	95	82	84.7	2,880
May	1,160	87	339	20,800
June	1,880	490	1,140	67,800
July	700	90	313	19,200
August	81	16	35.5	2,180
September	16	9	11.1	660
1920–21				
October	44	7	21.8	1,340
November	48	36	42.8	2,550
December			[a] 30	[a] 1,840
January			[a] 25	[a] 1,540
February			[a] 25	[a] 1,390
March			[a] 25	[a] 1,540
April			[a] 25	[a] 1,490
May	1,420	14	287	17,600
June	2,760	495	1,530	91,000
July	625	42	197	12,100
August	41	13	23.2	1,430
September	13	8	12.9	768
The year	2,760		187	135,000

[a] Estimated.

Monthly discharge of Boulder Creek near Boulder, Wyo., for 1904–1906 and 1915–1924—Continued

Month	Discharge in second-feet			Run-off in acre-feet
	Maximum	Minimum	Mean	
1921–22				
October	8	6	7.1	437
November 1–17	7	6	6.2	209
May	1,210	38	346	21,300
June	2,340	785	1,700	101,000
July	675	67	248	15,200
August	68	32	50.9	3,130
September	29	7	13.6	809
1922–23				
October	7	6	6.2	381
November	6	6	6.0	357
May	1,420	32	376	23,100
June	2,260	535	1,020	60,700
July	1,340	164	668	41,100
August	143	16	38.1	2,340
September	16	10	12.3	732
1923–24				
October	58	15	25.5	1,570
November 1–15	62	44	54.7	1,630
May	1,440	8	535	32,900
June	1,290	304	643	38,300
July	420	22	148	9,100
August	21	6	10.2	627
September	6	5	5.5	327

NORTH PINEY CREEK NEAR MARBLETON, WYO.

LOCATION.—In sec. 19, T. 31 N., R. 113 W., 300 yards above head gate of North Piney Canal and 20 miles northwest of Marbleton, in Lincoln County. No important tributary within several miles.

DRAINAGE AREA.—58 square miles (measured on special map published in United States Geological Survey Bulletin 543).

RECORDS AVAILABLE.—June 1, 1915, to September 30, 1916.

GAGE.—Lallie water-stage recorder on left bank 300 yards above head gate of North Piney Canal.

EXTREMES OF DISCHARGE.—1915–16: Maximum stage from recording-gage chart, 4.98 feet at noon June 19, 1916 (discharge, 613 second-feet); minimum discharge probably occurs during winter.

DIVERSIONS.—Prior to December 31, 1916, adjudicated diversions of about 8 second-feet from North Piney Creek above the station and 209 second-feet below.

ACCURACY.—Gage heights from continuous record. Rating curve well defined. Records excellent except during winter, for which they are fair.

Monthly discharge of North Piney Creek near Marbleton, Wyo., for 1915–16

Month	Discharge in second-feet			Run-off in acre-feet
	Maximum	Minimum	Mean	
1915				
June	130	64	99.0	5,890
July	88	42	54.2	3,330
August	43	30	37.4	2,300
September	41	28	32.8	1,950
The period				13,500

Monthly discharge of North Piney Creek near Marbleton, Wyo., for 1915–16—Con.

Month	Discharge in second-feet			Run-off in acre-feet
	Maximum	Minimum	Mean	
1915–16				
October	33	25	27	1,660
November			[a] 25	[a] 1,490
December			[a] 20	[a] 1,230
January			[a] 15	[a] 922
February			[a] 15	[a] 863
March			[a] 15	[a] 922
April	180		[a] 63	[a] 3,870
May	120	28	69.1	4,250
June	591	94	312	18,600
July	322	88	172	10,600
August	88	35	56.7	3,490
September	39	28	31.2	1,860
The year	591		68.9	49,800

[a] Estimated.

MIDDLE PINEY CREEK NEAR BIG PINEY, WYO.

LOCATION.—In sec. 30, T. 30 N., R. 113 W., at Black ranch, 15 miles west of Big Piney, in Sublette County. No important tributary within several miles.

DRAINAGE AREA.—46 square miles (measured on special map published in United States Geological Survey Bulletin 543).

RECORDS AVAILABLE.—April 1, 1915, to November 23, 1918. State engineer maintained station at Budd ranch during 1914.

GAGE.—Vertical staff at left bank 200 feet below house. Prior to 1916, gage was 1 mile downstream at C. P. Budd's ranch.

EXTREMES OF DISCHARGE.—1915–1918: Maximum stage recorded, 2.65 feet at 6 a. m. on June 16, 17, 18, 1918 (discharge, 282 second-feet); minimum stage recorded, 0.70 foot May 2–15, 1915 (discharge, 2 second-feet).

DIVERSIONS.—Prior to December 31, 1916, adjudicated diversions of 34 second-feet from Middle Piney Creek above station and 72 second-feet below.

ACCURACY.—Gage read twice daily. Rating curve well defined. Records excellent except during winter, for which they are fair.

Monthly discharge of Middle Piney Creek near Big Piney, Wyo., for 1915–1918

Month	Discharge in second-feet			Run-off in acre-feet
	Maximum	Minimum	Mean	
1915				
April	9	4	5.70	339
May	22	2	7.06	434
June	53	8	19.5	1,160
July	58	13	29.2	1,800
August	22	10	14.9	916
September	16	10	13.6	809
The period				5,460
1915–16				
October	16		12	738
November			[a] 10	[a] 595
December			[a] 8	[a] 492
January			[a] 5	[a] 307
February			[a] 5	[a] 288
March			[a] 5	[a] 307
April	37		[a] 16	[a] 952

[a] Estimated.

Monthly discharge of Middle Piney Creek near Big Piney, Wyo., for 1915–1918—Continued

Month	Discharge in second-feet			Run-off in acre-feet
	Maximum	Minimum	Mean	
1915–16				
May	28	12	17.2	1,060
June	134	12	66.8	3,970
July	98	42	62.8	3,860
August	56	22	32.4	1,990
September	23	11	16.1	958
The year	134		21.4	15,500
1916–17				
October	13	7	10.5	646
November			[a] 6	[a] 357
December			[a] 5	[a] 307
January			[a] 5	[a] 307
February			[a] 5	[a] 278
March			[a] 5	[a] 307
April	26	5	9	536
May	63	14	40.2	2,470
June	255	37	131	7,800
July	260	68	148	9,100
August	62	24	42.2	2,590
September	27	17	21.6	1,290
The year	260		36.0	26,000
1917–18				
October	16	8	12.4	762
November	12	5	7.8	464
December			[a] 5	[a] 307
January			[a] 5	[a] 307
February			[a] 5	[a] 278
March			[a] 5	[a] 307
April	22	6	14.9	887
May	33	16	23.2	1,430
June	282	19	141	8,390
July	82	42	56.4	3,470
August	47	16	28.0	1,720
September	17	10	13.9	827
The year	282		26.4	19,100
1918				
October	12	9	10.7	658
November 1–23	10	4	7.0	319

[a] Estimated.

LABARGE CREEK NEAR LABARGE, WYO.

Location.—In sec. 29, T. 26 N., R. 113 W., at Welty ranch, 3 miles west of Labarge, in Lincoln County. No important tributary between station and mouth, 6 miles below.

Drainage area.—176 square miles (measured on special map published in United States Geological Survey Bulletin 543).

Records available.—April 17 to September 20, 1913; April 1, 1915, to November 8, 1916. State engineer maintained station during 1913 and 1914.

Gage.—Vertical staff at right bank 250 feet downstream from highway bridge at Welty ranch.

Extremes of discharge.—1913; 1915–1916: Maximum stage recorded, 2.45 feet May 27, 1913 (discharge, 478 second-feet); minimum stage recorded, 0.65 foot at 7 p. m. July 1, 5 p. m. July 3, and July 7–14, 1915 (discharge, 3 second-feet).

Diversions.—Prior to December 31, 1916, there were adjudicated diversions of 185 second-feet from Labarge Creek above station and 103 second-feet below.

Accuracy.—Gage read twice daily. Rating curve fairly well defined except for periods of shifting control. Records fair.

Monthly discharge of Labarge Creek near Labarge, Wyo., for 1913 and 1915–16

Month	Discharge in second-feet			Run-off in acre-feet
	Maximum	Minimum	Mean	
1913				
April 17–30	316	154	222	6, 160
May	478	172	321	19, 700
June	442	172	250	14, 900
July	280	38	114	7, 010
August	136	64	101	6, 210
September 1–20	136	82	91. 8	3, 640
The period				57, 600
1915				
April 1–27	120	98	106	5, 680
May 4–28	104	55	74. 9	4, 160
June	62	6	29. 9	1, 780
July	38	4	13. 3	818
August	62	38	51. 6	3, 170
September	148	48	75. 8	4, 510
The period				20, 100
1915–16				
October	88	64	70. 8	4, 350
November 1–9	64	61	63. 1	1, 130
April 2–30	258	98	156	8, 970
May	302	214	256	15, 700
June	296	181	240	14, 300
July	170	104	129	7, 930
August	154	93	105	6, 460
September	110	82	90. 8	5, 400
1916				
October	98	82	89. 5	5. 500
November 1–8	98	93	96. 8	1, 540
The period				7, 040

FONTENELLE CREEK NEAR FONTENELLE, WYO.

Location.—About sec. 3, T. 24 N., R. 113 W., at bridge at Holden ranch on stage road from Opal to Big Piney and 5 miles west of Fontenelle, Lincoln County. No important tributary between station and mouth.

Drainage area.—224 square miles (measured on special map published in United States Geological Survey Bulletin 543).

Records available.—May 21, 1915, to September 30, 1919. State engineer maintained station during 1914.

Gage.—Vertical staff at downstream end of right abutment.

Extremes of discharge.—1915–1919: Maximum stage recorded, 2.7 feet on May 22, 1917 (discharge, 900 second-feet); minimum discharge, 1 second-foot or less on days during summer of 1919.

Diversions.—Prior to December 31, 1916, adjudicated diversions of 78 second-feet from Fontenelle Creek; percentage above station not known.

Accuracy.—Gage read once daily except during high water in 1917, when it was read twice daily. Rating curve fairly well defined. Records good except during winter, for which they are fair.

Monthly discharge of Fontenelle Creek near Fontenelle, Wyo., for 1915–1919

Month	Discharge in second-feet			Run-off in acre-feet
	Maximum	Minimum	Mean	
1915				
May 21–31	80	38	62.1	1,350
June	65	2	32.7	1,950
July 1–6	2	2	20	25
August	26	15	19.9	1,220
September	104	16	40.6	2,420
1915–16				
October	42	27	35.5	2,180
November 1–13	50	20	30.7	792
March 21–31	190	50	126	2,750
April	565	76	269	16,000
May	549	168	315	19,400
June	449	150	331	19,700
July	150	69	94.6	5,820
August	87	47	60.5	3,720
September	69	34	40.5	2,410
1916–17				
October	122	33	70.8	4,350
November			[a] 30	[a] 1,790
December			[a] 25	[a] 1,540
January			[a] 25	[a] 1,540
February			[a] 25	[a] 1,390
March			[a] 25	[a] 1,540
April			[a] 95	[a] 5,650
May	900	111	482	29,600
June	825	435	617	36,700
July	435	97	201	12,400
August	109	62	82.7	5,080
September	62	19	44.5	2,650
The year	900		144	104,000
1917–18				
October	49	23	32.8	2,020
November			[a] 28	[a] 1,670
December			[a] 25	[a] 1,540
January			[a] 25	[a] 1,540
February			[a] 25	[a] 1,390
March			[a] 40	[a] 2,460
April	240	54	140	8,330
May	496	176	319	19,600
June	496	143	308	18,300
July	143	62	97.6	6,000
August	70	40	56.1	3,450
September	54	37	41.9	2,490
The year	496		95.0	68,800
1918–19				
October	66	40	47.4	2,910
November			[a] 35	[a] 2,080
December			[a] 30	[a] 1,840
January			[a] 30	[a] 1,840
February			[a] 30	[a] 1,670
March			[a] 30	[a] 1,840
April	138	28	79.7	4,740
May	132	74	97.7	6,010
June	74	8	27.2	1,620
July			[a] 5.0	[a] 307
August	25	1	18.6	1,140
September	20	1	13.6	809
The year	138		37.0	26,800

[a] Estimated.

BIG SANDY CREEK NEAR BIG SANDY, WYO.

LOCATION.—At Leckie ranch, in sec. 18, T. 30 N., R. 104 W., 4 miles east of Big Sandy post office; below all mountain tributaries.

DRAINAGE AREA.—105 square miles (measured on base map of Wyoming).

RECORDS AVAILABLE.—July 26, 1910, to August 31, 1911.

GAGE.—Chain gage on left bank, a quarter of a mile below Leckie ranch house; read by Mrs. Annie Leckie.

Extremes of discharge.—Data too meager.

Diversions.—No diversions above station. Eden Irrigation Co. has a reservoir at the site of this gaging station.

Accuracy.—Gage probably read twice daily. Rating curve well defined. Record fair.

Monthly discharge of Big Sandy Creek near Big Sandy, Wyo., for 1910–11

Month	Discharge in second-feet			Run-off in acre-feet
	Maximum	Minimum	Mean	
1910				
July 26–31	71	47	53.0	631
August	77	16	30.3	1,860
September	20	16	19.1	1,140
The period				3,630
1910–11				
October	25	16	22.9	1,410
November 1–20	16	12	15.6	619
May	208	82	168	10,300
June	396	208	292	17,400
July	241	68	147	9,040
August	77	52	59.8	3,680

BIG SANDY CREEK NEAR EDEN, WYO.

Location.—At Poston ranch, 20 miles north of Eden in T. 28 N., R. 106 W.

Drainage area.—Approximately 265 square miles.

Records available.—May 1 to October 7, 1911.

Gage.—Probably vertical staff; read by W. E. Robertson.

Extremes of discharge.—Data too meager.

Diversions.—Prior to July 1, 1912, adjudicated diversions of 38 second-feet above station.

Accuracy.—Gage read once daily. Rating curve fairly well defined. Records fair to good.

Monthly discharge of Big Sandy Creek near Eden, Wyo., for 1911

Month	Discharge in second-feet			Run-off in acre-feet
	Maximum	Minimum	Mean	
May	294	27	174	10,700
June	818	342	536	31,900
July	510	86	180	11,100
August	86	13	45.3	2,790
September	56	13	28.9	1,720
October 1–7	118	56	102	1,420
The period				59,600

BIG SANDY CREEK NEAR FARSON, WYO.

Location.—In sec. 18, T. 27 N., R. 106 W., three-quarters of a mile below Ten Trees and 18 miles north of Farson, Sweetwater County. No tributary within several miles of station.

Drainage area.—322 square miles (measured on base map of Wyoming).

Records available.—May 6, 1915, to September 30, 1917; May 1, 1921, to September 30, 1924.

Gage.—Stevens 8-day water-stage recorder installed May 1, 1921, at left bank half a mile above head of Eden Canal, referred to datum of staff gage at same site used from 1915 to 1917.

EXTREMES OF DISCHARGE.—1915–1917; 1921–1924: Maximum stage recorded, 5.7 feet June 26, 1917 (discharge, 1,160 second-feet); minimum stage, 4 second-feet during September, 1922.

DIVERSIONS.—Prior to July 1, 1921, adjudicated diversions of 43 second-feet from Big Sandy Creek above station and 4 second-feet below.

ACCURACY.—Records fair for 1915 to 1917, and excellent for 1921.

Monthly discharge of Big Sandy Creek near Farson, Wyo., for 1915–1917 and 1921–1924

Month	Discharge in second-feet			Run-off in acre-feet
	Maximum	Minimum	Mean	
1915				
May 6–31	500	126	280	17, 200
June	600	220	330	19, 600
July	290	30	103	4, 140
August	200	20	67. 4	
September				
The period				47, 300
1916				
May	440	146	268	16, 500
June	740	340	547	32, 500
July	440	135	252	15, 500
August	116	34	71. 8	4, 410
September	135	22	60. 6	3, 610
The period				72, 500
1917				
May	410	252	333	20, 500
June	1, 160	252	700	41, 700
July	902	180	419	25, 800
August	278	12	71. 4	4, 390
September	76	7	30. 7	1, 830
The period				94, 200
1921				
May	752	28	304	18, 700
Jnne	1, 020	380	647	38, 500
July	353	74	183	11, 300
August	87	10	37. 0	2, 280
September	34	8	17. 6	1, 050
The period				71, 800
1921–22				
October	35	12	25. 6	1, 570
November 1–6	34	31	32. 3	384
May 6–31	608	78	293	15, 100
June	738	354	542	32, 300
July	326	46	146	8, 980
August	89	14	45. 1	2, 770
September	15	4	8. 4	500
1922–23				
October	14	5	9. 7	596
May 13–31	715	200	419	15, 800
June	701	282	454	27, 000
July	476	160	333	20, 500
August	140	17	53. 6	3, 300
September	70	15	25. 1	1, 490
1923–24				
October	106	30	57. 5	3, 540
November 1–12	58	18	33. 0	786
May	473	75	271	16, 700
June	430	212	294	17, 500
July	245	16	110	6, 760
August	16	5	9. 7	596
September	12	5	8. 3	494

SQUAW CREEK NEAR BIG SANDY, WYO.

LOCATION.—In sec. 4, T. 30 N., R. 104. W., at Dutch Joe ranger station, 1 mile above mouth of Dutch Joe Creek, 1½ miles above junction of Squaw and Big Sandy Creeks, and 6 miles southeast of Big Sandy.

DRAINAGE AREA.—Not measured.

RECORDS AVAILABLE.—May 17, 1911, to June 30, 1912.

GAGE.—Vertical staff attached to pine tree on left bank.

EXTREMES OF DISCHARGE.—1911–1912; Maximum stage recorded, 1.7 feet June 6, 1912 (discharge, 173 second-feet); minimum discharge occurs during winter.

DIVERSIONS.—No diversions above station.

ACCURACY.—Gage read about twice weekly. Rating curve well defined below 50 second-feet. Records good below 50 second-feet; poor above.

Monthly discharge of Squaw Creek near Big Sandy, Wyo., for 1911–12

Month	Discharge in second-feet			Run-off in acre-feet
	Maximum	Minimum	Mean	
1911				
May 17–31	51	30	43.3	1,290
June	101	44	63.7	3,790
July	51	14	28.9	1,780
August	14	8	10.7	658
September	10	8	9.0	536
The period				8,050
1911–12				
October	14	11	12.3	219
April	10	7.8	9.0	536
May	85	10	34.7	2,130
June	173	60	111	6,600

LITTLE SANDY CREEK NEAR EDEN, WYO.

LOCATION.—In sec. 34, T. 25 N., R. 106 W., at highway bridge a quarter of a mile above mouth and 6½ miles south of Eden.

DRAINAGE AREA.—823 square miles (measured on base map of Wyoming).

RECORDS AVAILABLE.—April 25, 1911, to September 11, 1912.

GAGE.—Vertical staff attached to highway bridge; read by W. E. Robertson.

EXTREMES OF DISCHARGE.—Data too meager.

DIVERSIONS.—Prior to July 1, 1912, adjudicated diversions of 63 second-feet from Little Sandy Creek.

ACCURACY.—Gage read once daily. Rating curve fairly well defined. Records fair.

Monthly discharge of Little Sandy Creek near Eden, Wyo., for 1911–12

Month	Discharge in second-feet			Run-off in acre-feet
	Maximum	Minimum	Mean	
1911				
April 25–30	21	16	17.3	206
May	60	23	36.9	2,270
June	213	34	126	7,500
July	101	20	59.1	3,630
August	20	0	6.0	369
September	4	0	.7	42
The period				14,000
1911–12				
October	13	4	9.7	596
May	70	35	52.7	3,240
June	222	94	129	7,680
July	160	60	84.1	5,170
August	60	17	33.2	2,040
September 1–11	15	13	13.2	288

BLACKS FORK NEAR URIE, WYO.

LOCATION.—In sec. 23, T. 16 N., R. 115 W., at highway bridge 4 miles northwest of Urie, Uinta County. No tributary within 10 miles.

DRAINAGE AREA.—261 square miles (measured on base map of Wyoming).

RECORDS AVAILABLE.—August 21, 1913, to September 30, 1924.

GAGE.—Vertical staff on downstream side of center pier. August, 1915, datum lowered 0.50 foot to avoid negative readings.

EXTREMES OF DISCHARGE.—1913–1924: Maximum stage recorded, 4.72 feet at 7 p. m. June 19 and 9 a. m. June 20, 1917 (discharge, 2,680 second-feet); minimum discharge recorded 0.3 second-foot during August and September, 1924.

DIVERSIONS.—Prior to July 1, 1921, adjudicated diversions of 636 second-feet from Blacks Fork above station and 4 second-feet below.

ACCURACY.—Gage read twice daily. Rating curve well defined. Records good.

Monthly discharge of Blacks Fork near Urie, Wyo., for 1913–1924

Month	Discharge in second-feet			Run-off in acre-feet
	Maximum	Minimum	Mean	
1913				
August 21–31	84	7	17.5	382
September	107	8	23.9	1,420
1913–14				
October	89	17	45.0	2,770
November	67	18	41.2	2,450
March 15–31	298	96	182	6,140
April	255	138	194	11,500
May	1,670	184	786	48,300
June	1,280	227	588	35,000
July	193	20	78.3	4,810
August	63	15	26.8	1,650
September	29	16	17.6	1,050
1914–15				
October	54	24	39.9	2,450
November	54	30	39.9	2,370
April	500	47	156	9,280
May	478	100	241	14,800
June	642	245	401	23,900
July	200	5	65.4	4,020
August	7.4	2.3	4.25	261
September	159	2.3	37.8	2,250
1915–16				
October	62	22	37.2	2,290
November 1–20	64	20	43.8	1,740
March 12–31	193	46	127	5,040
April	193	46	97.1	5,780
May	560	62	267	16,400
June	710	23	458	27,300
July	26	8	15.5	953
August	16	2	5.90	363
September	3	1	2.10	125
1916–17				
October	12	6	9.6	591
November 1–4	12	11	11.5	91
April 8–30	398	82	191	8,710
May	467	70	226	13,900
June	2,440	221	1,090	64,900
July	772	16	232	14,300
August	65	4	12.0	738
September	10	3	5.7	339
1917–18				
October	8	3	4.6	283
November	20	8	12.2	726
March 17–31	78	48	66.6	1,980
April	88	19	41.2	2,450
May	517	25	300	18,400
June	1,360	13	653	33,900
July	70	4	16.7	1,030
August	8	2	3.4	209
September	8	3	4.8	286

Monthly discharge of Blacks Fork near Urie, Wyo., for 1913–1924—Continued

Month	Discharge in second-feet			Run-off in acre-feet
	Maximum	Minimum	Mean	
1918–19				
October	45	10	19.4	1,190
November 1–23	25	7	11.6	529
March 23–31	61	44	51.6	921
April	46	14	21.0	1,250
May	680	27	309	19,000
June	108	6.0	31.0	1,840
July	8.0	1.8	4.28	263
August	6.8	2.2	3.99	245
September	6.0	3.0	4.19	249
1919–20				
October	13	6	10.0	615
November 1–15	13	10	10.2	303
March 20–31	101	44	64.3	1,530
April	206	44	102	6,070
May	1,220	101	535	32,900
June	1,130	52	393	23,400
July	35	15	19.3	1,190
August	32	5	16.3	1,000
September	20	8	14.2	845
1920–21				
October	20	10	16.5	1,010
November 1–13	18	13	14.6	376
March 20–31	45	20	29.4	700
April	54	20	38.9	2,310
May	1,270	38	447	27,500
June	2,180	320	1,070	63,700
July	480	28	128	7,870
August	42	5	21.1	1,300
September	106	13	35.7	2,120
1921–22				
October	24	6	14.5	892
November 1–15	13	13	13.0	387
April 17–30	280	54	185	5,140
May	1,480	178	505	31,000
June	1,010	310	592	35,200
July	300	7	59.1	3,630
August	25	7	9.7	596
September	19	6	8.6	512
1922–23				
October	17	10	12.3	756
November 1–13	27	17	21.4	552
April	300	97	173	10,300
May	2,260	135	720	44,300
June	1,720	208	716	42,600
July	380	93	200	12,300
August	102	21	43.2	2,660
September	31	8	18.6	1,110
1923–24				
October	72	23	35.5	2,180
November 1–15	70	57	62.5	1,860
March 23–31	58	39	52.6	939
April	280	66	143	8,510
May	1,150	102	559	34,400
June	360	8	93.4	5,560
July	19	1	6.0	369
August	2	.3	.86	53
September	2	.3	1.05	62

BLACKS FORK AT GRANGER, WYO.

Location.—A quarter of a mile below Granger. From April 18, 1896, to April 27, 1897, station was at Union Pacific Railroad bridge, 3 miles west of Granger and above Hams Fork.

Drainage area.—Upper station, 2,170 square miles. Lower station, 2,840 square miles (measured on base map of Wyoming).

Records available.—April 18, 1896, to September 30, 1900.

Gage.—Vertical staff used at upper station, and a cantilever wire gage at lower station.

Extremes of discharge.—1896–1900: Maximum discharge, 6,780 second-feet June 14–15, 1899. No flow August 31 to October 1, 1898, and August 15 to September 30, 1900.

Accuracy.—Gage probably read once daily. Rating curve fairly well defined. Records good except during winter, for which they are fair.

Monthly discharge of Blacks Fork at Granger, Wyo., for 1896–1900

Month	Discharge in second-feet			Run-off in acre-feet
	Maximum	Minimum	Mean	
1896				
April 18–30	470	230	388	10,000
May	4,160	380	1,130	69,500
June	5,020	440	1,760	105,000
July	410	190	278	17,100
August	620	40	174	10,700
September	620	60	131	7,800
The period				220,000
1896–97				
October	120	70	89.2	5,480
April	1,350	300	618	36,800
May	5,830	1,400	3,750	231,000
June	3,370	495	1,310	78,000
July	570	145	315	19,400
August	210	90	146	8,980
September	245	65	131	7,800
1897–98				
October			[a] 400	[a] 24,600
November			[a] 200	[a] 11,900
December			[a] 180	[a] 11,100
January			[a] 100	[a] 6,150
February			[a] 80	[a] 4,440
March			[a] 500	[a] 30,700
April	2,260	990	1,670	99,400
May	2,590	1,180	1,700	105,000
June	2,520	990	1,730	103,000
July	822	145	405	24,900
August	245	0	108	6,640
September			0	0
The year				428,000
1898–99				
October	210	0	127	7,810
November			[a] 80	[a] 4,760
December			[a] 70	[a] 4,300
January			[a] 60	[a] 3,690
February			[a] 50	[a] 2,780
March			[a] 400	[a] 24,600
April	2,090	520	987	58,700
May	3,870	640	2,260	139,000
June	6,780	2,950	4,740	282,000
July	3,710	455	1,630	100,000
August	510	110	287	17,600
September	145	15	62.2	3,700
The year				649,000
1899–1900				
October	145	15	90	5,530
November			[a] 100	[a] 5,950
December			[a] 80	[a] 4,920
January			[a] 70	[a] 4,300
February			[a] 70	[a] 3,890
March			[a] 450	[a] 27,700
April	860	372	576	34,300
May	2,650	770	1,650	101,000
June	2,270	135	910	54,100
July	110	19	44.1	2,710
August	27	0	10.6	652
September			[a] 1.0	[a] 60
The year				245,000

[a] Estimated.

HAMS FORK AT DIAMONDVILLE, WYO.

LOCATION.—In SW. ¼ sec. 24, T. 21 N., R. 116 W., at highway bridge in Diamondville, Lincoln County. No important tributary within many miles.

DRAINAGE AREA.—383 square miles (measured on base map of Wyoming).

RECORDS AVAILABLE.—May 1, 1918, to September 30, 1926. From May 2 to September 30, 1918, station maintained at Kemmerer, 2 miles upstream; records at two points comparable.

GAGE.—Staff attached to downstream side of bridge.

EXTREMES OF DISCHARGE.—1918–1926: Maximum discharge May 11, 1923, 3,130 second-feet; minimum stage, river dry August 29–31, 1919.

DIVERSIONS.—Adjudicated diversions for irrigation of 3,500 acres from Hams Fork above station and 7,800 acres below.

ACCURACY.—Gage read twice daily; rating curves well defined. Records excellent.

Monthly discharge of Hams Fork at Diamondville, Wyo., for 1918–1926

Month	Discharge in second-feet			Run-off in acre-feet
	Maximum	Minimum	Mean	
1918				
May	1,500	670	965	59,300
June	895	215	644	38,300
July	245	70	145	8,920
August	68	24	43.0	2,640
September	42	26	30.5	1,810
The period				110,000
1918–19				
October	45	32	39.4	2,420
November	43		[a] 32	[a] 1,900
December			[a] 30	[a] 1,840
January			[a] 25	[a] 1,540
February			[a] 25	[a] 1,390
March	[a] 248	[a] 22	[a] 43	[a] 2,640
April	600	55	276	16,400
May	600	294	385	23,700
June	405	27	123	7,320
July	25	5	10.3	633
August	18	0	10.5	646
September	23	1	13.3	791
The year	560	0	84.3	61,200
1919–20				
October	47	26	34.2	2,100
November	43	33	37.6	2,240
December			[a] 30	[a] 1,840
January			[a] 25	[a] 1,540
February			[a] 25	[a] 1,440
March	57		[a] 40	[a] 2,460
April	405	35	147	8,750
May	2,640	480	1,420	87,300
June	1,380	280	698	41,500
July	241	45	86.6	5,320
August	53	26	38.3	2,360
September	49	26	33.9	2,020
The year	2,640		220	159,000
1920–21				
October	60	39	48.7	2,990
November	56		[a] 43	[a] 2,560
December			[a] 30	[a] 1,840
January			[a] 30	[a] 1,840
February			[a] 25	[a] 1,390
March	228		[a] 75	[a] 4,610
April	643	78	307	18,300
May	2,170	444	1,480	91,000
June	1,830	330	1,060	63,100
July	306	68	145	8,920
August	83	35	50.9	3,130
September	48	31	37.6	2,240
The year	2,170		279	202,000

[a] Estimated.

Monthly discharge of Hams Fork at Diamondville, Wyo., for 1918–1926—Con.

Month	Discharge in second-feet			Run-off in acre-feet
	Maximum	Minimum	Mean	
1921–22				
October	70	33	40.2	2,470
November	49	23	37.6	2,240
March 19–31	105	16	40.5	1,040
April	500	35	113	6,720
May	1,930	500	1,210	74,400
June	1,120	260	712	42,400
July	247	42	97.9	6,020
August	137	29	52.7	3,240
September	42	24	31.3	1,860
1922–23				
October	54	30	36.5	2,240
November 1–15	57	34	43.3	1,290
March 25–31	54	20	31.9	443
April	802	42	191	11,400
May	3,130	705	1,630	100,000
June	1,050	370	710	42,200
July	370	79	203	12,500
August	79	23	42.9	2,640
September	122	22	43.2	2,570
1923–24				
October	155	72	95.9	5,900
November 1–15	105	64	77.3	2,300
March 16–31	31	23	26.5	841
April	1,790	30	676	40,200
May	1,260	645	923	56,800
June	560	73	268	15,900
July	69	17	38.3	2,360
August	25	11	18.4	1,130
September	25	12	17.2	1,020
1925				
May 14–31	600	438	528	18,900
June	432	90	217	12,900
July	185	23	52.5	3,230
August	67	15	22.7	1,400
September	39	16	25.4	1,510
The period				37,900
1925–26				
October	50	33	41.0	2,520
November 1–12	40	5	28.4	676
March	234		106	6,520
April	489	53	333	19,800
May	495	128	309	19,000
June	131	8	59.3	3,530
July	48	7	23.3	1,430
August	25	2	11.7	719
September	13	4	9.7	577

[a] Estimated.

BEAVER CREEK NEAR LODORE, COLO.

LOCATION.—At Myers ranch, about 16 miles from Lodore, Colo.

RECORDS AVAILABLE.—April 24, 1910, to November 30, 1911.

DRAINAGE AREA.—27 square miles (State engineer's report).

GAGE.—Vertical staff.

CHANNEL.—Apparently shifting.

DISCHARGE MEASUREMENTS.—Made by wading. High-water measurements made by slope method.

WINTER FLOW.—Ice caused backwater, and records were discontinued during winter.

DIVERSIONS.—Water was diverted for irrigation above station.

COOPERATION.—Station maintained by the State engineer, who furnished the records complete for publication.

Monthly discharge of Beaver Creek near Lodore, Colo., for 1910–11

Month	Discharge in second-feet			Run-off in acre-feet
	Maximum	Minimum	Mean	
1910				
April 24–30			455	6,320
May			65.2	4,010
September	1.0	0.3	.82	49
1910–11				
October	2.3	1.0	1.12	69
November	3	1	2.01	119
December	3	3	3	101
April	117	2.3	19.4	1,156
May	2.3	.3	.9	57.1
June	.3	.2	.3	15.8
July	.2	0	.1	5.2
August	0	0	0	0
September	.7	.2	.4	24
1911				
October	3.0	.7	1.3	80.9
November	2.3	1.2	1.9	115

VERMILION CREEK NEAR LODORE, COLO.

LOCATION.—About 5 miles from Lodore, Colo.

RECORDS AVAILABLE.—July 1, 1910, to November 30, 1911.

DRAINAGE AREA.—1,017 square miles (State engineer's report).

GAGE.—Vertical staff.

CHANNEL.—Practically permanent.

DISCHARGE MEASUREMENTS.—Made by wading at ordinary stages and by float method during high stages.

WINTER FLOW.—Ice caused backwater and records were discontinued during winter.

DIVERSIONS.—No data.

COOPERATION.—Station maintained by the State engineer, who furnished the records complete for publication.

Records very fragmentary. No tables prepared.

YAMPA RIVER AT YAMPA, COLO.

LOCATION.—About sec. 11, T. 2 N., R. 85 W., at highway bridge in Yampa, Routt County. Nearest tributary, Phillips Creek, enters below station.

DRAINAGE AREA.—52 square miles.

RECORDS AVAILABLE.—May 17, 1910, to December 31, 1915.

GAGE.—Vertical staff.

DISCHARGE MEASUREMENTS.—Made from bridge.

CONTROL.—Shifting during high water.

COOPERATION.—All records furnished by State engineer.

Monthly discharge of Yampa River at Yampa, Colo., for 1910–1915

Month	Discharge in second-feet			Run-off in acre-feet
	Maximum	Minimum	Mean	
May 17–31	104	62	73.0	2,170
June	92	3.5	47.3	2,810
July	3.5	.2	1.21	74
August	26	1.8	18.5	1,140
September	34	9	24.1	1,430
The period				7,620
1910–11				
October	17	6	11.7	719
November	22	13	17.1	1,020
December			[a] 15	[a] 922
January			[a] 15	[a] 922
February			[a] 17	[a] 944
March			[a] 18	[a] 1,110
April			[a] 25	[a] 1,490
May			[a] 50	[a] 3,070
June			[a] 175	[a] 10,400
July	59	4	26	1,600
August	46	7	21	1,310
September	22	12	16	932
The year			33.6	24,400
1911–12				
October	59	7	21	1,320
November	[a] 30	[a] 22	[a] 27	[a] 1,500
December			[a] 22	[a] 1,350
January			[a] 20	[a] 1,230
February			[a] 20	[a] 1,150
March			[a] 20	[a] 1,230
April	30	16	[a] 21	[a] 1,320
May	123	16	50	3,090
June	464	43	194	11,560
July	218	66	132	8,090
August	192	22	71	4,350
September	43	14	28	1,690
The year			52.4	38,000
1912–13				
October	31	22	29	1,790
November	31	22	28	1,682
December			[a] 20	[a] 1,230
January			[a] 19	[a] 1,170
February			[a] 18	[a] 1,000
March			[a] 16	[a] 984
April	62	11	[a] 34	[a] 1,950
May	100	25	51	3,140
June	54	.5	13	774
July	36	.5	8.8	541
August	25	.5	12	738
September	25	20	23	1,370
The year			22.6	16,400
1913–14				
October	30	20	26	1,600
November	36	30	31	1,840
December			[a] 25	[a] 1,450
January			[a] 20	[a] 1,230
February			[a] 20	[a] 1,110
March			[a] 20	[a] 1,230
April	38	17	[a] 27	[a] 1,860
May	212	27	115	7,100
June	248	77	184	10,900
July	93	17	51	3,110
August	50	17	31	1,900
September	38	17	27	1,600
The year			48.2	34,900

[a] Estimated.

Monthly discharge of Yampa River at Yampa, Colo., for 1910–1915—Continued

Month	Discharge in second-feet			Run-off in acre-feet
	Maximum	Minimum	Mean	
1914–15				
October	27	17	22	1,350
November	27	9	20	1,160
December			[a] 20	[a] 1,230
January			[a] 18	[a] 1,110
February			[a] 18	[a] 1,000
March			[a] 20	[a] 1,230
April	88	22	34.2	2,040
May	108	9	35.0	2,150
June	108	7	29.4	1,750
July	9	3	4.7	289
August	8	3	6.3	387
September	13	7	8.6	512
The year			19.6	14,200
1915				
October	13	9.5	10.1	621
November	26	10	16.9	1,010
December	19	19	19	1,170
The period				2,800

[a] Estimated.

YAMPA RIVER AT STEAMBOAT SPRINGS, COLO.

Location.—At Fifth Street Bridge in Steamboat Springs, Routt County. Spring Creek enters one-fourth mile above station and Soda Creek one-half mile below. Station was originally at bridge at east end of town and was moved to new bridge one-fourth mile downstream on May 8, 1905. Station was moved to Fifth Street Bridge April 26, 1915. Since 1923 station at First Street Bridge in Steamboat Springs, Routt County, Colo.

Drainage area.—500 square miles.

Records available.—May 3, 1904, to October 31, 1906; October 1, 1909, to September 30, 1926.

Gage.—Recording gage since 1910, chain from 1904 to 1906.

Discharge measurements.—Made from bridge.

Control.—Practically permanent.

Cooperation.—Complete records since 1910 furnished by State engineer.

Monthly discharge of Yampa River at Steamboat Springs, Colo., for 1904–1906 and 1909–1926

Month	Discharge in second-feet			Run-off in acre-feet
	Maximum	Minimum	Mean	
1904				
May 3–31	3,400	1,000	1,920	113,000
June	2,430	818	1,580	93,700
July	870	142	278	17,100
August	232	146	166	10,200
September	185	146	153	9,100
The period				243,000
1904–5				
October	200	142	166	10,200
November			[a] 140	[a] 8,330
December			[a] 115	[a] 7,070
January			[a] 100	[a] 6,150
February			[a] 90	[a] 5,000
March			[a] 150	[a] 9,220
April	775	250	418	24,900
May	2,320	462	1,400	86,400
June	4,240	550	2,440	145,000
July	840	86	254	15,600
August	173	51	92.5	5,690
September	104	55	73.1	4,350
The year			453	328,000

[a] Estimated.

Monthly discharge of Yampa River at Steamboat Springs, Colo., for 1904–1906 and 1909–1926—Continued

Month	Discharge in second-feet			Run-off in acre-feet
	Maximum	Minimum	Mean	
1905–6				
October	104	75	88.2	5,420
Nobember			[a] 90	[a] 5,360
December			[a] 85	[a] 5,230
January			[a] 80	[a] 4,920
February			[a] 90	[a] 5,000
March			[a] 150	[a] 9,220
April	2,030	260	813	48,400
May	4,020	745	2,220	136,000
June	4,560	901	2,500	149,000
July	805	140	398	24,500
August	280	116	166	10,200
September	240	125	171	10,200
The year			570	413,000
1906				
October	177	146	159	9,780
1909–10				
October			[a] 150	[a] 9,220
November			[a] 110	[a] 6,550
December			[a] 100	[a] 6,150
January			[a] 100	[a] 6,150
February			[a] 100	[a] 5,550
March	820	120	433	26,600
April	970	540	753	44,800
May	2,680	1,050	1.780	110,000
June	2,560	239	996	59,300
July	239	83	134	8,240
August	171	93	134	8,240
September	221	65	115	6,840
The year			412	298,000
1910–11				
October	221	51	110	6,760
November	221	93	134	7,970
December	103	57	78.7	4,840
January	105	73	91	5,580
February	105	93	101	5.620
March	355	105	203	12,500
April	680	380	482	28,700
May	2,480	680	1,450	89,100
June	2,640	430	1,700	101,000
July	515	130	298	18,300
August	198	70	106	6,510
September	145	70	89	5,280
The year			403	292,000
1911–12				
October	545	80	190	11,700
November	180	102	139	8,250
December			[a] 100	[a] 6,150
January			[a] 100	[a] 6,150
February	315	100	156	8,970
March	230	130	154	9,460
April	1,060	195	558	33,200
May	3,500	940	1,840	113,000
June	4,390	1,430	2,950	175,000
July	2,250	640	1,100	67,900
August	810	160	337	20,700
September	270	145	220	13,100
The year			649	474,000
1912–13				
October	315	230	260	16,000
November	270	100	192	11,400
December			[a] 110	[a] 6,760
January			[a] 100	[a] 6,150
February			[a] 100	[a] 5,550
March			[a] 150	[a] 9,220
April	1,560	350	1,080	[a] 47,900
May	2,430	1,260	1,830	113,000
June	1,760	225	891	53,000
July	590	85	159	9,780
August	108	55	83	5,100
September	92	62	82	4,880
The year			399	289,000

Estimated.

Monthly discharge of Yampa River at Steamboat Springs, Colo., for 1904–1906 and 1909–1926—Continued

Month	Discharge in second-feet			Run-off in acre-feet
	Maximum	Minimum	Mean	
1913–14				
October	108	70	87	5,350
November	92	70	76	4,520
December	78	70	[a] 70	[a] 4,350
January			[a] 65	[a] 4,000
February			[a] 75	[a] 4,160
March	340	100	193	11,900
April	1,520	310	783	46,600
May	4,740	690	2,420	149,000
June	5,120	495	2,350	140,000
July	588	220	308	19,000
August	285	140	185	11,400
September	340	100	157	9,360
The year			566	410,000
1914–15				
October	320	140	217	13,400
November	190	120	146	8,660
December			[a] 100	[a] 6,150
January			[a] 90	[a] 5,530
February			[a] 85	[a] 4,720
March			[a] 175	[a] 10,800
April			1,280	[a] 56,200
May	2,110	655	1,280	78,700
June	2,260	460	1,290	76,800
July	405	52	164	10,100
August	90	45	69.3	4,260
September	140	45	80.8	4,810
The year			375	280,000
1915–16				
October	155	100	122	6,490
November	140	30	80.9	4,810
December	140	38	56.6	3,480
January			[a] 45	[a] 2,770
February			[a] 50	[a] 2,880
March			[a] 518	[a] 21,100
April	1,640	310	879	52,300
May	2,340	880	1,490	91,600
June	2,980	800	2,010	120,000
July	840	125	309	19,000
August	460	155	256	15,700
September	380	112	153	9,100
The year			486	349,000
1916–17				
October	250	100	213	13,100
November	172	112	136	8,100
December			[a] 95	[a] 5,840
January			[a] 90	[a] 5,530
February			[a] 85	[a] 4,720
March			[a] 200	[a] 12,300
April	1,740		520	34,000
May	3,500	730	1,780	109,000
June	5,280	1,340	3,770	224,000
July	3,300	320	1,100	67,600
August	416	144	208	12,800
September	204	120	158	9,400
The year			698	506,000
1917–18				
October	158	81	112	6,890
November	172	100	124	7,380
December	132	98	108	6,640
January	124	108	120	7,380
February	125	125	125	6,940
March	652	125	251	15,400
April	660	470	604	35,900
May	2,840	660	1,690	104,000
June	4,730	960	2,510	149,000
July	800	144	562	34,600
August	204	100	150	9,220
September	278	81	159	9,460
The year	**4,730**	**81**	**543**	**393,000**

[a] Estimated.

Monthly discharge of Yampa River at Steamboat Springs, Colo., for 1904–1906 and 1909–1926—Continued

Month	Discharge in second-feet			Run-off in acre-feet
	Maximum	Minimum	Mean	
1918–19				
October	320	172	230	14,100
November	278	104	190	11,300
December			[a] 150	[a] 9,220
January			[a] 130	[a] 7,990
February			[a] 130	[a] 7,220
March			[a] 200	[a] 12,300
April			[a] 665	[a] 39,600
May	3,040	1,200	2,100	129,000
June	1,240	260	773	46,000
July	222	53	104	6,400
August	100	42	62.7	3,860
September	75	35	54.7	3,250
The year			401	290,000
1919–20				
October	100	40	66.2	4,070
November	130	58	110	6,540
December	98	50	69.3	4,260
January			[a] 75	[a] 4,610
February			[a] 100	[a] 5,750
March			[a] 115	[a] 7,070
April	712	132	352	20,900
May	4,210	1,090	2,790	172,000
June	4.630	1,620	3,120	186.000
July	1,530	207	495	30,400
August	318	132	205	12,600
September	164	108	135	8,030
The year			637	462,000
1920–21				
October	172	120	146	8,980
November	186	153	171	10,200
December	160	110	136	8,360
January			[a] 135	[a] 8,300
February			[a] 165	[a] 9,160
March	418	190	256	[a] 15,700
April	1,170	256	753	44,800
May	4,510	1,300	2,620	161,000
June	5.870	1,170	3,510	209,000
July	1,130	226	498	30,600
August	354	180	230	14,100
September	252	109	157	9,340
The year			732	530,000
1921–22				
October	126	98	109	6,700
November	126	114	122	7,260
December			[a] 115	[a] 7,070
January			[a] 110	[a] 6,760
February			[a] 132	[a] 7,330
March	362		[a] 180	[a] 10,700
April	1,020	172	446	26,500
May	2,960	750	1,500	92,200
June	2,580	379	1,480	88,100
July	431	105	188	11,600
August	158	100	126	7,750
September	108	72	85.7	5,100
The year			382	277,000
1922–23				
October	92	78	83	5,100
November	128	78	96.4	5,740
December			[a] 100	[a] 6,150
January			[a] 120	[a] 7,380
February			[a] 150	[a] 8,330
March			[a] 170	[a] 10,500
April	1,730	180	629	37,400
May	3,460	1,300	2,180	134,000
June	3,400	978	2,570	153,000
July	864	295	472	29,000
August	330	158	238	14,600
September	174	108	139	8,270
The year	3,460		87	419,000

[a] Estimated.

Monthly discharge of Yampa River at Steamboat Springs, Colo., for 1904–1906 and 1909–1926—Continued

Month	Discharge in second-feet			Run-off in acre-feet
	Maximum	Minimum	Mean	
1923–24				
October	225	132	172	10,600
November	179	81	139	8,270
December			[a] 95	[a] 5,840
January			[a] 102	[a] 6,270
February			[a] 98	[a] 5,640
March			[a] 114	[a] 7,010
April	1,480		[a] 631	[a] 37,500
May	2,920	546	1,760	108,000
June	3,280	440	1,880	112,000
July	440	81	211	13,000
August	79	40	61.3	3,770
September	151	40	75.3	4,480
The year				322,000
1924–25				
October	252	144	183	11,300
November	180	144	159	9,460
December			[a] 132	[a] 8,120
January			[a] 130	[a] 7,990
February			[a] 122	[a] 6,780
March			[a] 220	[a] 13,500
April	1,370	425	910	54,100
May	2,400	1,030	1,830	113,000
June	1,940	375	1,070	63,700
July	529	130	235	14,400
August	328	122	156	9,590
September	324	140	167	9,940
The year				322,000
1925–26				
October	406	141	197	12,100
November	194	143	159	9,460
December	152		[a] 144	[a] 8,850
January			[a] 130	[a] 7,990
February			[a] 125	[a] 6,940
March	466		[a] 231	[a] 14,200
April	1,750	189	975	58,000
May	3,840	880	2,370	146,000
June	3,490	284	1,460	86,900
July	880	144	288	17,700
August	318	66	170	10,500
September	152	69	106	6,310
The year				385,000

[a] Estimated.

YAMPA RIVER AT CRAIG, COLO.

Location.—In sec. 12, T. 6 N., R. 91 W., at highway bridge, 1 mile south of Craig, Moffat County. Nearest tributary, Fortification Creek, a short distance upstream.

Drainage area.—1,730 square miles.

Records available.—May 25, 1901, to September 30, 1902; October 1, 1903, to October 31, 1906; October 1, 1909, to November 13, 1916.

Gage.—Chain on bridge.

Discharge measurements.—Made from bridge.

Control.—Slightly shifting.

Cooperation.—Complete records since 1910 furnished by State engineer.

Monthly discharge of Yampa River at Craig, Colo., for 1901–2, 1903–1906, and 1909–1916

Month	Discharge in second-feet			Run-off in acre-feet
	Maximum	Minimum	Mean	
1901				
May 25–31	7, 090	6 280	6, 680	92, 700
June	6, 280	2, 200	4, 280	255, 000
July	1, 920	321	745	45, 800
August	423	198	301	18, 500
September	276	136	190	11, 300
The period				423, 000
1901–2				
October	235	136	181	11, 100
November			[a] 165	[a] 9, 820
December			[a] 150	[a] 9, 220
January			[a] 150	[a] 9, 220
February			[a] 200	[a] 11, 100
March			[a] 275	[a] 16, 900
April	4, 200	370	1, 800	107, 000
May	8, 730	3. 320	6, 720	413, 000
June	8, 520	825	3, 970	236, 000
July	1, 080	198	479	29, 500
August	165	90	115	7, 070
September			105	6, 250
The year	8, 730		1, 190	866, 000
1903–4				
October			[a] 400	[a] 24. 600
November			[a] 300	[a] 17, 900
December			[a] 250	[a] 15, 400
January			[a] 250	[a] 15, 400
February			[a] 225	[a] 12, 900
March			[a] 500	[a] 30, 700
April			[a] 2, 000	[a] 119, 000
May	7, 550	3, 480	5, 280	325, 000
June	5, 820	1, 960	4, 010	239, 000
July	1, 820	310	731	45, 000
August	375	238	299	18, 400
September	291	163	201	12, 000
The year	7, 550		1, 210	875, 000
1904–5				
October	291	163	230	14, 100
November			[a] 225	[a] 13, 400
December			[a] 200	[a] 12, 300
January			[a] 200	[a] 12, 300
February			[a] 200	[a] 11, 100
March			[a] 300	[a] 18, 400
April	3, 380	510	1, 580	94, 000
May	8, 000	1, 920	4, 180	257, 000
June	9, 000	2, 420	5, 710	340, 000
July	2, 360	370	1, 000	61, 600
August	570	100	333	-20, 500
September	230	100	124	7, 380
The year	9, 000		1, 190	862, 000
1905–6				
October	230	125	163	10, 000
November			[a] 200	[a] 11, 900
December			[a] 200	[a] 12, 300
January			[a] 200	[a] 12, 300
February			[a] 200	[a] 11, 100
March			[a] 350	[a] 21, 500
April	4, 460	808	2, 100	125, 000
May	9, 680	2, 550	6, 180	380, 000
June	8, 800	2, 480	5, 620	334, 000
July	2, 700	450	1, 470	90, 400
August	535	215	359	22, 100
September	425	200	283	16, 800
The year	9, 680		1, 450	1, 050, 000
1906				
October	350	265	285	17, 500

[a] Estimated.

Monthly discharge of Yampa River at Craig, Colo., for 1901–2, 1903–1906, and 1909–1916—Continued

Month	Discharge in second-feet			Run-off in acre-feet
	Maximum	Minimum	Mean	
1909–10				
October			[a] 400	[a] 24,600
November			[a] 300	[a] 17,900
December			[a] 250	[a] 15,400
January			[a] 250	[a] 15,400
February			[a] 225	[a] 12,500
March			[a] 600	[a] 36,900
April	5 650	1,740	3,080	183,000
May	5,650	2,830	4 130	254,000
June	5,870	662	2,490	148,000
July	662	72	237	14,600
August	292	95	167	10,300
September	360	95	233	13,800
The year	5,870		1,030	746,000
1910–11				
October	465	145	281	17,300
November	325	260	288	17,100
December			[a] 260	[a] 16,000
January			[a] 260	[a] 16,000
February			[a] 260	[a] 14,400
March			[a] 500	[a] 30,700
April	4,360	885	1,800	107,000
May	8,320	2,350	4,470	275,000
June	7,350	1,940	4,370	260,000
July	1,940	425	973	59,800
August	425	172	254	15,600
September	230	95	154	9,160
The year	8,320		1,160	838,000
1911–12				
October	1,810	260	551	33,900
November	325	230	261	15,500
December			[a] 240	[a] 14,800
January			[a] 220	[a] 13,500
February			[a] 200	[a] 11,500
March			[a] 400	[a] 24,600
April	3,340	1,260	2,220	132,000
May	9,700	2,670	6,150	378,000
June	10,300	3,490	7,080	422,000
July	5,450	1,620	2,820	173,000
August	1,880	615	998	61,400
September	932	615	680	40,400
The year	10,300		1,820	1,320,000
1912–13				
October	790	615	738	45,400
November	790	615	715	42,600
December			[a] 350	[a] 18,400
January			[a] 225	[a] 13,800
February			[a] 200	[a] 11,000
March			[a] 500	[a] 30,700
April	4,150	1,030	2,660	158,000
May	6,640	2,780	4,490	276,000
June	5,580	1,030	2,440	145,000
July	1,080	325	568	34,900
August	390	50	208	12,800
September	292	145	211	12,600
The year	6,640		1,100	801,000
1913–14				
October	390	260	325	20,000
November	390	325	[a] 365	21,700
December			[a] 250	[a] 15,400
January			[a] 200	[a] 12,300
February			[a] 225	[a] 12,500
March			[a] 500	[a] 30,700
April	4,150	1,870	2,930	175,000
May	9.700	3,080	6,790	418,000
June	10,300	2,000	6,210	370,000
July	2,280	745	1,150	70,800
August	790	390	514	31,600
September	615	325	246	26,600
The year	10,300		1,660	1,200,000

[a] Estimated.

Monthly discharge of Yampa River at Craig, Colo., for 1901–2, 1903–1906, and 1909–1916—Continued

Month	Discharge in second-feet			Run-off in acre-feet
	Maximum	Minimum	Mean	
1914–15				
October	790	390	632	38,900
November			420	[a] 25,000
December			250	[a] 15,400
January			[a] 225	[a] 13,800
February			[a] 225	[a] 12,500
March			[a] 500	[a] 30,700
April	4,470	1,040	2,640	157,000
May	4,560	1,880	3,070	189,000
June	5,150	2,010	3,360	200,000
July	1,880	230	724	44,500
August	230	120	143	8,790
September	260	85	190	11,300
The year	5,150		1,030	747,000
1915–16				
October			[a] 212	[a] 13,000
November			[a] 225	[a] 13,400
December			[a] 200	[a] 12,300
January			[a] 200	[a] 12,300
February			[a] 200	[a] 11 500
March			[a] 500	[a] 30,700
April	[a] 7,640		[a] 2,000	[a] 119,000
May	9,410	4,100	5,450	335,000
June	6,530	3,730	5,470	325,000
July	2,280	500	1,160	71,300
August	1,210	290	632	38,900
September	590	220	316	18,800
The year	9,410		1,380	1,000,000
1916				
October	1,380	290	754	46,400
November 1–13	500	330	443	11,400
The period				57,800

[a] Estimated.

YAMPA RIVER NEAR MAYBELL, COLO.

LOCATION.—In sec. 2, T. 6 N., R. 95 W., at highway bridge 3 miles west of Maybell, Moffat County. Nearest tributary, Deception Creek, enters 2 miles downstream. Station originally at bridge, in sec. 20, T. 7 N., R. 96 W., 7 miles west of Maybell, and maintained there until 1912. Flow at two points comparable.

DRAINAGE AREA.—Not measured.

RECORDS AVAILABLE.—April 17, 1904, to October 31, 1905; June 12, 1910, to November 30, 1912; April 24, 1916, to September 30, 1926.

GAGE.—Recording gage since 1919; chain gage previously.

DISCHARGE MEASUREMENTS.—Made from bridge.

CONTROL.—Permanent.

COOPERATION.—Complete records since 1917 furnished by State engineer.

Monthly discharge of Yampa River near Maybell, Colo., for 1904–5, 1910–1912, and 1916–1926

Month	Discharge in second-feet			Run-off in acre-feet
	Maximum	Minimum	Mean	
1904				
April 17–30	5,570	2,700	3,930	109,000
May	7,730	3,650	5,230	323,000
June	6,610	2,240	4,560	271,000
July	2,110	340	942	57,900
August	450	250	360	22,100
September	428	195	271	16,100
The period				798,000
1904–5				
October	405	195	301	18,500
April	3,660	655	1,820	109,000
May	9,320	2,920	5,580	343,000
June	10,800	2,700	6,770	403,000
July	2,020	450	968	59,500
August	880	145	303	18,600
September	250	130	185	11,000
1905				
October	290	145	188	11,600
1910				
June 12–30	4,340	985	2,000	75,400
July	985	151	450	27,700
August	253	105	141	8,670
September	214	116	153	9,100
The period				121,000
1910–11				
October	468	126	216	13,300
November	340	165	216	12,900
June 5–30	5,860	2,400	4,430	228,000
July	2,940	345	1,440	88,600
August	345	125	216	13,300
September	590	150	266	15,800
1911–12				
October	2,360	278	1,310	80,400
November	560	255	384	22,800
April	6,940	1,750	2,720	162,000
May	13,000	4,720	8,150	501,000
June	13,600	5,370	8,920	531,000
July	5,820	545	2,590	159,000
August	2,320	440	1,020	63,000
September	1,500	390	790	47,000
1912				
October	1,550	345	910	55,900
November	1,600	390	890	53,200
1916				
April 24–30	8,610	3,980	6,680	92,600
May	11,500	3,620	6,340	390,000
June	7,890	3,280	5,760	343,000
July	2,960	568	1,290	79,300
August	1,140	362	690	42,400
September	852	329	413	24,600
The period				972,000
1916–17				
October	1,430	345	751	46,200
November 1–12	504	356	429	10,200
April	10,200	760	3,580	213,000
May	17,300	3,740	10,000	615,000
June	15,300	8,540	12,800	762,000
July	11,400	1,550	4,490	276,000
August	1,920	421	744	45,700
September	500	356	412	24,500
The period				1,990,000

Monthly discharge of Yampa River near Maybell, Colo., for 1904-5, 1910-1912, and 1916-1926—Continued

Month	Discharge in second-feet			Run-off in acre-feet
	Maximum	Minimum	Mean	
1917-18				
October	470	277	337	20,700
November	430	250	364	21,700
December	400	290	327	20,100
January	338	296	312	19,200
February	360	340	354	19,700
March	2,100	380	934	57,400
April	4,200	1,410	2,330	139,000
May	7,420	1,800	5,880	362,000
June	10,100	4,350	7,390	440,000
July	5,930	930	2,270	140,000
August	810	280	425	26,100
September	630	240	410	24,400
The year			1,780	1,290,000
1918-19				
October	1,050	390	563	34,600
November	606	420	496	29,500
April	6,870	1,230	3,170	189,000
May	7,550	5,000	6,570	404,000
June	5.490	1,010	2,460	146,000
July	950	255	398	24,500
August	247	175	216	13,300
September	231	140	191	11,400
1919-20				
October	260	175	233	14,300
November	370	265	324	19,300
December	300	206	248	15,200
January			[a] 244	[a] 15,000
February			[a] 308	[a] 17,700
March			[a] 393	[a] 24,200
April	1,330	490	1,050	62,500
May	15,800	1,970	11,000	676,000
June	14,300	5,040	9,130	543,000
July	4,900	950	2,070	127,000
August	830	440	586	36,000
September	435	335	385	22,900
The year	15,800		2,160	1,570,000
1920-21				
October	410	360	388	23,900
November	490	380	429	25,500
March	3,140	724	1,580	97,200
April	5,190	1,280	2,500	149,000
May	14,400	2,410	9,130	561,000
June	16,600	4,440	11,500	684,000
July	4,100	830	1,990	122,000
August	1,080	420	682	41,900
September	400	296	315	18,700
1921-22				
October	301	287	292	18,000
November	310	287	298	17,700
December			[a] 330	[a] 20,300
January			[a] 300	[a] 18,400
February			[a] 385	[a] 21,400
March			[a] 760	[a] 46,700
April	3,790	940	1,640	97,600
May	10,600	4,110	6,950	427,000
June	8,780	2,540	5,860	349,000
July	2,550	360	1,250	76,900
August	500	260	359	22,100
September	310	135	186	11,100
The year	10,600		1,560	1,130,000

[a] Estimated.

Monthly discharge of Yampa River near Maybell, Colo., for 1904–5, 1910–1912, and 1916–1926—Continued

Month	Discharge in second-feet			Run-off in acre-feet
	Maximum	Minimum	Mean	
1922–23				
October	210	135	187	11,500
November	360	210	271	16,100
December			[a] 360	[a] 22,100
January			[a] 320	[a] 19,700
February			[a] 380	[a] 21,100
March			[a] 430	[a] 26,400
April	7,320		[a] 3,050	[a] 181,000
May	10,700	7,410	8,400	516,000
June	9,230	3,220	6,870	409,000
July	3,500	815	2,000	123,000
August	894	316	631	38,800
September	532	275	366	21,800
The year	10,700		1,940	1,410,000
1923–24				
October	520	342	421	25,900
November	401		336	20,000
December			[a] 250	[a] 15,400
January			[a] 245	[a] 15,100
February			[a] 270	[a] 15,500
March			[a] 320	[a] 19,700
April	5,250		2,510	149,000
May	7,050	2,010	5,170	318,000
June	7,140	1,940	4,860	289,000
July	1,800	314	893	54,900
August	308	153	256	15,700
September	276	134	222	13,200
The year				951,000
1924–25				
October	579	284	412	25,300
November	446	372	407	24,200
December			[a] 360	[a] 22,100
January			[a] 300	[a] 18,400
February			[a] 320	[a] 17,800
March			[a] 680	[a] 41,800
April	5,110	1,620	3,190	190,000
May	6,460	3,700	5,270	324,000
June	4,580	2,020	3,500	208,000
July	2,090	451	1,090	67,000
August	594	360	417	25,600
September	1,080	398	536	31,900
The year				996,000
1925–26				
October	1,120	350	540	33,200
November	499	312	392	23,300
December	520	340	400	24,600
January			[a] 385	[a] 23,700
February			[a] 370	[a] 20,500
March	2,310		[a] 880	[a] 54,100
April	7,020	560	3,810	227,000
May	8,350	3,270	6,390	393,000
June	7,400	1,300	4,160	248,000
July	2,310	370	937	57,600
August	576	277	369	22,700
September	270	189	227	22,700
The year				1,150,000

[a] Estimated.

WALTON CREEK NEAR STEAMBOAT SPRINGS, COLO.

LOCATION.—In sec. 11, T. 5 N., R. 84 W., at mouth of canyon, 7 miles southwest of Steamboat Springs, Routt County.

DRAINAGE AREA.—38 square miles.

RECORDS AVAILABLE.—October 1, 1920, to September 30, 1922.

GAGE.—Recording gage.

DISCHARGE MEASUREMENTS.—Made from highway bridge or by wading.

DIVERSIONS.—None above station.

COOPERATION.—Complete records furnished by State engineer's office.

Monthly discharge of Walton Creek near Steamboat Springs, Colo., for 1920–1922

Month	Discharge in second-feet			Run-off in acre-feet
	Maximum	Minimum	Mean	
1920–21				
October			[a] 10	[a] 615
November			[a] 11	[a] 655
December			[a] 9	[a] 553
January			[a] 7	[a] 430
February			[a] 7	[a] 389
March			[a] 10	[a] 615
April			[a] 30	[a] 1,790
May			[a] 350	[a] 21,500
June	2,800	307	1,140	67,800
July	386	18	118	7,260
August	60	6.4	22.1	1,360
September	23	6	9.33	555
The year	2,800		144	104,000
1921–22				
October	16	4.5	8.63	531
November	9.5	4.5	6.83	406
December	8	6	6.71	413
January			[a] 7	[a] 430
February			[a] 7	[a] 389
March			[a] 8	[a] 492
April	80	8	21.6	1,290
May	1,240	72	387	23,800
June	1,320	64	550	32,700
July	80	11	28.2	17,300
August	16	8	10.5	646
September	16	6	7.3	434
The year	1,320		109	78,800

[a] Estimated.

SODA CREEK AT STEAMBOAT SPRINGS, COLO.

LOCATION.—At Main Street Bridge in Steamboat Springs, Routt County. No tributary between station and mouth, a short distance below.

DRAINAGE AREA.—47 square miles.

RECORDS AVAILABLE.—June 8, 1910, to September 30, 1911; October 1, 1912, to November 30, 1919.

GAGE.—Chain.

DISCHARGE MEASUREMENTS.—Made from bridge.

CONTROL.—Practically permanent.

COOPERATION.—Complete records furnished by State engineer.

Monthly discharge of Soda Creek at Steamboat Springs, Colo., for 1910–11 and 1912–1919

Month	Discharge in second-feet			Run-off in acre-feet
	Maximum	Minimum	Mean	
1910				
June 8–30	262	23	71.4	3,260
July	26	2.0	8.85	544
August	5	1.2	2.02	123
September			2.0	119
The period				4,050
1910–11				
October			2.0	123
November			3.7	220
December			[a] 4.0	[a] 246
January			[a] 3	[a] 184
February			[a] 2	[a] 111
March			[a] 5	[a] 307
April			[a] 50	[a] 2,980
May	350	120	213	14,000
June	560	92	302	18,000
July	100	8	37	2,250
August	8	1	2.3	142
September			[a] 1	[a] 60
The year	560		53.2	38,600
1912–13				
October			[a] 5	[a] 307
November			[a] 4	[a] 238
December			[a] 4	[a] 246
January			[a] 3	[a] 184
February			[a] 2	[a] 111
March			[a] 5	[a] 307
April			45	2,680
May	225	97	168	10,300
June	225	25	87	5,170
July	30	2	8.2	504
August	1.2	.3	.6	37
September			.5	30
The year	225		27.6	20,100
1913–14				
October			[a] 1	[a] 61
November			[a] 1	[a] 60
December			[a] 1	[a] 61
January			[a] 1	[a] 61
February			[a] 1	[a] 56
March			[a] 5	[a] 307
April	64		49	2,900
May	375	57	203	12,500
June	490	81	262	15,600
July	72	2.5	16	1,010
August	2	1	1.3	85
September	11	.8	2	117
The year	490		45.2	32,800
1914–15				
October			[a] 3	[a] 184
November			[a] 5	[a] 298
December			[a] 4	[a] 246
January			[a] 4	[a] 246
February			[a] 3	[a] 167
March			[a] 5	[a] 307
April	291		50	2,980
May	273	73	145	8,920
June	381	49	179	10,700
July	46	3	12.9	793
August	3.5	1	2.3	141
September	4	1	2.5	149
The year	381		69.4	25,100

[a] Estimated.

Monthly discharge of Soda Creek at Steamboat Springs, Colo., for 1910–11 and 1912–1919—Continued

Month	Discharge in second-feet			Run-off in acre-feet
	Maximum	Minimum	Mean	
1915–16				
October	5	3	3.5	215
November	12	4	5.4	321
December			[a] 4	[a] 246
January			[a] 3	[a] 184
February			[a] 3	[a] 173
March	[a] 54		[a] 27.5	[a] 1,700
April	210	46	92.6	5,510
May	322	102	165	10,100
June	312	123	229	13,600
July	116	3.5	33.3	2,050
August	5	5	5.0	307
September	6	5	5.2	309
The year	322		47.9	34,700
1916–17				
October	9	5	6.3	387
November	5	4	4.4	262
December			[a] 4	[a] 246
January			[a] 3	[a] 184
February			[a] 2	[a] 111
March			[a] 5	[a] 307
April	69		52	3,080
May	383	69	229	14,100
June	462	254	386	23,000
July	383	27	159	9,780
August	30.0	4.5	14.1	867
September	3.0	.4	1.27	76
The year	462		72.2	52,300
1917–18				
October			[a] 2	[a] 123
November			[a] 3	[a] 179
December			[a] 3	[a] 184
January			[a] 2	[a] 123
February			[a] 2	[a] 111
March			[a] 3	[a] 184
April			[a] 75	[a] 4,460
May			215	13,000
June	694	103	390	23,200
July	68	4	24.6	1,510
August	235	.60	33.5	2,060
September			.7	42
The year	694		62.3	45,200
1918–19				
October	1.4	.70	1.04	64
November			[a] 1.4	[a] 81
December			[a] 1	[a] 61
January			[a] 1	[a] 61
February			[a] 1	[a] 56
March			[a] 5	[a] 307
April			[a] 118	[a] 7,000
May	358	119	239	14,700
June	170	30	101	6,010
July	29	0	8.92	541
August	0	0	0	0
September	0	0	0	0
The year	358		39.8	28,800
1919				
October	5	.5	2.51	157
November		3.2	4.4	[a] 250

[a] Estimated.

ELK RIVER AT HINMAN PARK, COLO.

LOCATION.—In sec. 9, T. 9 N., R. 84 W., at Hinman Park, Routt County. Nearest tributary, South Fork, enters a short distance downstream.

DRAINAGE AREA.—61 square miles.

RECORDS AVAILABLE.—October 1, 1911, to October 18, 1918.
GAGE.—Recording gage.
DISCHARGE MEASUREMENTS.—Made from cable and car.
CONTROL.—Permanent.
DIVERSIONS.—None above station.
COOPERATION.—Complete records furnished by State engineer.

Monthly discharge of Elk River at Hinman Park, Colo., for 1911–1918

Month	Discharge in second-feet			Run-off in acre-feet
	Maximum	Minimum	Mean	
1911–12				
October			[a] 215	[a] 13,200
November			[a] 80	[a] 4,760
December			[a] 60	[a] 3,690
January			[a] 50	[a] 3,070
February			[a] 45	[a] 2,590
March			[a] 45	[a] 2,770
April			[a] 140	[a] 8,330
May			[a] 570	[a] 35,000
June	1,340	330	888	52,800
July	820	205	508	31,200
August	260	90	145	8,920
September	105	75	84	5,000
The year	1,340			171,000
1912–13				
October	98	70	77	4,750
November			[a] 75	[a] 4,460
December			[a] 50	[a] 3,070
January			[a] 40	[a] 2,460
February			[a] 40	[a] 2,220
March			[a] 40	[a] 2,460
April	350		152	9,000
May	1,340	245	689	42,400
June	1,140	245	569	33,900
July	245	75	142	8,730
August	105	55	69	4,240
September	82	55	65	3,870
The year	1,340			122,000
1913–14				
October	90	55	67	4,120
November	90		[a] 59	[a] 3,500
December			[a] 40	[a] 2,460
January			[a] 35	[a] 2,150
February			[a] 35	[a] 1,940
March			[a] 40	[a] 2,460
April			[a] 140	[a] 8,330
May			[a] 650	[a] 40,000
June	1,240	390	843	50,200
July	505	120	282	17,400
August	150	65	94	5,800
September	140	50	76	4,530
The year	1,240		197	143,000
1914–15				
October	172	60	123	7,580
November	92	45	58	3,430
December			[a] 45	[a] 2,770
January			[a] 40	[a] 2,460
February			[a] 35	[a] 1,940
March			[a] 40	[a] 2,460
April	420		[a] 168	[a] 10,000
May	490	162	302	18,500
June	745	270	499	29,700
July	570	110	250	15,400
August	100	54	78	4,830
September	100	47	68	4,040
The year	745		142	103,000

[a] Estimated.

Monthly discharge of Elk River at Hinman Park, Colo., for 1911–1918—Continued

Month	Discharge in second-feet			Run-off in acre-feet
	Maximum	Minimum	Mean	
1915–16				
October	110	61	78	4,780
November	89	47	67	3,980
December			[a] 50	[a] 3,070
January			[a] 40	[a] 2,460
February			[a] 35	[a] 2,010
March			[a] 35	[a] 2,150
April			[a] 168	[a] 10,000
May	725	210	432	26,600
June	1,160	502	835	49,700
July	620	140	321	19,700
August	260	63	106	6,520
September	140	51	69.2	4,120
The year	1,160		186	135,000
1916–17				
October	140	63	87.2	5,360
November	63	57	59.6	3,550
December			[a] 45	[a] 2,770
January			[a] 40	[a] 2,460
February			[a] 35	[a] 1,940
March			[a] 35	[a] 2,150
April			[a] 130	[a] 7,740
May	830	140	456	28,000
June	1,530	1,030	1,370	81,500
July	1,410	330	765	47,000
August	375	120	164	10,100
September	115	54	77.3	4,600
The year	1,530		272	197,000
1917–18				
October	75	44	50.4	3,100
November	70	28	48.3	2,870
December			[a] 41	[a] 2,500
January			[a] 43	[a] 2,640
February			[a] 41	[a] 2,280
March			[a] 50	[a] 3,070
April			[a] 140	[a] 8,330
May			[a] 488	[a] 30,000
June	1,570	400	939	55,900
July	457	159	282	17,300
August	182	68	135	8,300
September	95	54	70.1	4,170
The year	1,570		197	140,000
1918				
October 1–18	290	68	170	6,070

[a] Estimated.

ELK RIVER NEAR CLARK, COLO.

Location.—In sec. 28, T. 9 N., R. 85 W., at highway bridge, 2 miles north of Clark, Routt County. Nearest tributary, Reed Creek, enters 2 miles upstream.

Drainage area.—206 square miles.

Records available.—May 1, 1910, to September 30, 1922.

Gage.—Chain on bridge.

Discharge measurements.—Made from bridge.

Control.—Permanent.

Diversions.—One small ditch diverts water above station.

Cooperation.—Complete records furnished by State engineer.

Monthly discharge of Elk River near Clark, Colo., for 1910–1922

Month	Discharge in second-feet			Run-off in acre-feet
	Maximum	Minimum	Mean	
1910				
May	1,980	300	1,060	65,200
June	2,850	335	915	54,400
July	300	125	157	9,650
August	125	46	78	4,800
September			[a] 36	2,140
The period				136,000
1910–11				
October			[a] 57	3,500
November			[a] 57	3,390
December			55	3,380
January			[a] 50	[a] 3,070
February			[a] 58	[a] 3,220
March			[a] 75	[a] 4,610
April			[a] 200	[a] 11,900
May			[a] 1,400	[a] 86,100
June	2,460	640	1,540	91,400
July	700	262	411	25,300
August	250	122	169	10,400
September	165	92	114	6,760
The year			337	253,000
1911–12				
October			[a] 228	[a] 14,000
November			[a] 80	[a] 4,760
December			[a] 70	[a] 4,300
January			[a] 73	[a] 4,490
February			[a] 78	[a] 4,490
March			[a] 81	[a] 4,980
April	555	65	204	12,100
May	4,010	450	2,010	124,000
June	4,470	1,250	2,340	139,000
July	1,180	410	812	49,800
August	390	175	314	19,300
September	205	65	146	8,700
The year	4,470		538	390,000
1912–13				
October	175	65	102	6,280
November	125	85	98	5,810
December	105	65	86	5,290
January			[a] 75	[a] 4,610
February			[a] 70	[a] 3,890
March			[a] 81	[a] 4,980
April	832	85	358	21,300
May	1,950	600	1,130	69,500
June	1,300	310	706	42,000
July	510	100	235	14,400
August	172	70	115	7,060
September	130	60	97	5,780
The year	1,950		264	191,000
1913–14				
October	172	70	117	7,200
November			[a] 92	[a] 5,430
December			[a] 70	[a] 4,300
January			[a] 70	[a] 4,300
February			[a] 70	[a] 3,890
March			[a] 81	[a] 4,980
April	600	140	330	19,600
May	2,890	532	1,390	85,500
June	3,410	890	1,540	91,600
July	832	215	401	24,700
August	185	70	126	7,750
September	185	70	106	6,300
The year	3,410		367	266,000

[a] Estimated.

Monthly discharge of Elk River near Clark, Colo., for 1910–1922—Continued

Month	Discharge in second-feet			Run-off in acre-feet
	Maximum	Minimum	Mean	
1914–15				
October	172	100	135	7,700
November		50	75	4,460
December			[a] 70	[a] 4,300
January			[a] 70	[a] 4,300
February			[a] 70	[a] 3,890
March			[a] 114	[a] 7,000
April			[a] 437	[a] 26,000
May	1,360	330	725	44,500
June	1,720	790	1,130	67,300
July	605	142	220	13,500
August	233	95	162	10,000
September	233	95	150	8,900
The year	1,720		279	202,000
1915–16				
October	102	76	95	5,830
November	111	82	94	5,570
December			[a] 75	[a] 4,610
January			[a] 70	[a] 4,300
February			[a] 70	[a] 3,890
March			[a] 90	[a] 5,530
April	2,000	62	340	20,200
May	2,360	328	1,010	62,100
June	1,760	1,100	1,480	88,100
July	1,420	238	662	40,700
August	615	132	294	18,100
September	280	98	145	8,630
The year	2,360		368	267,000
1916–17				
October			[a] 125	[a] 7,690
November			[a] 100	[a] 5,950
December			[a] 80	[a] 4,920
January			[a] 70	[a] 4,300
February			[a] 70	[a] 3,890
March			[a] 95	[a] 5,840
April			[a] 353	[a] 21,000
May	1,940	327	1,070	65,800
June	2,710	1,830	2,420	144,000
July	2,920	682	1,570	96,500
August	750	150	298	18,300
September	180	90	130	7,730
The year	2,920		533	386,000
1917–18				
October	90	54	70.8	4,350
November	90	48	68.3	4,060
December			[a] 60	[a] 3,690
January			[a] 75	[a] 4,610
February			[a] 58	[a] 3,220
March			[a] 70	[a] 4,300
April			[a] 240	[a] 14,300
May	1,980		1,530	94,000
June	2,800	998	2,030	121,000
July	1,880	305	590	36,300
August	280	75	168	10,300
September	100	64	76.7	4,560
The year	2,800		422	305,000
1918–19				
October			[a] 204	[a] 12,500
November			[a] 105	[a] 6,250
December			[a] 85	[a] 5,230
January			[a] 75	[a] 4,610
February			[a] 70	[a] 3,890
March			[a] 95	[a] 5,840
April			[a] 590	[a] 35,100
May	1,960	1,190	1,600	98,400
June	988	410	718	42,700
July	450	102	202	12,400
August	150	42	68.8	4,230
September	122	50	58.6	3,490
The year	1,960		311	235,000

[a] Estimated.

Monthly discharge of Elk River near Clark, Colo., for 1910–1922—Continued

Month	Discharge in second-feet			Run-off in acre-feet
	Maximum	Minimum	Mean	
1919–20				
October	86	42	59.8	3,680
November			[a] 64	[a] 3,810
December			[a] 70	[a] 3,690
January			[a] 52	[a] 3,200
February			[a] 70	[a] 4,030
March			[a] 70	[a] 4,300
April			[a] 152	[a] 9,040
May	3,620	210	2,360	145,000
June	3,390	1,880	2,540	151,000
July	1,980	293	895	55,000
August	330	122	203	12,500
September	150	79	109	6,490
The year	3,620		554	402,000
1920–21				
October	136	72	100	6,150
November			[a] 84	[a] 5,000
December			[a] 88	[a] 5,240
January			[a] 90	[a] 5,530
February			[a] 105	[a] 5,830
March			[a] 114	[a] 7,010
April			[a] 438	[a] 26,100
May	[a] 3,530	[a] 2,400	[a] 1,950	[a] 120,000
June	3,870	1,700	2,740	163,000
July	1,700	310	758	46,600
August			[a] 147	[a] 9,040
September			[a] 64	[a] 3,810
The year			557	403,000
1921–22				
October			[a] 60	[a] 3,690
November			[a] 64	[a] 3,810
December			[a] 90	[a] 5,530
January			[a] 82	[a] 5,040
February			[a] 99	[a] 5,500
March			[a] 98	[a] 6,030
April			[a] 232	[a] 13,800
May	3,430	276	1,430	87,900
June	3,530	957	1,930	115,000
July	872	143	378	23,200
August	170	66	113	6,950
September	55	46	47.2	2,810
The year	3,530		386	280,000

[a] Estimated.

ELK RIVER NEAR TRULL, COLO.

Location.—In sec. 6, T. 6 N., R. 85 W., on highway 2 miles southwest of Trull, Routt County. No important tributary between station and mouth.

Drainage area.—415 square miles.

Records available.—May 2, 1904, to September 30, 1906; October 1, 1909, to September 30, 1926.

Gage.—Recording gage since 1921; chain previously.

Discharge measurements.—Made from bridge.

Control.—Fairly permanent.

Cooperation.—Complete records since 1910 furnished by State engineer.

Monthly discharge of Elk River near Trull, Colo., for 1904–1906 and 1909–1926

Month	Discharge in second-feet			Run-off in acre-feet
	Maximum	Minimum	Mean	
1904				
May 2-31	3,480	1,500	2,170	133,000
June	2,430	1,210	1,750	104,000
July	1,130	260	539	33,100
August	294	97	185	11,400
September	213	80	110	6,540
The period				288,000
1904-5				
October	184	97	137	8,420
November			[a] 125	[a] 7,440
December			[a] 100	[a] 6,150
January			[a] 100	[a] 6,150
February			[a] 105	[a] 5,830
March			[a] 244	[a] 15,000
April			[a] 757	[a] 45,000
May	2,940	940	1,700	105,000
June	3,410	1,520	2,300	137,000
July	2,030	250	667	41,000
August	312	80	146	9,000
September	111	73	85	5,060
The year				391,000
1905-6				
October			[a] 98	[a] 6,030
November			[a] 95	[a] 5,650
December			[a] 85	[a] 5,230
January			[a] 90	[a] 5,530
February			[a] 95	[a] 5,280
March			[a] 163	[a] 10,000
April			[a] 673	[a] 40,000
May	4,280	870	2,630	162,000
June	3,860	1,480	2,590	154,000
July	1,950	295	1,010	62,100
August	355	[a] 150	[a] 206	[a] 12,700
September			[a] 125	[a] 7,440
The year				476,000
1909-10				
October			[a] 130	[a] 7,990
November			[a] 100	[a] 5,950
December			[a] 90	[a] 5,530
January			[a] 90	[a] 5,530
February			[a] 95	[a] 5,280
March	670	[a] 85	[a] 244	[a] 15,000
April	2,400	382	1,190	70,800
May	2,590	1,100	1,640	101,000
June	2,530	505	1,240	73,800
July	405	103	203	12,500
August	180	57	89.1	5,480
September	315	57	107	6,370
The year				315,000
1910-11				
October	128	73	87	5,350
November	91	61	79	4,700
December			[a] 74.4	[a] 4,580
January			[a] 75	[a] 4,610
February			[a] 85	[a] 4,720
March	268	148	[a] 193	[a] 11,900
April	1,950	268	753	44,800
May	3,350	1,140	2,130	131,000
June	3,530	1,220	2,390	142,000
July	1,260	268	619	38,000
August	251	80	159	9,780
September	161	71	105	6,260
The year	3,530		558	408,000

[a] Estimated.

Monthly discharge of Elk River near Trull, Colo., for 1904–1906 and 1909–1926—Continued

Month	Discharge in second-feet			Run-off in acre-feet
	Maximum	Minimum	Mean	
1911–12				
October	1,260	122	347	21,300
November	161	100	133	7,930
December			[a] 100	[a] 6,150
January			[a] 90	[a] 5,530
February			[a] 75	[a] 4,310
March			[a] 160	[a] 9,840
April	1,090	[a] 220	[a] 467	[a] 28,000
May	3,880	1,410	2,610	161,000
June	3,880	1,090	2,700	161,000
July	1,980	670	1,340	82,400
August	595	350	445	27,400
September	370	130	163	9,700
The year				525,000
1912–13				
October	180	155	159	9,780
November	180	180	180	10,700
December			[a] 110	[a] 6,760
January			[a] 85	[a] 5,230
February			[a] 63	[a] 3,500
March			[a] 148	[a] 9,100
April	1,640	390	908	52,000
May	2,800	1,300	1,690	104,000
June	2,600	670	1,440	85,700
July	585	120	314	19,300
August	132	90	110	6,760
September	100	80	96	5,710
The year	2,800			319,000
1913–14				
October	120	80	113	6,950
November	120	110	119	7,080
December			[a] 100	[a] 6,150
January			[a] 95	[a] 5,840
February			[a] 95	[a] 5,280
March			[a] 195	[a] 12,000
April			[a] 790	[a] 47,000
May	3,340		2,440	150,000
June	3,450	1,220	2,530	151,000
July	1,220	290	644	39,600
August	332	132	192	11,800
September	160	90	116	6,820
The year				450,000
1914–15				
October	290	110	226	14,100
November	190	90	121	7,200
December			[a] 100	[a] 6,150
January			[a] 95	[a] 5,840
February			[a] 95	[a] 5,280
March			[a] 180	[a] 11,100
April	1,630	215	804	47,800
May	1,460	675	1,180	72,500
June	1,840	1,340	1,570	93,600
July	1,100	148	450	27,700
August	148	68	112	6,880
September	185	68	124	7,370
The year			422	306,000
1915–16				
October	160	95	124	7,610
November		105	[a] 125	[a] 7,440
December			[a] 90	[a] 5,530
January			[a] 95	[a] 5,840
February			[a] 95	[a] 5,460
March			[a] 320	[a] 19,700
April	3,040	262	1,200	71,400
May	3,620	1,220	2,230	137,000
June	2,840	1,840	2,330	139,000
July	1,980	262	815	50,100
August	1,030	135	288	17,700
September	532	105	173	10,300
The year			648	477,000

[a] Estimated.

Monthly discharge of Elk River near Trull, Colo., for 1904–1906 and 1909–1926—Continued

Month	Discharge in second-feet			Run-off in acre-feet
	Maximum	Minimum	Mean	
1916–17				
October	708	135	273	16,800
November	245	148	187	11,100
December			[a] 110	[a] 6,760
January			[a] 100	[a] 6,150
February			[a] 95	[a] 5,280
March			[a] 228	[a] 14,000
April			[a] 1,010	[a] 60,000
May	4,280	720	2,350	144,000
June	4,280	2,890	3,820	227,000
July	3,600	840	1,940	119,000
August	934	152	362	22,300
September	178	98	130	7,740
The year			884	640,000
1917–18				
October	120	84	97.4	5,990
November	120	78	98.9	5,880
December	120	80	92.2	5,670
January	120	98	110	6,760
February	104	84	92.8	5,150
March	328	88	153	9,410
April	1,110	190	644	38,300
May	2,830	780	2,120	130,000
June	5,000	1,110	2,960	176,000
July	1,050	112	622	38,200
August	178	76	115	7,070
September	120	76	85.3	5,080
The year	5,000	76	600	434,000
1918–19				
October	1,120	120	424	26,100
November	368	92	234	13,900
December			[a] 110	[a] 6,760
January			[a] 110	[a] 6,760
February			[a] 100	[a] 5,550
March			[a] 310	[a] 19,100
April	2,300	775	1,210	72,000
May	2,540	1,520	2,040	125,000
June	1,710	625	1,140	67,800
July	745	84	219	13,500
August	168	50	98.7	6,070
September	69	42	53.2	3,170
The year	2,540		505	366,000
1919–20				
October	79	50	67.4	4,140
November	86	68	76.8	4,570
December	80	60	69.1	4,250
January			[a] 60	[a] 3,690
February			[a] 82	[a] 4,720
March			[a] 95	[a] 5,840
April	850		[a] 415	[a] 24,700
May	5,220	1,510	3,980	245,000
June	4,680	2,480	3,480	207,000
July	2,650	377	1,110	68,200
August	405	173	259	15,900
September	191	113	149	8,870
The year	5,220		823	597,000
1920–21				
October	182	130	151	9,280
November	148	118	134	7,970
December			[a] 115	[a] 7,070
January			[a] 120	[a] 7,380
February			[a] 145	[a] 8,050
March			[a] 275	[a] 16,900
April	1,100	435	718	42,700
May	4,480	1,100	3,120	192,000
June	5,350	1,920	3,410	203,000
July	1,860	374	854	52,500
August	382	96	212	13,000
September	150	70	93.1	5,540
The year	5,350		780	565,000

[a] Estimated

Monthly discharge of Elk River near Trull, Colo., for 1904–1906 and 1909–1926—Continued

Month	Discharge in second-feet			Run-off in acre-feet
	Maximum	Minimum	Mean	
1921–22				
October	82	64	71.9	4,420
November	130	58	84.5	5,030
December			[a] 110	[a] 6,760
January			[a] 100	[a] 6,150
February			[a] 130	[a] 7,220
March			[a] 180	[a] 11,100
April	1,140	180	443	26,400
May	3,800	1,030	2,330	143,000
June	3,460	1,180	2,270	135,000
July	1,030	163	404	24,800
August	210	94	131	8,060
September	114	50	73.5	4,370
The year	3,800		526	382,000
1922–23				
October	92	60	69.1	4,250
November	116	73	87.2	5,190
December			[a] 90	[a] 5,530
January			[a] 96	[a] 5,900
February			[a] 100	[a] 5,550
March			[a] 120	[a] 7,380
April	1,260		544	32,400
May	3,880	1,180	2,520	155,000
June	3,540	1,590	2,570	153,000
July	1,540	328	835	51,300
August	312	101	193	11,900
September	142	72	97.8	5,820
The year	3,880		611	443,000
1923–24				
October	154	122	134	8,240
November	143		110	6,550
December			[a] 90	[a] 5,530
January			[a] 90	[a] 5,530
February			[a] 98	[a] 5,640
March			[a] 110	[a] 6,760
April	928		428	25,500
May	2,400		790	108,000
June	3,170	824	1,830	109,000
July	757	118	331	20,400
August	114	50	77.3	4,750
September	103	44	68.2	4,060
The year				310,000
1924–25				
October	186	86	132	8,120
November	134	98	115	6,840
December			[a] 103	[a] 6,330
January			[a] 102	[a] 6,270
February			[a] 110	[a] 6,110
March			[a] 160	[a] 9,840
April	1,650		894	53,200
May	2,470	1,340	1,850	114,000
June	2,340	1,120	1,590	94,600
July	160	88	492	30,300
August	143	47	80.0	4,920
September	572	63	138	8,210
The year				349,000
1925–26				
October	724	63	156	9,590
November	98	71	82.1	4,890
April	2,280	150	1,010	60,100
May	2,880	824	1,930	119,000
June	3,100	858	1,870	111,000
July	1,000	147	403	24,800
August	172	80	120	7,380
September	100	72	84.2	5,010

[a] Estimated.

BIG CREEK NEAR STEAMBOAT SPRINGS, COLO.

LOCATION.—In sec. 3, T. 7 N., R. 85 W., at footbridge 300 feet above mouth and 9 miles northwest of Steamboat Springs, Routt County.

DRAINAGE AREA.—41 square miles.

RECORDS AVAILABLE.—October 1, 1917, to November 10, 1919.

GAGE.—Vertical staff.

DISCHARGE MEASUREMENTS.—Made from footbridge.

CONTROL.—Practically permanent.

COOPERATION.—Complete records furnished by State engineer.

Monthly discharge of Big Creek near Steamboat Springs, Colo., for 1917–1919

Month	Discharge in second-feet			Run-off in acre-feet
	Maximum	Minimum	Mean	
1917–18				
October			[a] 25	[a] 1,540
November			[a] 20	[a] 1,190
December			[a] 20	[a] 1,230
January			[a] 18	[a] 1,110
February			[a] 18	[a] 1,000
March			[a] 20	[a] 1,230
April			[a] 75	[a] 4,460
May	205		[a] 150	[a] 9,220
June	469	115	304	18,100
July	125	23	66.5	4,090
August	25	7	14.5	892
September	25	7	14.2	845
The year	469		61.9	44,900
1918–19				
October	135	7	30.6	1,880
November	155	12	31.7	1,890
December			[a] 25	[a] 1,540
January			[a] 20	[a] 1,230
February			[a] 20	[a] 1,110
March			[a] 25	[a] 1,540
April	219	18	88.7	5,280
May	350	122	203	12,500
June	194	72	136	8,090
July	72	15	34.6	2,130
August	46	2	13.0	799
September	22	6	8.7	518
The year			53.0	38,500
1919				
October	36	7	14.7	904
November 1–10	52	31	41.1	

[a] Estimated.

MAD CREEK NEAR STEAMBOAT SPRINGS, COLO.

LOCATION.—In sec. 14, T. 7 N., R. 85 W., at highway bridge 6 miles northwest of Steamboat Springs, Routt County. No tributary between station and mouth, a short distance below.

DRAINAGE AREA.—40 square miles.

RECORDS AVAILABLE.—July 1, 1912, to November 30, 1917.

GAGE.—Vertical staff.

DISCHARGE MEASUREMENTS.—Made from bridge.

CONTROL.—Permanent.

COOPERATION.—Complete records furnished by State engineer.

Monthly discharge of Mad Creek near Steamboat Springs, Colo., for 1912–1917

Month	Discharge in second-feet			Run-off in acre-feet
	Maximum	Minimum	Mean	
1912				
July	630	172	344	21,200
August	172	13	50	3,060
September	34	12	19	1,130
The period				25,400
1912–13				
October	48	17	25	1,510
November	48	24	32	1,900
December			15	922
January			[a] 10	[a] 615
February			[a] 5	[a] 278
March			[a] 3	[a] 184
April	182	2	22.6	1,340
May	815	182	348	21,400
June		139	[a] 336	[a] 20,000
July	126	8	56	3,440
August	12	5.5	7.4	455
September	12	5.5	7.2	428
The year	815	2	72.2	52,300
1913–14				
October	23	8	15.1	898
November			[a] 12	[a] 714
December			[a] 10	[a] 615
January			[a] 8	[a] 492
February			[a] 8	[a] 444
March			[a] 15	[a] 922
April			[a] 96	[a] 5,700
May	2,050	126	773	47,500
June	1,580	222	790	47,100
The period				104,000
1914–15				
October			[a] 20	[a] 1,230
November			[a] 20	[a] 1,190
December			[a] 15	[a] 922
January			[a] 10	[a] 615
February			[a] 10	[a] 555
March			[a] 12	[a] 738
April	247	83	[a] 40	[a] 2,380
May	582	74	292	18,000
June	490	222	379	22,600
July	182	12	82	5,040
August	20	7	11.6	713
September	31	6	10.6	631
The year	582		75.3	54,600
1915–16				
October	59	7	19.9	1,220
November	[a] 8	[a] 8	[a] 8	[a] 480
July	755	48	210	12,900
August	117	27	47.7	2,930
September	48	14	32.4	1,930
1916–17				
October	180	14	71.8	4,410
November	27	14	17.8	1,060
December			[a] 12	[a] 738
January			[a] 10	[a] 615
February			[a] 8	[a] 444
March			[a] 15	[a] 922
April	89	58	79.4	4,720
May	385	67	200	12,300
June	1,890	257	932	55,500
July	1,980	143	605	37,200
August	143	17	60.4	3,710
September	30	11	13.1	780
The year	1,980		168	122,000
1917				
October	11	9	9.52	585
November	11	9	9.67	575

[a] Estimated.

TROUT CREEK AT PINNACLE, COLO.

LOCATION.—About sec. 5, T. 3 N., R. 86 W., a quarter of a mile southwest of Pinnacle post office, Routt County. Little Trout Creek enters 3 miles upstream.

DRAINAGE AREA.—27 square miles.

RECORDS AVAILABLE.—April 9, 1910, to December 31, 1911.

GAGE.—Vertical staff.

DISCHARGE MEASUREMENTS.—Made by wading.

CONTROL.—Permanent.

COOPERATION.—Complete records furnished by State engineer.

Monthly discharge of Trout Creek at Pinnacle, Colo., for 1910–11

Month	Discharge in second-feet			Run-off in acre-feet
	Maximum	Minimum	Mean	
1910				
April 9–30	62	12	24.4	1,300
May	354	36	91.8	5,660
June	316	48	145	8,630
July	42	12	24.3	1,480
August	26	12	16.0	984
September	26	9	14.3	833
1910–11				
October	18	6	7.7	474
November	36	2	9.8	583
December			12.0	738
January			[a] 10	[a] 615
February			[a] 8	[a] 444
March	11	7	8.5	526
April	25	7	14	827
May	145	17	65	3,970
June	232	49	112	6,650
July	49	17	24	1,490
August	17	11	14	831
September	14	9	11	662
The year			24.6	17,800
1911				
October	80	7	17	1,060
November	21	7	12	714
December	11	7	11	668
The period				2,440

[a] Estimated.

FISH CREEK AT DUNKLEY, COLO.

LOCATION.—About sec. 15, T. 4 N., R. 87 W., at wagon bridge a quarter of a mile below Dunkley, Routt County.

DRAINAGE AREA.—29 square miles.

RECORDS AVAILABLE.—April 1, 1910, to November 30, 1911.

GAGE.—Vertical staff.

DISCHARGE MEASUREMENTS.—Made from bridge.

CONTROL.—Practically permanent.

COOPERATION.—Complete records furnished by State engineer.

Monthly discharge of Fish Creek at Dunkley, Colo., for 1910–11

Month	Discharge in second-feet			Run-off in acre-feet
	Maximum	Minimum	Mean	
1910				
April	131	19	[a] 45	[a] 2,670
May	131	33.5	60.2	3,700
June	33.5	6.5	13.1	780
July	8.6	2.2	5.0	307
August	3.2	2.2	2.7	166
September	6.7	2.2	3.3	190
The period				7,810
1910–11				
October	8	3.2	5.11	314
November	6.7	4.3	5.71	339
December	[a] 6.7	[a] 5.0	[a] 5.57	[a] 343
January			[a] 5	[a] 307
February			[a] 7	[a] 389
March	92	15	27	1,660
April	53	8	20	1,220
May	134	17	52	3,220
June	23	6	15	912
July	10	1	3.9	240
August	3	1	1.4	85
September	3	1	1.2	71
The year			12.5	9,100
1911				
October	15	1	4.5	274
November	3	.5	1.4	80

[a] Estimated.

FISH CREEK NEAR STEAMBOAT SPRINGS, COLO.

LOCATION.—In sec. 21, T. 6 N., R. 84 W., a quarter of a mile above main highway, 2 miles southeast of Steamboat Springs, Routt County. No tributary between station and mouth.

DRAINAGE AREA.—26 square miles.

RECORDS AVAILABLE.—October 1, 1918, to October 31, 1920.

GAGE.—Chain.

DISCHARGE MEASUREMENTS.—Made from footbridge.

CONTROL.—Permanent.

DIVERSIONS.—None above station.

COOPERATION.—Complete records furnished by State engineer.

Monthly discharge of Fish Creek near Steamboat Springs, Colo., for 1918–1920

Month	Discharge in second-feet			Run-off in acre-feet
	Maximum	Minimum	Mean	
1918–19				
October			[a] 10	[a] 615
November			[a] 12	[a] 714
December			[a] 15	[a] 922
January			[a] 14	[a] 861
February			[a] 12	[a] 666
March			[a] 15	[a] 922
April	220		[a] 174	[a] 3,440
May	690	132	381	23,400
June	690	44	240	14,300
July	35	2	12.6	775
August	35	2	6.52	401
September	22	2	7.97	474
The year			66.8	48,400
1919–20				
October	22	3	8.61	529
November			[a] 10	[a] 595
December			[a] 12	[a] 738
January			[a] 12	[a] 738
February			[a] 12	[a] 690
March			[a] 14	[a] 861
April	49	10	25.4	1,510
May	767	49	331	20,400
June	1,170	522	865	51,500
July	904	28	180	11,100
August	82	6	21.6	1,330
September	36	5	11.8	702
The year			125	90,700
1920				
October	28	9	16.2	996

[a] Estimated.

ELKHEAD CREEK NEAR CRAIG, COLO.

LOCATION.—About sec. 25, T. 7 N., R. 90 W., at highway bridge 1 mile above mouth and 6 miles east of Craig, Moffat County. No tributary between station and mouth.

DRAINAGE AREA.—249 square miles.

RECORDS AVAILABLE.—April 1 to September 30, 1906; October 1, 1909, to November 30, 1918.

GAGE.—Chain.

DISCHARGE MEASUREMENTS.—Made from bridge.

CONTROL.—Practically permanent.

COOPERATION.—Complete records since 1910 furnished by State engineer.

Monthly discharge of Elkhead Creek near Craig, Colo., 1906 and 1909–1918

Month	Discharge in second-feet			Run-off in acre-feet
	Maximum	Minimum	Mean	
1906				
April			[a] 201	[a] 12,000
May	1,080	267	840	51,600
June	629	27	257	15,300
July	29	4	13.5	830
August	3.6	2.6	3.0	184
September	2.8	2.7	2.5	[a] 156
The period				80,000
1909–10				
October			[a] 10	[a] 615
November			[a] 8	[a] 476
December			[a] 7	[a] 430
January			[a] 7	[a] 430
February			[a] 10	[a] 555
March			[a] 50	[a] 3,070
April	1,060	332	[a] 638	[a] 38,000
May	700	179	372	22,900
June	163	1	43	2,570
July	27	.5	2.8	172
August	4	0	.7	43
September	6	0	2.7	161
The year			95.7	69,400
1910–11				
October	30	6	10	615
November	10	3	7.8	464
December			[a] 6	[a] 369
January			[a] 6	[a] 369
February			[a] 8	[a] 444
March			[a] 125	[a] 7,690
April	867	100	364	21,600
May	1,220	294	648	39,800
June	284	15	130	7,740
July	27	6	16	1,010
August	6	0	.9	54
September	.5	0	.05	2
The year			111	80,200
1911–12				
October	94	2	16	970
November	15	6	7.6	450
December			[a] 6	[a] 369
January			[a] 6	[a] 369
February			[a] 6	[a] 345
March	100	6	[a] 20	[a] 1,220
April	642	76	251	14,900
May	1,760	294	1,020	62,700
June	930	41	331	19,700
July	41	6	18	1,080
August	6	2	3	212
September	4	2	2	147
The year			141	102,000
1912–13				
October	20	2	5	294
November	15	1	4	268
December			[a] 3	[a] 184
January			[a] 4	[a] 246
February			[a] 5	[a] 278
March			[a] 100	[a] 6,150
April	904		[a] 370	[a] 22,000
May	788	107	361	22,200
June	101	2.5	30.2	1,800
July	20	1	3.7	228
August	4	.5	1.2	74
September	10	.5	1.6	95
The year			74.5	54,000

[a] Estimated.

Monthly discharge of Elkhead Creek near Craig, Colo., 1906 and 1909–1918—Continued

Month	Discharge in second-feet			Run-off in acre-feet
	Maximum	Minimum	Mean	
1913–14				
October	18	4	7.4	455
November	18	7	11.0	655
December	10	10	10.0	[a] 615
January			[a] 10	[a] 615
February			[a] 10	[a] 555
March	225	46	114	[a] 7,000
April	865	150	388	23,100
May	1,270	460	798	49,000
June	450	38	208	12,400
July	24	6	9.4	583
August	10	3	4.5	276
September	12	3	4.2	252
The year			132	96,000
1914–15				
October	27	4	14.4	885
November	10	4	6.1	361
December			[a] 6	[a] 369
January			[a] 6	[a] 369
February			[a] 6	[a] 333
March	163		[a] 49	[a] 3,000
April	832	139	482	28,700
May	611	180	298	18,400
June	527	14	180	10,700
July	16	4	7.8	480
August	4	1	1.9	117
September	7	1	2.3	137
The year			88.2	63,900
1915–16				
October	7	4	5.4	332
November	7	4	6.3	375
December			[a] 6	[a] 380
January			[a] 6	[a] 369
February			[a] 6	[a] 333
March	[a] 233		[a] 100	[a] 6,150
April	1,240	140	539	32,100
May	1,290	470	714	43,900
June	480	25	211	12,600
July	80	1.0	19.2	1,180
August	65	.5	12.4	762
September	44	1.0	8.7	518
The year			136	99,000
1916–17				
October	97	4.5	33.5	1,990
November			[a] 7	[a] 417
December			[a] 7	[a] 430
January			[a] 6	[a] 369
February			[a] 6	[a] 333
March			[a] 61	[a] 3,750
April	1,060		390	23,200
May	1,550	261	919	56,500
June	1,380	307	863	51,300
July	261	4	61.3	3,770
August	24	.5	4.84	298
September	1.5	.1	.66	39
The year			196	142,000
1917–18				
October	5	.5	1.84	113
November	6	.7	23.7	141
December			[a] 4	[a] 246
January			[a] 5	[a] 307
February			[a] 6	[a] 333
March	377		[a] 110	[a] 6,760
April	595	49	268	15,900
May	1,170	296	615	37,800
June	354	14	120	7,140
July	49	.5	7.84	482
August	1	0	.32	19
September	3	0	.84	50
The year			95.5	69,300
1918				
October	10	1	2.61	160
November	3	1		130
December				

[a] Estimated.

FORTIFICATION CREEK AT CRAIG, COLO.

LOCATION.—On line between Tps. 6 and 7 N., R. 90 W., at highway bridge just east of Craig, Moffat County. No tributary between station and mouth 1 mile below.

DRAINAGE AREA.—256 square miles.

RECORDS AVAILABLE.—Fragmentary records in 1905 and 1906; October 1, 1909, to September 30, 1918.

GAGE.—Chain.

DISCHARGE MEASUREMENTS.—Made from bridge.

CONTROL.—Shifting.

COOPERATION.—Complete records furnished by State engineer

Monthly discharge of Fortification Creek at Craig, Colo., for 1905, 1906, and 1909–1918

Month	Discharge in second-feet			Run-off in acre-feet
	Maximum	Minimum	Mean	
1905				
May	435	0	176	10,500
1906				
May	427	97	263	16,200
June	272	0	117	6,960
1909–10				
October			[a] 4.2	[a] 258
November			[a] 4.4	[a] 262
December			[a] 7.4	[a] 455
January			[a] 8	[a] 492
February			[a] 10	[a] 555
March	507	68	227	14,000
April	234	45	135	8,030
May	136	41	75.1	4,620
June	30	.3	4.1	238
July	38	0	2.1	127
August	0	0	0	0
September	14	0	1.8	107
The year			40.2	29,100
1910–11				
October	14	0	4.19	258
November	9.0	3.5	4.44	262
December	[a] 11	[a] 4.5	[a] 7.4	[a] 455
January			[a] 8	[a] 492
February			[a] 10	[a] 555
March	500		[a] 230	[a] 13,500
April	210	45	98	5,810
May	320	50	137	8,400
June	80	10	39.5	2,350
July	13	0	1.7	102
August	75	0	4.7	288
September	0	0	0	0
The year			42.6	32,500
1911–12				
October	152	6	23	1,420
November	18	12	14	847
December			[a] 10	[a] 615
January			[a] 8	[a] 492
February			[a] 10	[a] 575
March			[a] 130	[a] 7,740
April	400	70	[a] 152	[a] 9,000
May	565	105	365	22,500
June	480	22	170	10,100
July	22	2	7	456
August	15	0	2	147
September	12	2	3	165
The year			74	54,100

[a] Estimated.

Monthly discharge of Fortification Creek at Craig, Colo., for 1905, 1906, and 1909–1918—Continued

Month	Discharge in second-feet			Run-off in acre-feet
	Maximum	Minimum	Mean	
1912–13				
October			[a] 5	[a] 307
November			[a] 5	[a] 298
December			[a] 5	[a] 307
January			[a] 5	[a] 307
February			[a] 7	[a] 389
March			[a] 100	[a] 6,150
April	220	30	[a] 110	[a] 6,500
May	210	25	87	5,350
June	18	0	2.3	137
July	40	0	2.8	172
August	17	0	.5	34
September	35	0	4.00	235
The year			279	20,200
1913–14				
October	25	.5	5.0	307
November	14	1	6.6	393
December	12	[a] 6	[a] 6.8	[a] 418
January			[a] 6	[a] 369
February			[a] 8	[a] 444
March	750	120	[a] 358	[a] 22,000
April	654	115	284	16,900
May	501	175	340	20,900
June	305	5	122	7,260
July	66	1	5.5	337
August	5	0	.7	43
September	5	0	1.1	64
The year			95.8	69,400
1914–15				
October	90	1	[a] 12.2	750
November	10	1	[a] 3.7	[a] 220
December			[a] 7	[a] 430
January			[a] 7	[a] 430
February			[a] 7	[a] 389
March	278	35	[a] 105	[a] 6,500
April	398	108	215	12,800
May	327	61	123	7,560
June	308	0	89	5,310
July	4	0	.5	32
August	47	0	2.4	151
September	0	0	0	0
The year			47.7	34,600
1915–16				
October			[a] 1	[a] 61
November			[a] 2	[a] 119
December			[a] 4	[a] 246
January			[a] 4	[a] 246
February			[a] 10	[a] 575
March	706	50	[a] 260	[a] 16,000
April	456	67	224	13,300
May	456	88	212	13,000
June	112	1.5	41.6	2,480
July	3.0	0	.7	43
August	71	0	10.7	658
September	15	.1	1.6	95
The year			64.5	46,800
1916–17				
October	155	.1	27.4	1,680
November	15	6.0	10.0	595
December			8	492
January			8	492
February			8	444
March			200	12,300
April	711	112	436	25,900
May	631	184	383	23,600
June	467	123	285	17,000
July	134	.6	14.8	910
August	2.0	0	.339	20
September	.6	0	.1	5
The year			115	83,400

[a] Estimated.

Monthly discharge of Fortification Creek at Craig, Colo., for 1905, 1906, and 1909–1918—Continued

Month	Discharge in second-feet			Run-off in acre-feet
	Maximum	Minimum	Mean	
1917–18				
October	1.2	0	0.2	14
November	2.0	0	.8	48
December			2.0	123
January			4	246
February			15	833
March	424	59	163	10,000
April	224	39	86.1	5,120
May	392	71	205	12,600
June	100	3	49	2,920
July	80	0	7.0	430
August	0	0	0	0
September	0	0	0	0
The year			44.6	32,300

WILLIAMS FORK NEAR PYRAMID, COLO.

Location.—About sec. 33, T. 4 N., R. 88 W., at Dunstan ranch, 3 miles north of Pyramid, Rio Blanco County.

Drainage area.—98 square miles (measured on Hayden Atlas).

Records available.—October 1, 1909, to November 30, 1911.

Gage.—Vertical staff.

Discharge measurements.—Made from footbridge.

Control.—Permanent.

Diversions.—Williams high-line ditch diverts water several miles above station. The natural flow is somewhat regulated by Basin Reservoir on the headwaters.

Cooperation.—Complete records furnished by State engineer.

Monthly discharge of Williams Fork near Pyramid, Colo., 1909–1911

Month	Discharge in second-feet			Run-off in acre-feet
	Maximum	Minimum	Mean	
1909–10				
October			[a] 45	[a] 2,770
November			[a] 30	[a] 1,790
December			[a] 25	[a] 1,540
January			[a] 20	[a] 1,230
February			[a] 20	[a] 1,110
March			[a] 40	[a] 2,460
April	518		[a] 168	[a] 10,000
May	790	252	413	25,400
June	790	128	397	23,600
July	128	51	85	5,230
August	86	35	53	3,260
September	99	35	45	2,680
The year	790			81,100
1910–11				
October	51	23	37.1	2,280
November	43	19	29.0	1,730
December	51	13	26.0	1,580
January			[a] 20	[a] 1,230
February			[a] 20	[a] 1,110
March	36	23	30	1,820
April	214	36	78	4,630
May	678	114	349	21,400
June	790	160	387	23,000
July	214	62	130	8,060
August	73	36	46	2,840
September	44	26	35	2,100
The year	790			71,800
1911				
October	214	26	45	2,800
November	36	31	35	2,080

[a] Estimated.

WILLIAMS FORK AT HAMILTON, COLO.

LOCATION.—In sec. 21, T. 5 N., R. 91 W., at highway bridge at Hamilton, Moffat County. Nearest tributary, Marapos Creek, enters a short distance downstream.

DRAINAGE AREA.—341 square miles.

RECORDS AVAILABLE.—May 1, 1904, to October 31, 1906; October 1, 1909, to September 30, 1926.

GAGE.—Chain.

DISCHARGE MEASUREMENTS.—Made from bridge.

CONTROL.—Shifting.

DIVERSIONS.—There are court decrees for diversions of 40 second-feet from Williams Fork above the station, and 7 second-feet below. There are also decrees for diversions of 87 second-feet from tributaries entering above.

COOPERATION.—Complete records since 1910 furnished by State engineer.

Monthly discharge of Williams Fork at Hamilton, Colo., for 1904–1906 and 1909–1926

Month	Discharge in second-feet			Run-off in acre-feet
	Maximum	Minimum	Mean	
1904				
May	1,370	685	1,000	61,700
June	970	345	667	39,700
July	330	75	166	10,200
August	148	59	87	5,350
September	148	21	60	3,570
The period				121,000
1904–5				
October	95	39	61	3,750
November			[a] 60	[a] 3,570
December			[a] 58	[a] 3,570
January			[a] 55	[a] 3,380
February			[a] 58	[a] 3,220
March			[a] 65	[a] 4,000
April	336	70	135	8,030
May	1,680	255	737	45,300
June	1,550	231	745	44,300
July	212	58	115	7,070
August	126	23	46.6	2,860
September	62	23	36.6	2,180
The year			156	131,000
1905–6				
October	102	30	43.6	2,680
November			[a] 45	[a] 2,680
December			[a] 40	[a] 2,460
January			[a] 40	[a] 2,460
February			[a] 45	[a] 2,500
March			[a] 75	[a] 4,610
April	634	89	218	13,000
May	2,580	260	1,340	82,400
June	1,730	514	1,120	66,600
July	480	75	230	14,100
August	126	54	78.4	4,820
September	158	35	74.0	4,400
The year			280	203,000
1906				
October	75	28	53.2	3,270

[a] Estimated.

Monthly discharge of Williams Fork at Hamilton, Colo., for 1904–1906 and 1909–1926—Continued

Month	Discharge in second-feet			Run-off in acre-feet
	Maximum	Minimum	Mean	
1909–10				
October			[a] 70	[a] 4,300
November			[a] 60	[a] 3,570
December			[a] 50	[a] 3,070
January			[a] 45	[a] 2,770
February			[a] 48	[a] 2,670
March			[a] 105	[a] 6,460
April	1,320	272	[a] 421	[a] 25,100
May	1,580	570	840	51,600
June	1,220	196	576	34,300
July	176	57	101	6,210
August	130	42	55	3,380
September	112	35	62	3,690
The year			203	147,000
1910–11				
October	104	50	64	3,940
November	64	50	58	3,450
December			[a] 50	[a] 3,070
January			[a] 45	[a] 2,770
February			[a] 48	[a] 2,670
March	143	74	[a] 101	[a] 6,200
April	470	82	172	10,200
May	1,230	125	737	45,300
June	1,050	215	593	35,300
July	238	58	121	7,440
August	58	30	44	2,690
September	58	36	47	2,810
The year			174	126,000
1911–12				
October	272	19	80	4,910
November 1–11			[a] 46	[a] 2,740
December			[a] 40	[a] 2,460
January			[a] 45	[a] 2,770
February			[a] 45	[a] 2,590
March			[a] 100	[a] 6,150
April	249	116	152	9,050
May	2,060	226	901	55,400
June	1,770	562	1,090	65,000
July	745	215	377	23,200
August	272	74	138	8,510
September	100	58	78	4,630
The year			258	187,000
1912–13				
October	91	74	79	4,890
November	108	74	80	4,770
December			[a] 65	[a] 4,000
January			[a] 55	[a] 3,380
February			[a] 45	[a] 2,500
March			[a] 150	[a] 9,220
April	985	185	472	28,100
May	1,150	415	750	46,100
June	678	155	327	19,500
July	320	65	123	7,560
August	95	50	71	4,370
September	235	50	98	5,830
The year			193	140,000
1913–14				
October	125	45	80.4	4,940
November	50	30	38.0	2,260
December			[a] 35	[a] 2,150
January			[a] 40	[a] 2,460
February			[a] 45	[a] 2,500
March			[a] 71.5	[a] 4,380
April	415	98	226	13,500
May	1,800	328	1,030	63,300
June	1,310	340	762	45,300
July	328	105	180	11,100
August	130	30	64	3,960
September	90	30	51	3,040
The year			220	159,000

[a] Estimated.

Monthly discharge of Williams Fork at Hamilton, Colo., for 1904–1906 and 1909–1926—Continued

Month	Discharge in second-feet			Run-off in acre-feet
	Maximum	Minimum	Mean	
1914–15				
October	150	30	81	4,960
November	75	20	58	3,430
December			[a] 50	[a] 3,070
January			[a] 50	[a] 3,070
February			[a] 50	[a] 2,780
March			[a] 95	[a] 5,840
April	878	98	289	17,200
May	765	215	435	26,700
June	640	202	422	25,100
July	178	31	78.4	4,820
August	82	28	34.5	2,120
September	90	31	46.1	2,740
The year			141	102,000
1915–16				
October	52	34	42.0	2,580
November	75		47.7	[a] 2,640
December			[a] 45	[a] 2,770
January			[a] 50	[a] 3,070
February			[a] 55	[a] 3,160
March	210		[a] 111	[a] 6,800
April	1,070	70	281	16,700
May	1,940	390	956	58,800
June	1,280	510	885	52,700
July	458	76	219	13,500
August	235	64	113	6,950
September	168	52	74.4	4,430
The year			240	174,000
1916–17				
October	272	70	109	6,700
November	100	52	[a] 67	[a] 4,000
December			[a] 55	[a] 3,380
January			[a] 50	[a] 3,070
February			[a] 60	[a] 3,330
March			[a] 80	[a] 4,920
April	604		[a] 265	[a] 15,800
May	2,540	246	1,220	75,000
June	3,190	1,150	2,040	121,000
July	1,330	200	590	36,300
August	222	85	130	7,990
September	123	55	74.2	4,410
The year			395	286,000
1917–18				
October	79	55	61.8	3,800
November	68	63	65.6	3,900
December	75	62	64.0	3,940
January	62	57	61.0	3,750
February	86	57	65.3	3,630
March	120	42	92.5	5,690
April	257	48	153	9,100
May	1,580	270	1,000	61,500
June	1,480	415	955	56,800
July	415	102	223	13,700
August	102	29	52.6	3,230
September	48	29	41.8	2,490
The year			237	172,000
1918–19				
October	98	48	60.4	3,710
November	204	61	118	7,020
April	785	93	281	16,700
May	950	488	686	42,200
June	443	96	252	15,000
July	89	32	45.0	2,770
August	62	32	38.7	2,380
September	48	31	36.2	2,150

[a] Estimated.

Monthly discharge of Williams Fork at Hamilton, Colo., for 1904–1906 and 1909–1926—Continued

Month	Discharge in second-feet			Run-off in acre-feet
	Maximum	Minimum	Mean	
1919–20				
October	142	32	53. 6	3, 300
November	110	96	106	6, 310
December	110	46	68. 6	4, 220
January			[a] 41	[a] 2, 520
February			[a] 56	[a] 3, 220
March			[a] 92	[a] 5, 660
April			[a] 225	[a] 13, 400
May	1, 990	388	1, 240	76, 200
June	1, 950	510	1, 150	68, 400
July	494	50	212	13, 000
August	104	50	53. 1	3, 260
September	80	50	51. 8	3, 080
The year				203, 000
1920–21				
October	61	50	51. 2	3, 150
November			[a] 76. 7	[a] 4, 560
December			[a] 66. 0	[a] 4, 060
January			[a] 53. 0	[a] 3, 260
February			[a] 46. 0	[a] 2, 550
March	96	15	45. 7	2, 810
April	88	15	50. 4	3, 000
May	1, 750	88	964	59, 300
June	1, 640	403	1, 060	63, 000
July	418	80	204	12, 500
August	139	38	68. 8	4, 230
September	80	20	34. 0	2, 020
The year				164, 000
1921–22				
October	33	20	22. 2	1, 360
November	20	20	20. 0	1, 190
December			[a] 28. 0	[a] 1, 720
April	306	33	98. 9	5, 880
May	1, 540	306	824	50, 700
June	1, 060	232	647	38, 500
July	221	38	93	5, 720
August	80	28	38. 6	2, 370
September	80	15	21. 2	1, 260
1922–23				
October	28	15	20. 3	1, 250
November	20	15	18. 0	[a] 1, 070
December			[a] 15. 0	[a] 922
May	1, 580	726	1, 190	73, 200
June	1, 220	353	742	44, 200
July	353	106	212	13, 000
August	144	70	96	5, 900
September	100	55	70. 5	4, 200
1923–24				
October	82	60	70. 5	4, 330
November	70	60	64. 0	3, 810
December	65	60	63. 7	3, 920
April	375	50	174	10, 400
May	1, 210	237	805	49, 500
June	1, 160	160	660	38, 300
July	168	55	90. 9	5, 590
August	60	18	41. 0	2, 520
September	48	20	32. 7	1, 950
1924–25				
October	126	48	74. 1	4, 560
November			[a] 66	[a] 3, 930
March	173		98	6, 030
April	870	132	445	26, 500
May	1, 080	726	850	52, 300
June	670	244	429	25, 500
July	364	72	163	10, 000
August	92	60	75. 5	4, 640
September	187	64	85. 7	5, 100

[a] Estimated.

Monthly discharge of Williams Fork at Hamilton, Colo., for 1904–1906 and 1909–1926—Continued

Month	Discharge in second-feet			Run-off in acre-feet
	Maximum	Minimum	Mean	
1925–26				
October	300	52	75.9	4,670
November	72		59.2	3,520
March	98		70.8	4,350
April	1,080	72	385	22,900
May	1,320	434	916	56,300
June	1,040	178	539	32,100
July	310	72	152	9,350
August	98	44	65.6	4,030
September	44	36	41.3	2,460

MILK CREEK NEAR AXIAL, COLO.

LOCATION.—In sec. 18, T. 4 N., R. 92 W., at highway bridge, 3 miles northeast of Axial, Moffat County. No important tributary between station and mouth.

DRAINAGE AREA.—Not measured.

RECORDS AVAILABLE.—October 1, 1903, to September 30, 1905.

GAGE.—Vertical staff.

DISCHARGE MEASUREMENTS.—Made from bridge.

CONTROL.—Shifting.

Monthly discharge of Milk Creek near Axial, Colo., for 1903–1905

Month	Discharge in second-feet			Run-off in acre-feet
	Maximum	Minimum	Mean	
1903–4				
October			[a] 7	[a] 430
November			[a] 4	[a] 238
December			[a] 3	[a] 184
January			[a] 3	[a] 184
February			[a] 4	[a] 230
March			[a] 10	[a] 615
April	236	104	[a] 100	[a] 5,950
May	218	76	157	9,650
June	143	10	55	3,270
July	8	2	3.6	221
August	87	1	6.7	412
September	17	1	4.8	286
The year			29.9	21,700
1904–5				
October	23	2	6.6	406
November			[a] 4	[a] 238
December			[a] 3	[a] 184
January			[a] 3	[a] 184
February			[a] 4	[a] 222
March			[a] 10	[a] 615
April	123	12	[a] 35.9	[a] 2,140
May	276	97	184	11,300
June	206	4	70.4	[a] 41,900
July	7	2	3.5	215
August	10	4	5	307
September			[a] 4	[a] 238
The year			80	58,000

[a] Estimated.

MIDDLE FORK OF LITTLE SNAKE RIVER NEAR BATTLE CREEK, COLO.

LOCATION.—In sec. 21, T. 12 N., R. 86 W., at county road bridge, 10 miles east of Battle Creek, Routt County.

DRAINAGE AREA.—About 120 square miles.

RECORDS AVAILABLE.—May 1, 1912, to September 30, 1922.

GAGE.—Recording gage.

DISCHARGE MEASUREMENTS.—Made from bridge.

CONTROL.—Practically permanent.

DIVERSIONS.—None above station.

COOPERATION.—Complete records furnished by State engineer.

Monthly discharge of Middle Fork of Little Snake River near Battle Creek, Colo., for 1912–1922

Month	Discharge in second-feet			Run-off in acre-feet
	Maximum	Minimum	Mean	
1912				
May			[a] 750	[a] 46,400
June	1,310	248	649	38,600
July	209	36	98	6,020
August	62	9	22	1,340
September	36	10	20	1,220
The period				93,600
1912–13				
October	40		[a] 27.5	[a] 1,700
November			[a] 20	[a] 1,190
December			[a] 15	[a] 922
January			[a] 15	[a] 922
February			[a] 15	[a] 833
March			[a] 50	[a] 3,070
April	629		[a] 243	[a] 14,500
May	758	261	459	28,200
June	328	120	182	10,800
July			[a] 89	[a] 5,490
August	23	9	15	922
September	23	12	18	1,070
The year			96	69,600
1913–14				
October	49	18	29	1,780
November	[a] 26	[a] 18	[a] 20	[a] 1,180
December			[a] 15	[a] 922
January			[a] 15	[a] 922
February			[a] 15	[a] 833
March			[a] 30	[a] 1,840
April	[a] 416		[a] 185	[a] 11,000
May	1,460	328	881	54,200
June	982	83	391	23,200
July	110	29	50	3,050
August	32	13	20	1,250
September	35	10	19	1,110
The year			139	101,000
1914–15				
October	59	18	38	2,320
November			[a] 24	[a] 1,440
December			[a] 18	[a] 1,110
January			[a] 18	[a] 1,110
February			[a] 18	[a] 1,000
March			[a] 35	[a] 2,150
April			[a] 250	[a] 14,900
May	478	210	331	20,400
June	526	103	298	17,760
July	86	20	42	2,610
August	26	10	15	918
September	29	10	16.5	978
The year			91.8	66,600

[a] Estimated.

Monthly discharge of Middle Fork of Little Snake River near Battle Creek, Colo., for 1912–1922—Continued

Month	Discharge in second-feet			Run-off in acre-feet
	Maximum	Minimum	Mean	
1915–16				
October	26	14	18.5	1,140
November	20	10	13.6	807
December			[a] 13.5	[a] 820
January			[a] 12	[a] 738
February			[a] 12	[a] 690
March			[a] 65	[a] 4,000
April	[a] 824		[a] 235	[a] 14,000
May	1,380	368	696	42,800
June	720	128	433	25,800
July	119	26	55.2	3,390
August	80	16	30.6	1,880
September	50	14	21.7	1,290
The year			134	97,400
1916–17				
October	138	23	45.4	2,790
November			[a] 30	[a] 1,790
December			[a] 20	[a] 1,230
January			[a] 20	[a] 1,230
February			[a] 20	[a] 1,110
March			[a] 50	[a] 3,070
April			[a] 200	[a] 11,900
May			[a] 810	[a] 49,800
June			[a] 1,110	[a] 66,000
July	820	75	253	15,600
August	69	19	34.1	2,100
September	20	12	16.1	958
The year			218	158,000
1917–18				
October			[a] 13	[a] 799
November			[a] 12	[a] 714
December			[a] 12	[a] 738
January			[a] 12	[a] 738
February			[a] 12	[a] 666
March			[a] 50	[a] 3 070
April			[a] 83	[a] 4,900
May	1,050	125	796	48,900
June	850	125	504	30,000
July	125	9	60.3	3,710
August	20	6	10.0	615
September	50	8	16.6	988
The year			134	95,900
1918–19				
October	70	14	27.3	1,680
November			[a] 21	[a] 1,250
December			[a] 18	[a] 1,110
January			[a] 18	[a] 1,110
February			[a] 18	[a] 1,000
March			[a] 80	[a] 4,920
April	[a] 562		[a] 253	[a] 15,000
May	695	406	577	35,500
June	402	36	159	9,460
July	68	9	20.5	1,260
August	12	6	7.2	442
September	8	5	6.2	371
The year			101	73,100
1919–20				
October	12	5	7.6	468
November	10	6	7.5	448
December			[a] 7	[a] 430
January			[a] 8	[a] 492
February			[a] 8	[a] 460
March			[a] 15	[a] 922
April			[a] 29	[a] 1,710
May	2,760	41	1,170	71,900
June	1,460	186	747	44,500
July	131	12	42.5	2,610
August	26	8	10.6	652
September	26	6	9.9	587
The year			172	125,000

[a] Estimated.

Monthly discharge of Middle Fork of Little Snake River near Battle Creek, Colo., for 1912–1922—Continued

Month	Discharge in second-feet			Run-off in acre-feet
	Maximum	Minimum	Mean	
1920–21				
October	24	8	11.5	707
November			14.6	870
December			a 12	a 738
January			a 12	a 738
February			a 12	a 666
March			a 12	a 738
April	46	8	24.5	1,460
May	2,380	46	1,030	63,300
June	1,910	124	810	48,200
July	88	17	51	3,140
August	52	8	15.9	978
September	28	7	9.4	558
The year			168	122,000
1921–22				
October	14	7	8.3	508
November	14	6	7.4	440
December			a 7	a 430
January			a 8	a 492
February			a 8	a 444
March			a 12	a 738
April			a 25	a 1,490
May	1,430	260	704	43,300
June	854	60	427	25,400
July	55	6	18.1	1,110
August	30	6	15.3	941
September	15	4	6.2	369
The year			104	75,700

a Estimated.

LITTLE SNAKE RIVER NEAR DIXON, WYO.

Location.—In sec. 6, T. 12 N., R. 90 W., at highway bridge 1 mile west of Dixon, in Carbon County. No important tributary within several miles.

Drainage area.—1,060 square miles.

Records available.—May 27, 1910, to September 30, 1923.

Gage.—Chain gage on bridge.

Extremes of discharge.—1910–1923: Maximum discharge recorded, 8,960 second-feet during May, 1920. Minimum stage recorded, 0.2 foot on August 6, 1911 (discharge, 5 second-feet).

Diversions.—Prior to July 1, 1921, adjudicated diversions of 101 second-feet from Little Snake River above station and 112 second-feet below.

Cooperation.—Complete records furnished by State engineer of Colorado.

Monthly discharge of Little Snake River near Dixon, Wyo., for 1910–1923

Month	Discharge in second-feet			Run-off in acre-feet
	Maximum	Minimum	Mean	
1910				
May 27-31			1,910	19,000
June	1,900	77	663	39,500
July	149	11	34.3	2,110
August	47	9	16.3	1,000
September	69	17	38.4	2,280
The period				63,990
1910–11				
October	149	55	78.9	4,850
November	95	54	77.3	4,600
December			77.1	4,740
March	488	140	219	13,400
April	2,110	320	830	49,400
May	3,000	1,230	2,150	132,000
June	2,690	400	1,520	90,400
July	360	15	117	7,200
August	22	5	12	758
September	75	10	23	1,350
1911–12				
October	760	65	198	12,200
November	160	75	117	7,000
April	991	193	526	31,300
May	6,140	778	3,240	199,000
June	5,480	1,210	2,910	173,000
July	1,120	122	401	24,600
August	272	20	76	4,680
September	122	20	77	4,560
1912–13				
October	420	82	158	9,700
November	223	100	152	9,220
April	2,320	363	1,350	80,300
May	2,600	1,370	1,890	116,000
June	1,580	163	611	36,400
July	135	11	51	3,140
August	20	8	12.3	756
September	49	11	36.6	2,180
1913–14				
October	135	34	88	5,410
November	135	82	103	6,130
March 22-31	505	163	304	6,020
April	3,430	390	1,570	93,400
May	6,740	2,060	4,160	256,000
June	5,660	580	2,400	143,000
July	580	57	209	12,900
August	122	20	43	2,640
September	82	20	42	2,500
1914–15				
October	330	65	145	8,930
November	122	100	106	6,320
May	2,570	1,040	1,580	97,200
June	2,970	370	1,690	101,000
July	310	8	95.8	5,890
August	15	9	10.2	627
September	120	8	41.6	2,480
1915–16				
October	105	60	78.3	4,810
November	120	70	95.6	5,690
March 13-31	1,070	425	601	22,600
April	3,700	365	1,320	78,600
May	4,370	1,520	2,480	152,000
June	2,660	598	1,660	98,800
July	530	30	189	11,600
August	665	70	198	12,200
September	220	70	96.7	5,750

Monthly discharge of Little Snake River near Dixon, Wyo., for 1910–1923—Contd.

Month	Discharge in second-feet			Run-off in acre-feet
	Maximum	Minimum	Mean	
1916–17				
October	735	90	282	17,300
April	2,660	507	1,200	71,400
May	5,260	760	3,000	184,000
June	4,990	3,100	4,040	240,000
July	2,850	332	1,160	71,300
August	432	30	126	7,750
September	100	38	67.4	4,010
1917–18				
October	140	70	95.6	5,880
November	188	100	136	8,090
March 17–31	638	255	437	13,000
April	1,320	345	653	38,900
May	3,950	1,110	2,790	172,000
June	3,370	358	2,100	125,000
July	358	18	173	10,600
August	21	5.7	9.4	578
September	125	9.1	34.8	2,070
1918–19				
October	381	60	105	6,460
November 1–24	170	96	134	6,380
March 23–31	1,960	702	1,340	23,900
April	3,960	411	1,700	101,000
May	3,420	2,310	2,910	179,000
June	2,510	133	1,020	60,700
July	161	5	31.9	1,960
August	43	5	10.9	670
September	170	6	17.5	1,040
1919–20				
October	337	66	134	8,240
November 1–15	147	124	135	4,026
April	1,180	155	512	30,500
May	8,960	860	5,700	350,000
June	6,840	1,060	3,630	216,000
July	1,230	100	330	20,300
August	112	56	75.5	4,640
September	190	66	94.7	5,640
1920–21				
October	280	100	173	10,600
November	330	125	245	14,600
April	1,090	251	576	34,300
May	6,680	1,290	4,560	280,000
June	6,280	1,010	3,530	210,000
July	908	54	275	16,900
August	203	22	76.3	4,690
September	87	24	47.5	2,830
1921–22				
October	169	38	73.5	4,520
November	74	38	57.8	3,440
March 22–31	------	------	41.4	8,210
April	1,700	184	489	29,100
May	5,110	3,140	3,230	199,000
June	3,280	274	1,780	106,000
July	233	24	68.1	4,190
August	108	22	32.3	1,990
September	34	24	25.8	1,540
1922–23				
October	45	28	33.3	2,050
November	50	34	40.8	2,430
April	942	100	363	21,600
May	4,140	874	2,650	163,000
June	3,420	444	1,790	107,000
July	422	50	198	12,200
August	158	31	48.8	3,000
September	74	31	44.3	2,640

LITTLE SNAKE RIVER NEAR LILY, COLO.

LOCATION.—In sec. 20, T. 7 N., R. 98 W., at highway bridge near mouth of canyon, 6 miles above Lily, Moffat County. No tributary between station and mouth of river at Lily.

DRAINAGE AREA.—Not measured.

RECORDS AVAILABLE.—June 9 to August 14, 1904; May 1, 1922, to September 30, 1926.

GAGE.—Recording gage since 1922; vertical staff in 1904.

DISCHARGE MEASUREMENTS.—Made from bridge.

CONTROL.—Fairly permanent.

COOPERATION.—Complete records furnished by State engineer.

Monthly discharge of Little Snake River near Lily, Colo., for 1904 and 1922–1926

Month	Discharge in second-feet			Run-off in acre-feet
	Maximum	Minimum	Mean	
1904				
June 9–30	2,140	760	1,370	59,800
July	715	63	306	18,800
August 1–14	153	43	64	1,780
September				
The period				80,400
1922				
May	5,650	2,020	3,680	226,000
June	3,980	346	2,200	131,000
July	306	40	108	6,640
August	114	20	44.1	2,710
September	28	14	19.4	1,150
The period				368,000
1922–23				
October	66	20	45.8	2,820
November	59	40	49.0	2,920
May	4,900	2,150	3,120	192,000
June	3,580	694	2,280	136,000
July	598	24	263	16,200
August	122	6	54.7	3,360
September	146	89	136	8,090
1923–24				
October	283	161	199	12,200
November			[a] 120	[a] 7,140
December			[a] 70	[a] 4,300
January			[a] 70	[a] 4,300
February			[a] 90	[a] 5,180
March			[a] 150	[a] 9,220
April			[a] 1,600	[a] 95,200
May	3,580	1,750	2,850	175,000
June	2,940	186	1,210	72,000
July	186	0	92.1	5,660
August	0	0	0	0
September	116	0	8.73	519
The year				391,000
1924–25				
October	130	24	60.5	3,720
April	2,320	968	1,790	107,000
May	2,880	1,350	2,070	127,000
June	2,260	636	1,220	72,600
July	692	207	416	25,600
August	1,070	81	270	16,600
September	721	23	211	12,600
1925–26				
October	1,210	23	385	23,700
April	4,560	730	2,100	125,000
May	8,950	1,620	3,560	219,000
June	4,560	278	1,720	102,000
July	520	24	173	10,600
August	71	12	26.7	1,640
September	350	12	96.8	5,760

[a] Estimated.

SOUTH FORK OF LITTLE SNAKE RIVER NEAR BATTLE CREEK, COLO.

LOCATION.—In sec. 28, T. 12 N., R. 86 W., at Gardner ranch, 10 miles east of Battle Creek, Routt County. No important tributary between station and mouth.

DRAINAGE AREA.—46 square miles.

RECORDS AVAILABLE.—May 1, 1912, to November 30, 1920, at above location. From April 8, 1922 to September 30, 1923, at sec. 1, T. 11 N., R. 87 W., at Flemings, 6 miles above mouth.

GAGE.—Recording gage.

DISCHARGE MEASUREMENTS.—Made from bridge.

CONTROL.—Practically permanent.

COOPERATION.—Complete records furnished by State engineer.

Monthly discharge of South Fork of Little Snake River near Battle Creek, Colo., for 1912–1920 and 1922–23

Month	Discharge in second-feet			Run-off in acre-feet
	Maximum	Minimum	Mean	
1912				
May	280	107	[a] 189	[a] 11,600
June	210	71	135	8,050
July	62	12	33	2,010
August	30	1	7	446
September	12	2	6	355
The period			31.1	22,500
1912–13				
October			[a] 17	[a] 1,070
November			[a] 15	[a] 893
December			[a] 10	[a] 615
January			[a] 10	[a] 615
February			[a] 11	[a] 611
March			[a] 30	[a] 1,840
April	196	8	[a] 126	[a] 7,500
May	164	123	135	8,300
June	113	8	37	2,200
July	13	2	4	246
August	4	1.5	2.5	154
September	8	3	4.2	250
The year			33.5	24,300
1913–14				
October	20	6	10.2	627
November			[a] 13	750
December			[a] 10	[a] 615
January			[a] 10	[a] 615
February			[a] 10	[a] 555
March			[a] 15	[a] 922
April	105		[a] 54	[a] 3,200
May	240	105	174	10,700
June	164	20	78	4,670
July	20	10.5	14	873
August	13	8	9.7	596
September	16	8	12	728
The year			34.3	24,900
1914–15				
October	48	16	24	1,450
November			[a] 15	[a] 900
December			[a] 12	[a] 738
January			[a] 12	[a] 738
February			[a] 12	[a] 666
March			[a] 16	[a] 984
April	[a] 95		[a] 56	[a] 3,300
May	80	46	61	3,750
June	104	14	51	3,040
July	14	3	7.8	482
August	8	3	4.2	260
September	14	3	6.9	411
The year			22.6	16,700

[a] Estimated.

Monthly discharge of South Fork of Little Snake River near Battle Creek, Colo., for 1912–1920 and 1922–23—Continued

Month	Discharge in second-feet			Run-off in acre-feet
	Maximum	Minimum	Mean	
1915–16				
October	14	8	8.9	546
November	26	6	13	785
December			[a] 11.5	[a] 700
January			[a] 10	[a] 615
February			[a] 10	[a] 575
March			[a] 50	[a] 3,070
April			[a] 60.5	[a] 3,600
May	226	76	134	8,240
June	118	30	71.8	4,270
July	25	4.5	12.0	738
August	9	3	4.1	252
September	6	3	4.1	244
The year			32.6	23,600
1916–17				
October	25	3	6.5	400
November			[a] 5	[a] 298
December			[a] 5	[a] 307
January			[a] 5	[a] 307
February			[a] 6	[a] 333
March			[a] 20	[a] 1,230
April			[a] 60	[a] 3,570
May			[a] 120	[a] 7,380
June		79	[a] 202	[a] 12,000
July	79	13	32.2	1,980
August	13	3.4	7.9	486
September	8	2.9	5.1	305
The year			39.5	28,600
1917–18				
October	6.5	5.0	5.2	322
November			[a] 7	[a] 417
December			[a] 7	[a] 430
January			[a] 7	[a] 430
February			[a] 7	[a] 389
March			[a] 8	[a] 492
April	50		[a] 14	[a] 830
May	154	33	90.6	5,570
June	68	7.5	29.8	1,770
July	10	1.5	3.22	204
August	3.5	1.5	1.83	113
September	14	1.5	3.54	211
The year			15.5	11,200
1918–19				
October	28	1.7	5.70	350
November			[a] 7	[a] 417
December			[a] 7	[a] 430
January			[a] 7	[a] 430
February			[a] 7	[a] 389
March			[a] 55	[a] 3,380
April	[a] 184		[a] 101	[a] 6,000
May	184	56	92.0	5,660
June	72	2.7	29.2	1,740
July	9.0	1.4	2.87	176
August	2.1	.4	.86	53
September	5.0	.4	1.27	76
The year			26.4	19,100

[a] Estimated.

Monthly discharge of South Fork of Little Snake River near Battle Creek, Colo., for 1912–1920 and 1922–23—Continued

Month	Discharge in second-feet			Run-off in acre-feet
	Maximum	Minimum	Mean	
1919–20				
October	3.5	0.9	1.32	82
November	.9	.4	.74	44
December			[a] 2	[a] 123
January			[a] 4	[a] 246
February			[a] 4	[a] 230
March			[a] 8	[a] 492
April			[a] 25	[a] 1,490
May	760	66	324	19,900
June	170	24	108	6,430
July	28	3	11.5	707
August	16	1	6.97	429
September	1.5	.8	1.06	63
The year			41.7	30,200
1920				
October	1.1	.8	.95	58
November	1.5	1.0	1.2	71
1922				
April 8–30			9.9	452
May	240	24	108	6,640
June	165	18	68.4	4,070
July	13	4	8.19	503
August	6	1	2.94	181
September	6	1	2.00	119
The period				12,000
1922–23				
October	6	2	3.1	191
November			3.0	179
April	54	8	22.3	1,330
May	174	49	121	7,440
June	124	14	58.9	3,500
July	17	2	6.87	422
August	6	2	3.13	192
September	7	1	2.33	139

[a] Estimated.

SLATER FORK AT BAXTER RANCH, NEAR SLATER, COLO.

LOCATION.—In sec. 22, T. 11 N., R. 89 W., at Baxter ranch, 10 miles south of Slater, Moffat County.

DRAINAGE AREA.—80 square miles.

RECORDS AVAILABLE.—October 1, 1911, to December 30, 1920; May 1, to September 30, 1922.

GAGE.—Recording gage.

DISCHARGE MEASUREMENTS.—Made from bridge.

CONTROL.—Permanent.

DIVERSIONS.—None above station.

COOPERATION.—Complete records furnished by State engineer.

Monthly discharge of Slater Fork at Baxter ranch, near Slater, Colo., for 1911–1920 and 1922

Month	Discharge in second-feet			Run-off in acre-feet
	Maximum	Minimum	Mean	
1911–12				
October			[a] 25	[a] 1,540
November			[a] 20	[a] 1,190
December			[a] 20	[a] 1,230
January			[a] 15	[a] 922
February			[a] 15	[a] 863
March			[a] 40	[a] 2,460
April			[a] 75	[a] 4,460
May	706	88	[a] 373	[a] 22,900
June	441	176	300	17,900
July	201	26	89	5,440
August	46	6	16	1,010
September	35	6	13	779
The year	441	6	83.7	60,700
1912–13				
October			[a] 25	[a] 1,540
November			[a] 20	[a] 1,190
December			[a] 20	[a] 1,230
January			[a] 15	[a] 922
February			[a] 15	[a] 833
March			[a] 40	[a] 2,460
April	336		[a] 142	[a] 8,460
May	336	150	244	15,000
June	172	10	66.7	3,970
July	28	13	19.1	1,170
August	40	22	27.7	1,700
September	40	15	23.3	1,390
The year	336		54.9	39,900
1913–14				
October	40	20	26.2	1,610
November			[a] 25	[a] 1,490
December			[a] 20	[a] 1,230
January			[a] 15	[a] 922
February			[a] 15	[a] 833
March			[a] 40	[a] 2,460
April	305		[a] 146	[a] 8,700
May	745	234	549	33,800
June	700	128	373	22,200
July	118	28	54	3,320
August	32	13	19	1,140
September	25	12	16	934
The year	745		108	78,600
1914–15				
October	50	17	[a] 34	[a] 2,090
November			[a] 25	[a] 1,490
December			[a] 20	[a] 1,230
January			[a] 15	[a] 922
February			[a] 15	[a] 833
March			[a] 40	[a] 2,460
April	280		[a] 185	[a] 11,000
May	440	252	308	18,900
June	458	101	248	14,700
July	86	12	38	2,340
August	34	10	13.5	829
September	49	10	20	1,200
The year	458		80	58,000
1915–16				
October	29	15	21	1,300
November			[a] 26	[a] 1,570
December			[a] 20	[a] 1,230
January			[a] 15	[a] 922
February			[a] 15	[a] 863
March			[a] 40	[a] 2,460
April			[a] 100	[a] 5,950
May			[a] 300	[a] 18,400
June			[a] 311	[a] 18,500
July			[a] 57	[a] 3,500
August	58	13	27.2	1,670
September	26	13	16.8	1,000
The year			79.2	57,400

[a] Estimated.

Monthly discharge of Slater Fork at Baxter ranch, near Slater, Colo., for 1911–1920 and 1922—Continued

Month	Discharge in second-feet			Run-off in acre-feet
	Maximum	Minimum	Mean	
1916–17				
October	134	21	51.1	3,140
November	58		[a] 44	[a] 2,600
December			[a] 30	[a] 1,840
January			[a] 25	[a] 1,540
February			[a] 25	[a] 1,390
March			[a] 40	[a] 2,460
April			[a] 75	[a] 4,460
May	795	40	362	22,200
June	895	396	597	35,500
July	432	33	153	9,410
August	38	15	24.2	1,490
September	22	12	17.2	1,020
The year	895		120	87,000
1917–18				
October	25	15	18.4	1,130
November	25	15	19.6	1,130
December			[a] 15	[a] 922
January			[a] 15	[a] 922
February			[a] 12	[a] 666
March			[a] 40	[a] 2,460
April	114	25	69.6	4,140
May	510	105	354	21,800
June	414	60	268	15,900
July	96	15	44.2	2,720
August	18	7	10.8	664
September	22	6	8.57	510
The year	510		73.1	53,000
1918–19				
October	42	10	21.6	1,330
November	42		[a] 32	[a] 1,900
December			[a] 25	[a] 1,540
January			[a] 20	[a] 1,230
February			[a] 15	[a] 833
March			[a] 60	[a] 3,690
April	240	11	83.2	4,950
May	414	225	329	20,200
June	205	24	121	7,20
July	25	3.4	7.74	478
August	7.6	1.5	2.71	167
September	5.0	1.5	3.20	190
The year	414		60.3	43,700
1919–20				
October	18	4	10.8	664
November	32	12	18.1	1,080
December			[a] 15	[a] 922
January			[a] 12	[a] 738
February			[a] 10	[a] 575
March			[a] 8	[a] 492
April			[a] 8	[a] 476
May	630	28	231	14,200
June	630	200	420	25,000
July	176	30	67.6	4,160
August	44	25	32.0	1,970
September	48	25	36.4	2,170
The year	630		72.3	52,400
1920				
October			[a] 15	[a] 922
November			[a] 15	[a] 893
December			[a] 15	[a] 922
The period				2,740
1922				
May	650	275	451	27,700
June	510	98	336	20,000
July	84	21	44.8	2,750
August	28	14	16.4	1,010
September	12	6	8.6	510
The period				52,000

[a] Estimated.

SLATER FORK NEAR SLATER, COLO.

Location.—About sec. 28, T. 12 N., R. 89 W., at private bridge 3 miles south of Slater, Routt County. No important tributary between station and mouth.
Drainage area.—143 square miles.
Records available.—June 1, 1910, to October 31, 1911.
Gage.—Vertical staff.
Discharge measurements.—Made from bridge.
Control.—Practically permanent.
Cooperation.—Complete records furnished by State engineer.

Monthly discharge of Slater Fork near Slater, Colo., for 1910–11

Month	Discharge in second-feet			Run-off in acre-feet
	Maximum	Minimum	Mean	
1910				
June	490	37	174	10,330
July	37	2	20	1,254
August	20	5	9	528
September	37	8	14	837
The period				12,900
1910–11				
October 1–3	31	12	19	115
November 9–30	25	8	22	938
December 1–9	25	12	20	361
March	50	15	27	1,630
April	440	25	113	6,720
May	1,020	200	534	32,800
June	710	82	354	21,000
July	82	12	32	1,950
August	12	5	6.5	397
September	31	6	12	708
October	170	25	60	3,720

Note.—These figures are from Colorado State Engineers Biennial Report No. 16. Figures given in Water-Supply Paper 289 are taken from Biennial Report No. 15 and were compiled without sufficient data; the above are the corrected estimates.

SAVERY CREEK AT SAVERY, WYO.

Location.—About in sec. 8, T. 12 N., R. 89 W., half a mile east of Savery, in Carbon County. No tributary between station and mouth, 1½ miles below.
Drainage area.—354 square miles (measured on base map of Wyoming).
Records available.—May 1, 1915, to September 30, 1916; April 5, 1918, to September 30, 1922.
Gage.—Vertical staff.
Extremes of discharge.—1915–1916; 1918–1922: Maximum mean daily stage recorded, 5.7 feet May 19, 21, 22, 1921 (discharge, 1,770 second-feet). No flow July 6 to September 3, 1915; August 5–6, August 9 to September 14, 1918.
Diversions.—Prior to July 1, 1921, adjudicated diversions of 64 second-feet from Savery Creek and 13 second-feet from tributaries entering above.
Cooperation.—Complete records furnished by State engineer of Colorado.

Monthly discharge of Savery Creek at Savery, Wyo., for 1915–16 and 1918–1922

Month	Discharge in second-feet			Run-off in acre-feet
	Maximum	Minimum	Mean	
1915				
May	395	164	223	13,700
June	448	46	181	10,800
July	52	0	7.0	430
August	0	0	0	0
September	52	6	16.4	976
The period				25,900
1915–16				
October	39	6	17	1,050
November	46	15	31.8	1,890
December 1–13	65	46	59.5	1,530
March 19–31	264	110	206	5,310
April	896	110	377	22,400
May	793	160	398	24,500
June	264	48	136	8,090
July	25	3	13.3	818
August	25	9	17.8	1,090
September	25	9	15.0	893
1918				
April 5–30	321	56	178	7,300
May	509	202	319	19,600
June	275	18	164	9,760
July	131	.6	339	2,080
August	.6	0	.08	4.9
September	63	0	12.0	714
The period				39,500
1918–19				
October	63	18	30.8	1,890
November 1–21	79	24	50.0	2,080
March 27–31	870	790	834	8,280
April	870	111	507	30,200
May	630	190	362	22,300
June	254	2	94.4	5,620
July	3	0	1.50	92
August	0	0	0	0
September	6	0	.02	12
1919–20				
October	140	18	52.3	3,220
November	50	18	33.8	2,010
April 9–30	650	72	213	9,290
May	1,770	434	1,180	72,600
June	908	50	353	21,000
July	60	4	11.0	676
August	13	2	5.0	307
September	40	3	12.6	750
1920–21				
October	50	24	34.5	2,120
March	220	188	194	3,080
April	622	188	355	21,100
May	1,590	292	1,240	76,200
June	1,300	116	542	32,300
July	92	18	52.4	3,220
August	274	18	79.1	4,860
September	40	18	23.8	1,420
1921–22				
October	40	9	23.8	1,460
November	50	32	35.0	2,080
March			388	9,990
April	472	62	208	12,400
May	994	616	770	47,300
June	508	76	277	16,500
July	76	13	38.6	2,370
August	50	9	18.5	1,140
September	50	18	30.9	1,840

WILLOW CREEK NEAR BAGGS, WYO.

LOCATION.—About sec. 26, T. 11 N., R. 90 W., 2 miles northeast of Ryan ranch and 22 miles southeast of Baggs, Wyo., in Moffatt County, Colo. No important tributary between station and mouth.

DRAINAGE AREA.—About 5 square miles.

RECORDS AVAILABLE.—October 1, 1911, to July 31, 1923.

GAGE.—Recording gage.

DISCHARGE MEASUREMENTS.—Made from footbridge.

CONTROL.—Permanent.

DIVERSIONS.—None above station.

COOPERATION.—Complete records furnished by Colorado State engineer.

Monthly discharge of Willow Creek near Baggs, Wyo., for 1911–1923

Month	Discharge in second-feet			Run-off in acre-feet
	Maximum	Minimum	Mean	
1911–12				
October			[a] 3	[a] 184
November			[a] 3	[a] 179
December			[a] 2	[a] 123
January			[a] 2	[a] 123
February			[a] 1	[a] 58
March			[a] 3	[a] 184
April			[a] 10	[a] 595
May	62	3	30	[a] 1,830
June	128	20	56	3,320
July	28	4	13	805
August	24	4	7	446
September	8	3	6	337
The year	128		11.3	8,180
1912–13				
October	4	3	3	184
November			[a] 2	[a] 119
December			[a] 2	[a] 123
January			[a] 1	[a] 61
February			[a] 1	[a] 56
March			[a] 3	[a] 184
April	26		[a] 16	[a] 950
May	54	14	32.3	1,990
June	36	5.2	14.1	839
July	15	4.4	8.5	523
August	4.4	3.1	3.6	221
September	3.5	2.8	3.1	184
The year	54		7.45	5,400
1913–14				
October	3.8	2.9	3.3	203
November			3	179
December			[a] 2	[a] 123
January			[a] 2	[a] 123
February			[a] 1	[a] 56
March			[a] 3	[a] 184
April	11		[a] 7	[a] 320
May	64	9	31	1,900
June	134	25	58	3,430
July	21	6	11.8	726
August	4	3	3.6	222
September	5	4.2	4.5	267
The year	134		10.2	7,730
1914–15				
October	7	3.5	4.6	286
November	3		[a] 3	[a] 179
December			[a] 2	[a] 123
January			[a] 2	[a] 123
February			[a] 1	[a] 56
March			[a] 3	[a] 184
April	30		[a] 14.4	[a] 850
May	42	10	23	1,410
June	51	17	27	1,630
July	17	2.5	10	617
August	4.5	1	2.1	129
September	8.5	1	4.5	270
The year	51		8.08	5,860

[a] Estimated.

Monthly discharge of Willow Creek near Baggs, Wyo., for 1911–1923—Continued

Month	Discharge in second-feet			Run-off in acre-feet
	Maximum	Minimum	Mean	
1915–16				
October	10	2.5	6.3	388
November			3	179
December			2	123
January			[a] 1	[a] 61
February			[a] 1	[a] 58
March			[a] 3	[a] 184
April	28		[a] 8.5	[a] 500
May	69	8.2	27.3	1,680
June	98	20	54	3,210
July	24	4.1	11.2	689
August	16	1.5	5.5	338
September	2.2	1.0	1.4	83
The year	98		10.3	7,490
1916–17				
October	28	1.2	3.1	191
November	1.8	1.2	1.28	76
December			[a] 1	[a] 61
January			[a] 1	[a] 61
February			[a] 1	[a] 56
March			[a] 1	[a] 61
April			[a] 5	[a] 298
May	73		[a] 56	[a] 3,400
June	88	54	67.2	4,000
July	47	6.2	24.6	1,510
August	7.5	1.5	4.22	259
September	7.5		1.9	110
The year	88		13.9	10,100
1917–18				
October			[a] 2	[a] 123
November			[a] 1	[a] 60
December			[a] 1	[a] 61
January			[a] 1	[a] 61
February			[a] 1	[a] 56
March			[a] 1	[a] 61
April	3.8		[a] 2	[a] 119
May	40	14	25.1	1,540
June	25	12	15.6	928
July	14	6.4	9.14	562
August	12	4.8	7.85	483
September	14	3.8	7.18	427
The year	40		6.18	4,480
1918–19				
October	16	6.4	9.45	581
November			[a] 4.5	[a] 270
December			[a] 3	[a] 184
January			[a] 2	[a] 123
February			[a] 2	[a] 111
March			[a] 5	[a] 307
April	35	6.2	17.0	1,010
May	55	30	43.1	2,650
June	42	14	31.0	1,840
July	19	10	14.3	879
August	13	8	8.83	543
September	14	5	9.67	575
The year	55		12.5	9,100
1919–20				
October	10	5	7.34	451
November			[a] 5	[a] 300
December			[a] 4	[a] 246
January			[a] 3	[a] 184
February			[a] 2	[a] 115
March			[a] 3	[a] 184
April			[a] 7	[a] 417
May			[a] 43	[a] 2,470
June	74	14	35.9	2,140
July	14	1.6	5.60	344
August	7.8	2	3.75	231
September	8.8	4	7.32	436
The year	74		10.4	7,520

[a] Estimated.

Monthly discharge of Willow Creek near Baggs, Wyo., for 1911–1923—Continued

Month	Discharge in second-feet			Run-off in acre-feet
	Maximum	Minimum	Mean	
1920–21				
October	22	4	12.1	744
November			[a] 8	[a] 476
December			[a] 4	[a] 246
January			[a] 3	[a] 184
February			[a] 2	[a] 111
March			[a] 3	[a] 184
April	16		[a] 9	[a] 536
May	59	18	37.2	2,290
June	59	31	46.6	2,770
July	31	18	25.8	1,590
August	20	7	10.6	652
September	10	7	8.7	518
The year	59		14.2	10,300
1921–22				
October	16	5	8.13	500
November	20	7	13.9	827
December			[a] 5	[a] 307
January			[a] 3	[a] 184
February			[a] 2	[a] 111
March			[a] 2	[a] 123
April			[a] 7	[a] 417
May	59		[a] 27	[a] 1,660
June	70	8	32.9	1,960
July	5	3	4	246
August	4	2.5	2.95	181
September	3	1	1.73	103
The year	70		9.12	6,620
1922–23				
October	[a] 2.0	[a] .8	[a] 1.26	[a] 77
June	130	44	93.9	5,590
July	38	8	17.3	1,060

[a] Estimated.

MUDDY CREEK NEAR BAGGS, WYO.

Location.—About in sec. 33, T. 13 N., R. 91 W., at highway bridge 1¼ miles northeast of Baggs, in Carbon County. No tributary between station and mouth, 1 mile below.

Drainage area.—904 square miles (measured on base map of Wyoming).

Records available.—May 1, 1915, to July 30, 1916; April 6 to September 30, 1918.

Gage.—Chain gage on upstream side of single-span bridge.

Extremes of discharge.—1915–16, 1918: Maximum mean daily gage height recorded, 10.0 feet June 23, 1918 (discharge, 445 second-feet). No flow July 20 to August 1, 7–9, 17–31, September 12–13, 16–30, November 20–30, 1915; August 14–17, August 27 to September 23, 1918.

Diversions.—Prior to December 31, 1916, adjudicated diversions of 3 second-feet from Muddy Creek, above station.

Cooperation.—Complete records furnished by State engineer of Colorado.

Monthly discharge of Muddy Creek near Baggs, Wyo., for 1915–16 and 1918

Month	Discharge in second-feet			Run-off in acre-feet
	Maximum	Minimum	Mean	
1915				
May	40	14	23.8	1,460
June	147	.8	38.2	2,280
July	4.2	0	1.0	65
August	3.8	0	.7	44
September	5	0	1.3	78
The period				3,930
1915–16				
October	179	40	90.9	5,590
November	90	0	13.8	821
March 11–31	399	92	250	10,400
April	87	44	67.7	4,030
May	354	44	130	7,990
June	66	.2	11.3	672
July	1.0	.0	.72	44.3
1918				
April 6–30	134	12	25.4	1,760
May	39	12	23.2	1,430
June	445	6	51.1	3,040
July	240	8	56.4	3,470
August	158	0	23.0	1,410
September	392	0	46.2	3,750
The period				13,900

FOURMILE CREEK NEAR BAGGS, WYO.

Location.—In sec. 9, 10 N., R. 90 W., at ranger station near Ryan ranch, 20 miles southeast of Baggs, Wyo.

Drainage area.—About 4 square miles.

Records available.—October 1, 1911, to July 30, 1923.

Gage.—Recording gage.

Discharge measurements.—Made from footbridge.

Control.—Apparently permanent.

Cooperation.—Complete records furnished by State engineer.

Monthly discharge of Fourmile Creek near Baggs, Wyo., for 1911–1923

Month	Discharge in second-feet			Run-off in acre-feet
	Maximum	Minimum	Mean	
1911–12				
October			[a] 1	[a] 61
November			[a] 1	[a] 60
December			[a] 1	[a] 61
January			[a] 1	[a] 61
February			[a] 1	[a] 58
March			[a] 1	[a] 61
April			[a] 5	[a] 298
May	99	2	48	2,750
June	56	8	24	1,460
July	8	4	7	403
August	5	2	2	153
September	2	1	2	117
The year	99		7.37	5,540

[a] Estimated.

Monthly discharge of Fourmile Creek near Baggs, Wyo., for 1911–1923—Continued

Month	Discharge in second-feet			Run-off in acre-feet
	Maximum	Minimum	Mean	
1912–13				
October	2	2	2	123
November			a 1	a 60
December			a 1	a 61
January			a 1	a 61
February			a 1	a 56
March			a 2	a 123
April	53		a 22	a 1,300
May	60	8.5	30.2	1,860
June	24	3.5	74.3	442
July	5.5	2	3.2	197
August	3.5	1.2	2.3	141
September	7	1	4.2	250
The year	60		6.44	4,670
1913–14				
October	3.5	1.2	2.1	129
November	2.5		1.5	89
December			1	61
January			a 1	a 61
February			a 1	a 56
March			a 2	a 123
April	34		a 12.6	a 750
May	85	13.5	51	3,160
June	40	3.5	16.4	978
July	3.5	.5	1.6	97
August	1.5	.8	1.1	66
September	3	.8	1.4	80
The year	85		7.8	5,650
1914–15				
October	2.5	1.2	1.7	103
November	1.5		a 1	a 60
December			a 1	a 61
January			a 1	a 61
February			a 1	a 56
March			a 2	a 123
April	49		a 16	a 952
May	38	8	16	1,000
June	38	5	15	867
July	8	1.5	3.2	198
August	1.5	1	1.2	73
September	3.8	1	1.5	90
The year	49		5.02	3,640
1915–16				
October	2.5	1	1.6	100
November			a 1	a 60
December			a 1	a 61
January			a 1	a 61
February			a 1	a 58
March			a 2	a 123
April	a 44		a 10	a 600
May	62	13	28.1	1,730
June	24	3.8	12.3	732
July	5.0	.5	1.5	92
August	10	.8	3.6	221
September	3.8	1.5	2.1	123
The year	62		5.46	3,960
1916–17				
October	16	2.0	4.6	283
November	5	1.2	1.6	95
December			a 1	a 61
January			a 1	a 61
February			a 1	a 56
March			a 2	a 123
April			a 15	a 893
May	132		a 63	a 3,870
June	123	28	73.9	4,400
July	23	.6	4.08	251
August	1.0	.6	.79	48
September	5.5	.8	2.29	136
The year	132		14.2	10,300

a Estimated.

Monthly discharge of Fourmile Creek near Baggs, Wyo., for 1911–1923—Continued

Month	Discharge in second-feet			Run-off in acre-feet
	Maximum	Minimum	Mean	
1917–18				
October	5.5	2.0	3.08	189
November	4.2	.6	2	119
December			[a] 1	[a] 61
January			[a] 1	[a] 61
February			[a] 1	[a] 56
March			[a] 2	[a] 123
April	10.5	3.0	7	417
May	22	4	11.5	707
June	17.5	3	9.42	560
July	22	1.7	10.1	621
August	4.0	.3	1.09	67
September	4.0	.3	.91	54
The year	22		4.19	3,040
1918–19				
October	3.0	0.5	1.19	73
November	.8	.8	.8	48
December			[a] .8	[a] 49
January			[a] .8	[a] 49
February			[a] .8	[a] 44
March			[a] 2.0	[a] 123
April	21	2.6	8.53	508
May	37	11	22.4	1,380
June	18	.9	6.30	375
July	1.5	.2	.59	36
August	.8	.2	.37	23
September	.8	.3	.40	24
The year	37		3.76	2,730
1919–20				
October	.6	.2	.34	21
November			[a] .3	[a] 18
December			[a] .5	[a] 31
January			[a] .5	[a] 31
February			[a] .5	[a] 29
March			[a] 1.0	[a] 61
April			[a] 10	[a] 595
May	50		[a] 30.2	[a] 1,860
June	50	7.5	22.0	1,310
July	12	1.0	3.15	194
August	1.4	1.0	1.23	76
September	1.7	1.2	1.46	87
The year	50		5.94	4,310
1920–21				
October	1.6	.9	1.26	78
November			[a] 1	[a] 60
December			[a] 1	[a] 61
January			[a] 1	[a] 61
February			[a] 1	[a] 56
March			[a] 2	[a] 123
April	19		[a] 10	[a] 590
May	28	13	20.5	1,260
June	25	15	22.3	1,330
July	19	1.4	3.28	202
August	1.7	1.2	1.43	88
September	2.5	1.2	1.71	102
The year	28		5.53	4,010
1921–22				
October	1.4	1.0	1.24	76
November	2.5	1.4	1.75	104
December			[a] 1.5	[a] 92
January			[a] 1	[a] 61
February			[a] 1	[a] 56
March			[a] 1	[a] 61
April			[a] 6.5	[a] 360
May	53	11	31.6	1,940
June	47	10	22.1	1,320
July	8.6	1.8	4.67	287
August	1.8	.4	1.04	64
September	.8	.4	.62	37
The year	53		6.15	4,460
1922–23				
October	3.6	1.8	1.80	111
June	19	9.5	13.1	780
July	11	3.6	7.10	437

[a] Estimated.

ASHLEY CREEK NEAR VERNAL, UTAH

LOCATION.—In sec. 1, T. 3 S., R. 20 E., three-quarters of a mile above heading of power canal of Utah Power & Light Co.; 4 miles above mouth of Dry Fork, and 12 miles northwest of Vernal, Uintah County.

DRAINAGE AREA.—101 square miles (measured on topographic map).

RECORDS AVAILABLE.—Records are available for a point below mouth of Dry Fork from March 15, 1900, to December 31, 1904; from October 1, 1911, to December 31, 1912; and October 1, 1914, to September 30, 1926.

GAGE.—Stevens continuous water-stage recorder on left bank three-quarters of a mile above heading of power canal installed June 14, 1919; inspected by C. A. Johnston.

DISCHARGE MEASUREMENTS.—Made from cable or by wading near gage.

CHANNEL AND CONTROL.—Bed steep and rough, composed of gravel and cobbles, subject to change during high water. No well-defined control.

EXTREMES OF DISCHARGE.—1911–1926: Maximum discharge, 2,050 second-feet at 9 p. m. May 29, 1921; minimum discharge, 26 second-feet February 7, 1920.

ICE.—None.

DIVERSIONS.—None above station.

REGULATION.—None.

ACCURACY.—Records for estimated periods fair; others good.

During the period from October, 1911, to June, 1914, fragmentary records were obtained at the power plant. Gage heights only for 1913 and 1914 are published in Water-Supply Papers 359 and 389.

Monthly discharge of Ashley Creek near Vernal, Utah, for 1900–1904, 1911–12, 1914–1917, and 1918–1926

Month	Discharge in second-feet			Run-off in acre-feet
	Maximum	Minimum	Mean	
1900				
March 15-31	37	37	37	2,280
April	49	37	40	2,380
May	859	43	478	29,400
June	534	112	245	14,600
July	102	55	74	4,550
August	49	40	45	2,770
September	64	37	43	2,560
The period				58,500
1900-1091				
October	55	43	44	2,710
November	49	40	42	2,500
December	40	37	38	2,340
January	36	36	36	2,210
February	43	36	36	2,000
March	55	34	37	2,280
April	864	34	122	7,260
May	1,136	354	683	42,000
June	460	141	232	13,800
July	141	72	100	6,150
August	932	72	149	9,160
September	131	72	96	5,710
The year	1,136	34	134	98,100

Monthly discharge of Ashley Creek near Vernal, Utah, for 1900–1904, 1911–12, 1914–1917, and 1918–1926—Continued

Month	Discharge in second-feet			Run-off in acre-feet
	Maximum	Minimum	Mean	
1901–2				
October	72	55	62	3,810
November	63	48	58	3,450
December	55	48	52	3,200
January	50	45	45	2,780
February	45	45	45	2,500
March	45	40	42	2,610
April	315	40	78	4,670
May	882	315	533	32,800
June	636	152	306	18,200
July	164	62	108	6,630
August	62	55	56	3,430
September	69	45	52	3,100
The year	882	40	120	87,200
1902–3				
October	55	50	52	3,100
November	55	45	46	2,740
December	45	45	45	2,770
January	45	45	45	2,770
February	45	45	45	2,500
March	69	37	42	2,600
April	315	45	94	5,600
May	1,267	286	602	37,000
June	2,065	236	893	53,100
July	270	105	172	10,600
August	105	58	76.4	4,700
September	105	47	60.2	3,590
The year	2,065	37	181	131,000
1903–4				
October	96	47	63.2	3,890
November	58	38	45.3	2,700
December	31	31	31	1,900
January	31	31	31	1,900
February	71	25	30.9	1,780
March	42	25	26.3	1,620
April	523	31	182	10,800
May	985	176	511	31,400
June	568	126	309	18,400
July	126	87	107	6,580
August	116	71	86.2	5,300
September	205	71	78.8	4,690
The year	985	25	125	91,000
1904				
October	79	58	69.2	4,260
November	71	38	53.3	3,170
December	47	31	36.5	2,240
The period				9,670
1911–12				
October			[a] 92.2	[a] 5,670
November			[a] 57.9	[a] 3,450
December			[a] 44.7	[a] 2,750
January			[a] 35.5	[a] 2,180
February			[a] 31.3	[a] 1,800
March			[a] 30.4	[a] 1,870
April			[a] 36.3	[a] 2,160
August			[a] 63.0	[a] 3,870
September			[a] 56.0	[a] 3,330
1912				
October			[a] 54.0	[a] 3,320
November			[a] 61.2	[a] 3,640
December			[a] 42.4	[a] 2,610
The period				9,570

[a] Estimated.

Monthly discharge of Ashley Creek near Vernal, Utah, for 1900–1904, 1911–12, 1914–1917, and 1918–1926—Continued

Month	Discharge in second-feet			Run-off in acre-feet
	Maximum	Minimum	Mean	
1914–15				
October			[a] 79	[a] 4,860
November			[a] 65	[a] 3,870
December			[a] 44	[a] 2,710
January			[a] 37	[a] 2,280
February			[a] 33	[a] 1,830
March			[a] 30	[a] 1,840
April	290		[a] 109	[a] 6,490
May	855	139	401	24,700
June	710	218	403	24,000
July	226	96	137	8,420
August	92	71	83.5	5,130
September	137	70	88.0	5,240
The year	855		126	91,400
1915–16				
October	93	69	82.4	5,070
November	68	48	57.8	3,440
December	50	40	44.7	2,750
January	40	35	38.5	2,370
February	36		[a] 34.0	[a] 1,950
March	53		[a] 43.3	[a] 2,660
April	381	44	114	6,780
May	585	227	376	23,100
June	452	147	281	16,700
July	143	95	114	7,010
August	112	70	85.8	5,280
September	70	51	60.3	3,590
The year	585		111	80,700
1916–17				
October	193	51	85.8	5,280
November	77	48	61.0	3,630
December	46	42	43.4	2,670
January	42	30	35.6	2,190
February	30	30	30	1,670
March	30	30	30	1,840
April	49	28	36.9	2,200
July 12–31	237	138	185	7,340
August	136	101	120	7,380
September	101	91	95.3	5,670
1918–19				
October			[a] 75	[a] 4,610
November			[a] 55	[a] 3,270
December			[a] 40	[a] 2,460
January			[a] 35	[a] 2,150
February			[a] 30	[a] 1,670
March			[a] 30	[a] 1,840
April			[a] 75	[a] 4,460
May			[a] 225	[a] 13,800
June		80	[a] 115	[a] 6,840
July	80	53	63.2	3,890
August	61	39	49.3	3,030
September	71	37	49.4	2,940
The year			70	51,000
1919–20				
October	67	55	63.3	3,890
November	53		[a] 42.9	[a] 2,550
December			[a] 31.1	[a] 1,910
January	33	31	32.7	2,010
February	33	26	29.3	1,690
March	31	28	28.2	1,730
April	33	28	29.7	1,770
May	1,140	37	493	30,300
June	980	204	503	29,900
July	186	86	112	6,890
August	99	68	76.2	4,690
September	70	57	65.2	3,880
The year	1,140	26	126	91,200

[a] Estimated.

Monthly discharge of Ashley Creek near Vernal, Utah, for 1900–1904, 1911–12, 1914–1917, and 1918–1926—Continued

Month	Discharge in second-feet			Run-off in acre-feet
	Maximum	Minimum	Mean	
1920–21				
October	62	54	56.4	3 470
November	62		[a] 55.8	[a] 3,320
December			[a] 44.9	[a] 2,760
January			[a] 37.8	[a] 2,320
February			[a] 33.2	[a] 1,840
March			[a] 33.6	[a] 2,070
April	53	35	45.3	2,700
May	1,750	57	534	32,800
June	1,690	277	907	54,000
July	262	112	172	10,600
August	175	85	108	6,640
September	172	88	107	6,370
The year	1,750		178	129,000
1921–22				
October	90	69	79.4	4,880
November	70	52	59.5	3,540
December	50	45	47.4	2,910
January	45	39	41.9	2,580
February	39	36	37.8	2,100
March	40	35	36.2	2,230
April	74	37	43.5	2,590
May	1,110	79	541	33,300
June	1,480	335	846	50,300
July	299	107	159	9,780
August	134	103	113	6,950
September	111	84	93.9	5,590
The year	1,480	35	175	127,000
1922–23				
October	86	68	75.4	4,640
November	70	56	62.9	3,740
December	58	48	52.1	3,200
January	48	41	44.3	2,720
February	41	38	39.3	2,180
March	37	33	35.5	2,180
April	69	34	47.0	2,800
May	1,010	69	496	30,500
June	827	257	490	29,200
July	244	125	182	11,200
August	127	58	88.5	5,440
September	62	46	54.6	3,250
The year	1,010	33	140	101,000
1923–24				
October	68	52	61.4	3,780
November		44	[a] 49.0	[a] 2,920
December	45	39	41.9	2,580
January			[a] 36.8	[a] 2,260
February		35	35.7	2,050
March	35	33	34.5	2,120
April		33	[a] 48.8	[a] 2,900
May	538	50	308	18,900
June	283	90	159	9,460
July	92	60	76.7	4,720
August	59	39	46.8	2,880
September		39	40.7	2,420
The year	538	33	78.5	57,000

[a] Estimated.

Monthly discharge of Ashley Creek near Vernal, Utah, for 1900–1904, 1911–12, 1914–1917, and 1918–1926—Continued

Month	Discharge in second-feet			Run-off in acre-feet
	Maximum	Minimum	Mean	
1924–25				
October	40	36	38.7	2,380
November			[a] 35.5	[a] 2,110
December			[a] 32.7	[a] 2,010
January			[a] 30.2	[a] 1,860
February			[a] 30.4	[a] 1,690
March			[a] 29.9	[a] 1,840
April	118	28	57.0	3,390
May	290		231	14,200
June	354	151	198	11,800
July	157	90	110	6,760
August	123	67	82.2	5,050
September	165	69	90.4	5,380
The year	354		80.7	58,500
1925–26				
October	247	82	109	6,700
November	95	63	78.5	4,670
December	63		[a] 52.1	[a] 3,200
January			[a] 38.5	[a] 2,370
February			[a] 31.8	[a] 1,770
March		29	[a] 30.3	[a] 1,860
April	385	30	142	8,450
May	564	190	340	20,900
June	270	100	152	9,040
July		83	97.1	5,970
August	96	61	78.2	4,810
September	61	41	50.5	3,000
The year	564	29	100	72,700

[a] Estimated.

UTAH POWER & LIGHT CO.'S TAILRACE[1] NEAR VERNAL, UTAH

LOCATION.—In NW. ¼ sec. 18, T. 3 S., R. 21 E., at Vernal power plant of Utah Power & Light Co., 10 miles northwest of Vernal, Uintah County. (Acquired in November, 1915, from Vernal Milling & Light Co.)

RECORDS AVAILABLE.—May 3 to September 30, 1917, and March 18, 1920, to September 30, 1926.

GAGE.—Indicating gage installed March 17, 1920, in office of power plant actuated by float in stilling well in tailrace beneath plant; read by employee of Power Co.

DISCHARGE MEASUREMENTS.—Made by wading.

CHANNEL AND CONTROL.—Channel straight for 50 feet below gage. Banks high; one channel at all stages. Bed of gravel and cobbles.

ICE.—None.

ACCURACY.—Records good.

COOPERATION.—Gage-height record furnished by Utah Power & Light Co.

[1] Published prior to 1926 as Vernal Milling & Light Co.'s tailrace near Vernal, Utah.

Monthly discharge of Utah Power & Light Co.'s tailrace near Vernal, Utah, for 1917 and 1920–1926

Month	Discharge in second-feet			Run-off in acre-feet
	Maximum	Minimum	Mean	
1917				
May 3–31	28	14	18.7	1,080
June	18	5.9	15.3	910
July	19	12	16.7	1,030
August	20	11	17.1	1,050
September	21	1.5	16.8	1,000
The period				5,070
1920				
March 18–31	24	21	23.2	643
April	24	5	20.8	1,240
May	23	19	21.4	1,320
June	24	10	22.2	1,320
July	24	10	21.2	1,300
August	24	9	20.9	1,290
September	24	12	21.9	1,300
The period				8,410
1920–21				
October	26	13	23.1	1,420
November	27	21	24.6	1,460
December	27	21	24.8	1,520
January	27	20	23.2	1,430
February	24	15	22.6	1,260
March	24	14	21.8	1,340
April	23	10	21.2	1,260
May	25	4	20.3	1,250
June	25	6	22.9	1,360
July	26	16	23.4	1,440
August	27	18	24.3	1,490
September	27	0	24.0	1,430
The year	27	0	23.0	16,700
1921–22				
October	27	16	25.5	1,570
November	29	18	26.4	1,570
December	29	23	26.9	1,650
January	27	23	25.1	1,540
February	27	17	25.0	1,390
March	26	17	22.5	1,380
April	23	12	20.0	1,190
May	24	16	20.8	1,280
June	25	0	12.2	726
July	26	17	22.5	1,380
August	23	8	19.8	1,220
September	23	18	21.5	1,280
The year	29	0	22.4	16,200
1922–23				
October	27	15	22.5	1,380
November	29	23	26.8	1,590
December	28	22	26.0	1,600
January	27	22	25.3	1,560
February	28	23	25.5	1,420
March	26	18	24.7	1,520
April	26	17	23.1	1,370
May	25	17	22.3	1,370
June	28	18	24.0	1,430
July	30	20	26.3	1,620
August	29	13	25.1	1,540
September	30	24	27.1	1,610
The year	30	13	24.9	18,000
1923–24				
October	31	23	27.6	1,700
November	31	24	29.4	1,750
December	31	26	29.0	1,780
January	29	26	27.3	1,680
February	29	24	26.7	1,540
March	28	16	26.1	1,600
April	26	22	23.8	1,420
May	25	17	23.1	1,420
June	26	22	23.8	1,420
July	27	21	23.7	1,460
August	26	15	24.0	1,480
September	27	22	24.6	1,460
The year	31	15	25.7	18,700

Monthly discharge of Utah Power & Light Co.'s tailrace near Vernal, Utah, for 1917 and 1920–1926—Continued

Month	Discharge in second-feet			Run-off in acre-feet
	Maximum	Minimum	Mean	
1924–25				
October	27	22	25.2	1,550
November	28	23	26.2	1,560
December	28	0	24.5	1,510
January	27	21	24.4	1,500
February	26	22	24.4	1,360
March	26	16	23.9	1,470
April	26	20	24.4	1,450
May	27	21	24.4	1,500
June	27	19	25.2	1,500
July	27	16	24.3	1,490
August	27	19	25.3	1,560
September	28	23	25.8	1,540
The year	28	0	24.8	18,000
1925–26				
October	28	10	26.2	1,610
November	26	21	24.1	1,430
December	26	17	22.9	1,410
January	23	0	17.0	1,050
February	23	19	21.8	1,210
March	24	19	21.5	1,320
April	22	18	20.6	1,230
May	20	17	19.2	1,180
June	22	0	17.7	1,050
July	18	14	15.5	953
August	17	13	15.7	965
September	17	13	15.0	893
The year	28	0	19.7	14,300

NORTH FORK OF DUCHESNE RIVER NEAR HANNA, UTAH

Location.—In NW. ¼ NE. ¼ sec. 35, T. 2 N., R. 9 W., Uinta special base and meridian, 250 feet below Hades Creek, 6 miles above confluence with West Fork, and 10 miles northwest of Hanna, Duchesne County.

Drainage area.—75 square miles (measured on topographic map).

Records available.—August 16, 1921, to September 30, 1923, when station was discontinued.

Gage.—Vertical enamel staff on left bank 10 feet downstream from cable; read by V. R. Savage.

Discharge measurements.—Made from cable or by wading.

Channel and control.—Channel straight for half a mile above gage; makes sharp turn to left 50 feet below gage. One channel at all stages. Bed composed of gravel and small boulders. Right bank high; left bank lower but probably not subject to overflow. Cobble riffle control immediately below gage. Stage of zero flow—0.8 foot; determined October 1, 1921.

Extremes of discharge.—Maximum stage recorded, 4.65 feet at 8 p. m. June 8 and 9, 1922 (discharge, 1,490 second-feet); minimum stage during winter.

Ice.—Stream freezes over each winter.

Diversions.—None.

Regulation.—None.

Accuracy.—Records fair.

Monthly discharge of North Fork of Duchesne River near Hanna, Utah, for 1921–1923

Month	Discharge in second-feet			Run-off in acre-feet
	Maximum	Minimum	Mean	
1921				
August 16–31	74	49	63.6	2,020
September	116	36	54.7	3,250
1921–22				
October	39	26	29.7	1,830
November			[a]23.5	[a]1,400
December			[a]22.1	[a]1,360
January			[a]20.0	[a]1,230
February			[a]20.0	[a]1,110
March			[a]22.0	[a]1,350
April	120	24	40.1	2,390
May	895	94	382	23,500
June	1,490	382	941	56,000
July			[a]270	[a]16,600
August	200	65	121	7,440
September		26	35.0	2,080
The year	1,490		161	116,000
1922–23				
October	26	21	23.2	1,430
November	24	21	21.3	1,270
December			[a]21.8	[a]1,340
January			[a]23.0	[a]1,410
February			[a]25.0	[a]1,390
March			[a]27.1	[a]1,670
April			[a]60.0	[a]3,570
May	935		[a]413	[a]25,400
June	1,270	400	682	40,600
July	589	116	243	14,900
August	108	39	66.6	4,100
September	45	29	34.2	2,040
The year	1,270		137	99,100

[a] Estimated.

DUCHESNE RIVER NEAR TABIONA, UTAH

LOCATION.—In SW. ¼ sec. 17, T. 2 S., R. 6 W., Uinta special base and meridian, at highway bridge 5½ miles above Rock Creek, and 8 miles southeast of Tabiona, Duchesne County.

DRAINAGE AREA.—352 square miles.

RECORDS AVAILABLE.—January 16, 1919, to September 30, 1926.

GAGE.—Stevens steel tape gage on downstream side of bridge; read by Lyman Duke and Leonard Brown.

DISCHARGE MEASUREMENTS.—Made by wading or from bridge.

CHANNEL AND CONTROL.—Channel composed of gravel and sand. Left bank high and not subject to overflow. Right bank overflowed at extremely high stage, allowing water to pass around bridge. Gravel riffle 100 feet below gage forms control.

EXTREMES OF DISCHARGE.—1919–1926: Maximum discharge, about 2,500 second-feet on June 13, 1921; minimum discharge not determined.

ICE.—River freezes over each winter.

DIVERSIONS.—Some small diversions for irrigation above station.

REGULATION.—None.

ACCURACY.—Stage-discharge relation permanent, except for ice effect. Rating curve well defined. Records good.

Monthly discharge of Duchesne River near Tabiona, Utah, for 1919–1926

Month	Discharge in second-feet			Run-off in acre-feet
	Maximum	Minimum	Mean	
1919				
January 16–31			85.7	2,720
February	102	74	88.8	4,930
March	188	74	114.0	7,010
April	312	116	183.0	10,900
May	1,420	374	842.0	51,800
June	785	131	351.0	20,900
July	131	68	96.0	5,900
August	88	61	71.2	4,380
September	211	49	111.0	6,600
The period				115,000
1919–20				
October	148	120	131	8,060
November	124	102	117	6,960
December			[a] 91.4	[a] 5,620
January			[a] 80.0	[a] 4,920
February	102		[a] 91.1	[a] 5,240
March	125	88	106	6,520
April	163	89	130	7,740
May	1,850	165	811	49,900
June	1,900	530	1,130	67,200
July	530	158	292	18,000
August	215	122	153	9,410
September	172	122	148	8,810
The year	1,900		273	198,000
1920–21				
October	186	116	146	8,890
November	156	102	124	7,380
December	127		[a] 107	[a] 6,580
January	103		[a] 95	[a] 5,840
February	220	83	106	5,890
March	223	103	137	8,420
April	195	141	173	10,300
May	1,360	215	676	41,600
June	2,490	1,140	1,660	98,800
July	1,110	190	498	30,600
August	240	190	212	13,000
September	222	188	207	12,300
The year	2,490	83	345	250,000
1921–22				
October	182	140	154	9,470
November	155	139	146	8,690
December	146	126	136	8,360
January	132		[a] 92.3	[a] 5,680
February			[a] 105	[a] 5,830
March	125		[a] 115	[a] 7,070
April	288	108	159	9,460
May		280	[a] 988	[a] 60,800
June		833	[a] 1,580	[a] 94,000
July	824	199	388	23,900
August	255	166	207	12,700
September	244	133	170	10,100
The year			354	256,000
1922–23				
October	161	138	153	6,410
November	162	124	143	8,510
December	142	100	127	7,810
January			[a] 100	[a] 6,150
February			[a] 90	[a] 5,000
March	142	95	113	6,950
April	248	140	198	11,800
May	1,920	227	903	55,500
June	1,920	644	1,130	67,200
July	855	257	469	28,800
August	273	177	195	12,000
September	338	177	197	11,700
The year				228,000

[a] Estimated.

Monthly discharge of Duchesne River near Tabiona, Utah, for 1919–1926—Con.

Month	Discharge in second-feet			Run-off in acre-feet
	Maximum	Minimum	Mean	
1923–24				
October	192	155	175	10,800
November	170	118	139	8,270
December			[a] 127	[a] 7,810
January			[a] 110	[a] 6,760
February			[a] 109	[a] 6,270
March	109	78	100	6,150
April	183	92	153	9,100
May	900	192	567	34,900
June	368	88	224	13,300
July	130	85	107	6,580
August	81	49	62.4	3,840
September	101	50	77.2	4,590
The year			163.0	118,000
1924–25				
October	108	96	102	6,270
November	118	95	108	6,340
December			[a] 101	[a] 6,210
January			[a] 91.7	[a] 6,640
February			[a] 94.3	[a] 5,240
March	116	77	97.1	5,970
April	194	108	144	8,570
May	930	177	514	31,600
June	524	273	367	21,800
July	268	112	190	11,700
August	171	87	107	6,580
September	171	118	143	8,510
The year			172	124,000
1925–26				
October	174	134	149	9,160
November	141	93	110	6,550
December	112	85	100	6,150
January			[a] 80	[a] 4,920
February			[a] 85.8	[a] 4,770
March	127	84	106.0	6,520
April	442	89	199	11,800
May	950	297	557	34,200
June	755	75	332	19,800
July	150	67	96.3	5,920
August	157	40	77.8	4,780
September	89	42	73.8	4,390
The year			164.0	119,000

[a] Estimated.

DUCHESNE RIVER AT DUCHESNE, UTAH

Location.—In NE. ¼ NW. ¼ sec. 1, T. 4 S., R. 5 W., Uinta special base and meridian, at Seventh Street Bridge in Duchesne, Duchesne County, and a quarter of a mile above the mouth of Strawberry River.

Drainage area.—660 square miles.

Records available.—December 3, 1917, to September 30, 1926.

Gage.—Vertical staff gage installed to new datum on left bank bridge abutment May 10, 1924; read by E. S. Winslow.

Discharge measurements.—Made from bridge or by wading.

Channel and control.—Channel straight for 100 feet above gage and for several hundred feet below. Bed composed of gravel and cobbles. The head of a long heavy gravel riffle is a short distance below gage. Banks are low but not subject to overflow.

Extremes of discharge.—1918–1926: Maximum stage recorded, 8.65 feet (chain gage) at noon June 10, 1922 (discharge, 4,420 second-feet); minimum stage recorded 0.6 foot August 4, 5, 7–14, 27–31, and September 1–4, 1924 (discharge, 50 second-feet).

Ice.—Stream freezes every winter.

Diversions.—Numerous diversions above and below station. Rock Creek enters between this station and the station near Tabiona.

Regulation.—None except by diversion.

Accuracy.—Records good except for estimated periods for which they are fair.

Monthly discharge of Duchesne River at Duchesne, Utah, for 1917–1926

Month	Discharge in second-feet			Run-off in acre-feet
	Maximum	Minimum	Mean	
1917–18				
December 3-31	238	140	197	11,300
January	207		[a] 141	[a] 8,670
February			[a] 140	[a] 7,780
March	229	160	195	12,000
April	238	178	200	11,900
May	924	248	610	37,500
June	2,740	640	1,650	98,200
July	774	178	447	27,500
August	248	100	147	9,040
September	468	122	229	13,600
The period				237,000
1918–19				
October	468	207	322	19,800
November	310	222	267	15,900
December	310		[a] 217	[a] 13,300
January			[a] 186	[a] 11,400
February			[a] 200	[a] 11,100
March	310		[a] 224	[a] 13,800
April	495	198	296	17,600
May	2,140	533	1,310	80,600
June	1,300	249	710	42,200
July	241	53	137	8,420
August	282	53	103	6,330
September	282	90	201	12,000
The year	2,140	53	349	252,000
1919–20				
October	327	211	249	15,300
November	241	203	218	13,000
December			[a] 184	[a] 11,300
January			[a] 170	[a] 10,500
February			[a] 200	[a] 11,500
March		154	[a] 187	[a] 11,500
April	304	154	222	13,200
May	2,760	262	1,150	70,700
June	2,820	980	2,000	119,000
July	1,120	205	531	32,600
August	400	170	231	14,200
September	268	188	215	12,800
The year	2,820	154	462	336,000
1920–21				
October	340	205	250	15,400
November	315	225	256	15,200
December	245		[a] 179	[a] 11,000
January			[a] 170	[a] 10,500
February	305		[a] 209	[a] 11,600
March	330	240	272	16,700
April	355	220	290	17,300
May	2,580	260	1,090	67,000
June	4,060	1,820	2,780	165,000
July	1,770	370	910	56,000
August	710	260	364	22,400
September	750	245	320	19,000
The year	4,060		591	427,000

[a] Estimated.

Monthly discharge of Duchesne River at Duchesne, Utah, for 1917–1926—Continued

Month	Discharge in second-feet			Run-off in acre-feet
	Maximum	Minimum	Mean	
1921–22				
October	275	230	249	15,300
November	269	242	248	14,800
December	290	215	257	15,800
January	290		[a] 196	[a] 12,100
February			[a] 209	[a] 11,600
March	260		[a] 233	[a] 14,300
April	550	230	310	18,400
May	4,020	515	2,260	139,000
June	4,420	2,040	3,560	212,000
July	1,860	400	827	50,800
August	570	270	366	22,500
September	400	180	247	14,700
The year	4,420		747	541,000
1922–23				
October	245	180	210	12,900
November	300	220	268	15,900
December	330		[a] 242	[a] 14,900
January			[a] 200	[a] 12,300
February			[a] 175	[a] 9,720
March	225	180	204	12,500
April	410	195	284	16,900
May	2,750	305	1,290	79,300
June	3,530	1,260	2,070	123,000
July	1,980	440	1,100	67,600
August	650	280	408	25,000
September	355	210	263	15,600
The year	3,530		560	406,000
1923–24				
October	470	305	353	21,700
November	330	240	274	16,300
December			[a] 236	[a] 14,500
January			[a] 200	[a] 12,300
February			[a] 207	[a] 11,900
March	195	150	169	10,400
April	280	158	242	14,400
May	2,180	280	1,130	69,500
June	950	166	449	26,700
July	251	59	121	7,440
August	73	50	57.6	3,540
September	145	50	94.0	5,590
The year	2,180	50	295	214,000
1924–25				
October	166	124	135	8,300
November	192	124	157	9,340
December			[a] 148	[a] 9,100
January			[a] 131	[a] 8,060
February			[a] 140	[a] 7,780
March	145	124	130	7,990
April	251	124	166	9,880
May	1,840	145	1,080	66,400
June	1,360	541	937	55,800
July	710	145	323	19,900
August	401	92	158	9,720
September	283	166	208	12,400
The year	1,840	92	311	225,000
1925–26				
October	495	165	237	14,600
November	269	189	213	12,700
December	213	144	198	12,200
January	189	144	160	9,840
February	269	165	218	12,100
March	213	144	193	11,900
April	593	165	283	16,800
May	2,430	409	1,220	75,000
June	1,840	223	888	52,800
July	369	84	206	12,700
August	290	78	141	8,670
September	117	70	87.6	5,210
The year	2,430	70	338	245,000

[a] Estimated.

DUCHESNE RIVER AT MYTON, UTAH

LOCATION.—In NW. ¼ sec. 25, T. 3 S., R. 2 W., Uinta special base and meridian, at highway bridge at Myton, Duchesne County, 3 miles below mouth of Lake Fork, and 15 miles above mouth of Uinta River.

DRAINAGE AREA.—2,750 square miles (measured on topographic map).

RECORDS AVAILABLE.—October 1, 1899, to September 30, 1926, fragmentary.

GAGE.—Chain gage on upstream rail near left end of steel highway bridge; installed August 6, 1910; read by C. J. Preece.

DISCHARGE MEASUREMENTS.—Made from highway bridge or by wading.

CHANNEL AND CONTROL.—Bed of coarse gravel; banks comparatively low, but not likely to be overflowed, although they are subject to erosion during high water. Current comparatively swift and makes an angle with bridge at low stages. Gravel riffle at ford 100 or 200 feet below gage; shifts occasionally.

EXTREMES OF DISCHARGE.—1900–1926: Maximum stage recorded, 7.94 feet at 8 a. m. June 10, 1922 (discharge from extension of rating, 12,800 second-feet); minimum discharge September 4–9, 1924, 6 second-feet.

ICE.—Stage-discharge relation seriously affected by ice every winter.

DIVERSIONS.—Much of the low-water flow of the river and its tributaries is diverted for irrigation above station.

REGULATION.—Annual run-off is affected by storage in the reservoir of the United States Bureau of Reclamation on Strawberry River, one of the main tributaries.

ACCURACY.—Records fair.

Monthly discharge of Duchesne River at Myton, Utah, for 1899–1926

Month	Discharge in second-feet			Run-off in acre-feet
	Maximum	Minimum	Mean	
1899–1900				
October			[a] 403	[a] 24,800
November			[a] 398	[a] 23,700
December			[a] 347	[a] 21,300
January			[a] 370	[a] 22,800
February			[a] 370	[a] 20,500
March	700	315	394	24,200
April	860	350	467	27,800
May	5,880	630	2,330	143,000
June	4,440	600	1,700	101,000
July	570	275	377	23,200
August	350	235	271	16,700
September	450	245	296	17,600
The year	5,880		644	467,000
1900–1901				
October	330	300	313	19,200
November	330	288	305	18,100
December			[a] 342	[a] 21,000
January			[a] 280	[a] 17,200
February			[a] 280	[a] 15,600
March		278	[a] 289	[a] 17,800
April	1,190	247	498	29,600
May	6,680	1,190	3,170	195,000
June	2,860	870	1,480	88,100
July	910	408	597	36,700
August	950	313	453	27,900
September	408	262	307	18,300
The year	6,680		693	504,000

[a] Estimated.

Monthly discharge of Duchesne River at Myton, Utah, for 1899–1926—Continued

Month	Discharge in second-feet			Run-off in acre-feet
	Maximum	Minimum	Mean	
1901–2				
October	439	278	322	19,800
November	355	278	316	18,800
December			[a] 300	[a] 18,400
January			[a] 280	[a] 17,200
February			[a] 280	[a] 15,600
March			[a] 291	[a] 17,900
April	1,360	304	656	39,000
May	5,820	820	1,970	121,000
June	4,900	892	2,240	133,000
July	892	292	555	34,100
August	410	240	273	16,800
September	374	184	258	15,400
The year	5,820		645	467,000
1902–3				
October	320	280	297	18,300
November	332	312	322	19,200
December			[a] 300	[a] 18,400
April 5–30	900	320	456	23,500
May	2,300	665	1,330	81,800
June	4,750	1,580	3,260	194,000
July	1,460	570	912	56,100
August	535	296	375	23,100
September	500	275	329	19,600
1903–4				
October	605	319	383	23,600
November	431	296	353	21,000
December			415	4,120
March 10–31	406	308	335	14,600
April	1,230	323	691	41,100
May	6,080	1,100	2,860	176,000
June	4,880	1,890	3,450	205,000
July	1,830	615	1,030	63,300
August	2,080	423	623	38,300
September	581	269	369	22,000
1904–5				
October	484	355	401	24,700
November	411	313	346	20,600
March 13–31	355	274	313	11,800
April	840	274	448	26,700
May	2,260	643	1,220	75,000
June	5,150	1,300	3,100	184,000
July 1–22	2,150	484	902	39,400
September 24–30	920	219	455	6,320
1905–6				
October	484	313	355	21,800
November 1–28	366	313	319	17,700
April	1,770	423	893	53,600
May	4,970	1,440	3,320	204,000
June	7,320	2,800	4,520	269,000
July 1–10	3,850	2,720	3,140	62,300
1906–7				
April 10–30	2,650	794	2,060	85,800
May	6,000	1,900	3,290	202,000
June	7,610	3,400	5,390	321,000
July	9,560	2,470	5,680	349,000
August	2,440	1,120	1,560	95,900
September	1,400	670	874	52,000
The period				1,110,000
1907–8				
October	792	670	693	42,600
November	670	525	564	33,600
December 1–15	595	525	551	16,400
March 18–31	620	430	490	13,600
April	1,550	430	813	48,400
May	1,490	815	1,160	71,300
June	4,670	845	2,400	143,000
July	2,000	668	1,230	75,600
August	2,440	480	869	53,400
September	850	422	539	32,100

[a] Estimated.

Monthly discharge of Duchesne River at Myton, Utah, for 1899–1926—Continued

Month	Discharge in second-feet: Maximum	Minimum	Mean	Run-off in acre-feet
1908–9				
October	770	602	682	41, 900
November	668	450	522	31, 100
December			527	32, 400
April	1, 480	562	841	50, 000
May	4, 430	1, 080	2, 850	175, 000
June 1–6			5, 740	68, 300
July 10–31	3, 270	2, 100	2, 410	105, 000
August	1, 960	1, 200	1, 490	91, 600
September	3, 270	928	1, 520	90, 400
1909–10				
October	980	775	866	53, 200
November	775	605	731	43, 500
December			637	39, 200
March 12–31	2, 240	875	1, 140	45, 200
April	4, 540	980	2, 110	126, 000
May	5, 440	2, 700	3, 690	227, 000
June	4, 840	875	1, 970	117, 000
July	1, 090	385	588	36, 200
August	685	285	384	23, 600
September	1, 150	285	501	29, 800
1910–11				
October	935	425	533	32, 800
November	480	455	458	27, 300
August	382	193	246	15, 100
September	770	193	255	15, 200
1911–12				
October	605	345	423	26, 000
November	444	262	360	21, 400
December	402	247	343	21, 100
January			[a] 300	[a] 18, 400
February			[a] 280	[a] 16, 100
March	474		[a] 354	[a] 21, 800
April	550	362	423	25, 200
May	4, 020	404	1, 470	90, 400
June	6, 320	2, 700	4, 150	247, 000
July	2, 960	536	1, 090	67, 000
August	598	184	313	19, 200
September	464	222	299	17, 800
The year				591, 000
1912–13				
October	899	292	489	30, 100
November	586	358	456	27, 100
December			[a] 338	[a] 20, 800
January			[a] 280	[a] 17, 200
February			[a] 300	[a] 16, 700
March	1, 300		[a] 408	[a] 25 100
April	1, 110	428	662	39, 400
May	3, 880	767	2, 020	124, 000
June	4, 160	732	1, 660	98, 800
July	1, 790	336	745	45, 800
August	404	184	253	15, 600
September	1, 530	328	657	39, 100
The year				500, 000
1913–14				
October	732	418	525	32, 300
November	598	328	445	26, 500
December			[a] 321	[a] 19, 700
January			[a] 396	[a] 24, 300
February			[a] 380	[a] 21, 100
March	732		[a] 492	[a] 30, 300
April	1, 410	480	947	56, 400
May	5, 940	1, 030	3, 340	205, 000
June	6, 240	1, 660	3, 780	225, 000
July	1, 660	532	1, 030	63, 300
August	710	244	397	24, 400
September	336	244	292	17, 400
The year	6, 240	244	1, 030	746, 000

[a] Estimated.

Monthly discharge of Duchesne River at Myton, Utah, for 1899–1926—Continued

Month	Discharge in second-feet			Run-off in acre-feet
	Maximum	Minimum	Mean	
1914–15				
October	710	442	479	29,500
November	470	253	379	22,600
December	442		[a] 317	[a] 19,500
January			[a] 310	[a] 19,100
February			[a] 320	[a] 17,800
March	448		[a] 356	[a] 21,900
April	1,100	145	554	33,000
May	2,020	523	1,090	67,000
June	3,770	1,280	2,510	149,000
July	1,250	164	507	31,200
August	172	104	133	8,180
September	978	104	379	22,600
The year	3,770	104	610	441,000
1915–16				
October	710	335	471	29,000
November	530	260	373	22,200
December	500	285	377	23,200
January			[a] 370	[a] 22,800
February			[a] 400	[a] 23,000
March			[a] 879	[a] 54,000
April	2,200	620	1,040	61,900
May	3,540	1,430	2,150	132,000
June	4,560	1,130	2,870	171,000
July	995	385	627	38,600
August	955	200	459	28,200
September	350	200	259	16,000
The year	4,560	200	857	622,000
1916–17				
October	1,410	442	659	40,500
November	502	225	410	24,400
December			[a] 278	[a] 17,100
January			[a] 245	[a] 15,100
February			[a] 565	[a] 31,400
March	964		[a] 852	[a] 52,400
April	1,500	442	800	47,600
May	2,820	794	1,710	105,000
June	9,690	2,210	5,770	343,000
July	6,180	754	2,370	146,000
August	1,320	336	528	32,500
September	1,100	346	525	31,200
The year	9,690		1,220	886,000
1917–18				
October	567	431	475	29,200
November	567	442	497	29,600
December	638		[a] 466	[a] 28,700
January			[a] 331	[a] 20,400
February			[a] 390	[a] 21,700
March	508	293	398	24,500
April	508	270	341	20,300
May	1,420	317	830	51,000
June	4,590	844	2,730	162,000
July	1,710	170	680	41,800
August	250	68	129	7,930
September	1,020	56	280	16,700
The year	4,590	56	628	454,000
1918–19				
October	1,010	293	537	33,000
November	606	327	456	27,100
December	640		[a] 415	[a] 25,500
January			[a] 251	[a] 15,400
February			[a] 350	[a] 19,400
March	1,030		[a] 632	[a] 38,900
April	1,110	420	650	38,700
May	3,380	1,010	2,060	127,000
June	1,750	200	770	45,800
July	310	25	109	6,700
August	855	11	139	8,550
September	815	34	292	17,400
The year	3,380	11	556	403,000

[a] Estimated.

Monthly discharge of Duchesne River at Myton, Utah, for 1899–1926—Continued

Month	Discharge in second-feet			Run-off in acre-feet
	Maximum	Minimum	Mean	
1919-20				
October	450	325	372	22,900
November	550		379	22,600
December			[a] 303	[a] 18,600
January			[a] 290	[a] 17,800
February			[a] 375	[a] 21,600
March			[a] 522	[a] 32,100
April	622	390	456	27,100
May	5,500	390	2,210	136,000
June	5,570	1,630	3,290	196,000
July	1,430	335	653	40,200
August	1,340	285	545	33,500
September	420	240	322	19,200
The year	5,570	240	809	588,000
1920-21				
October	645	285	427	26,300
November	645		[a] 497	[a] 29,600
December			[a] 350	[a] 21,500
January			[a] 325	[a] 20,000
February			[a] 486	[a] 27,000
March	1,340		[a] 688	[a] 42,300
April	718	386	559	33,300
May	4,450	703	1,930	119,000
June	9,350	3,900	6,150	366,000
July	3,560	640	1,500	92,200
August	1,610	405	695	42,700
September		304	551	32,800
The year	9,350	285	1,180	853,000
1921-22				
October	578	282	360	22,100
November	486	304	352	20,900
December	695	410	518	31,900
January	540		[a] 400	[a] 24,600
February			[a] 425	[a] 23,600
March			[a] 660	[a] 40,600
April	1,280	365	692	41,200
May	7,040	1,240	3,940	242,000
June	8,770	3,120	6,360	378,000
July	2,410	566	1,010	62,100
August	1,150	416	619	38,100
September	840	328	481	28,600
The year	8,770	282	1,320	954,000
1922-23				
October	587	290	408	25,100
November	706	385	542	32,300
December	601		[a] 508	[a] 31,200
January			[a] 425	[a] 26,100
February			[a] 400	[a] 22,200
March	723		[a] 468	[a] 28,800
April	926	601	755	44,900
May	5,440	854	2,870	176,000
June	7,120	2,190	3,680	219,000
July	2,950	615	1,490	91,600
August	806	323	527	32,400
September	580	258	379	22,600
The year	7,120	258	1,040	752,000
1923-24				
October	783	469	579	35,600
November	601	450	502	29,900
December			[a] 443	[a] 27,200
January			[a] 400	[a] 24,600
February			[a] 480	[a] 27,600
March	587	362	433	26,600
April	755	362	528	31,400
May	3,030	374	1,350	83,000
June	896	42	407	24,200
July	193	8	56.8	3,490
August	161	8	27.6	1,700
September	170	6	73.5	4,370
The year	3,030	6	440	320,000

[a] Estimated.

Monthly discharge of Duchesne River at Myton, Utah, for 1899–1926—Continued

Month	Discharge in second-feet			Run-off in acre-feet
	Maximum	Minimum	Mean	
1924–25				
October	208	124	178	10, 900
November	362	213	268	15, 900
December	351		[a] 276	[a] 17, 000
January			[a] 262	[a] 16, 100
February			[a] 280	[a] 15, 600
March	312	222	278	17, 100
April	274	157	251	14, 900
May	2, 250	165	1, 160	71, 300
June			[a] 1, 050	[a] 62, 50
July			[a] 387	[a] 23, 800
August			[a] 233	[a] 14, 300
September	546	222	346	20, 600
The year	2, 250		414	300, 000
1925–26				
October	922	241	430	26, 400
November	394	309	347	20, 600
December	443	285	343	21, 100
January	348		[a] 298	[a] 18, 300
February			[a] 422	[a] 23, 400
March		267	[a] 334	[a] 20, 500
April	874	292	498	29, 600
May	3, 570	541	1, 490	91, 600
June	3, 000	150	854	50, 800
July	426	26	142	8, 730
August	1, 120	16	170	10, 500
September	107	12	43. 8	2, 610
The year	3, 570	12	448	324, 000

[a] Estimated.

WEST FORK OF DUCHESNE RIVER NEAR HANNA, UTAH

Location.—Near east line in SE. ¼ sec. 27, T. 1 N., R. 9 W., Uinta special base and meridian, a quarter of a mile above Wolf Creek, 3 miles above confluence with North Fork, and 6 miles northwest of Hanna, Duchesne County.

Drainage area.—54 square miles.

Records available.—August 16, 1921, to March 31, 1922, and October 1, 1922, to September 30, 1923, when station was discontinued.

Gage.—Vertical enamel staff on left bank; read by J. T. Murdock.

Discharge measurements.—Made by wading or from bridge 50 feet above gage. One channel at all stages. Bed composed of gravel and cobbles. Left bank high. Right bank may be overflowed during extremely high water. Control, cobble riffle immediately below gage; shifts occasionally. Stage of zero flow at gage height, −0.4 foot, determined September 29, 1921.

Extremes of discharge.—Maximum stage recorded, 2.70 feet at 2 p. m. June 12, 1923 (discharge, 534 second-feet); minimum stage not recorded.

Ice.—Stream usually freezes over at times each winter.

Diversions.—None.

Regulation.—None.

Accuracy.—Records fair.

Monthly discharge of West Fork of Duchesne River near Hanna, Utah, for 1921–1923

Month	Discharge in second-feet			Run-off in acre-feet
	Maximum	Minimum	Mean	
1921				
August 16–31	48	36	38.8	1,230
September	44	26	30.2	1,800
The period				3,030
1921–22				
October	28	23	25.4	1,560
November	22	21	21.1	1,260
December	22	21	21.6	1,330
January	24	22	22.1	1,360
February	24	20	22.7	1,260
March	20	18	18.3	1,130
The period				7,900
1922–23				
October	19	18	18.6	1,140
November	19	16	17.4	1,040
December			[a] 20.0	[a] 1,230
January			[a] 20.0	[a] 1,230
February			[a] 20.0	[a] 1,110
March			[a] 20.0	[a] 1,230
April	58	19	34.5	2,050
May	436	56	223	13,700
June	534	135	260	15,500
July	135	52	89.2	5,480
August	52	33	40.2	2,470
September	38	33	36.2	2,150
The year	534		66.7	48,300

[a] Estimated.

WOLF CREEK NEAR HANNA, UTAH

Location.—Near west line, in SW. ¼ sec. 26, T. 1 N., R. 9 W., Uinta special base and meridian, 600 feet above mouth and 6 miles northwest of Hanna, Duchesne County.

Drainage area.—19 square miles.

Records available.—August 16, 1921, to March 31, 1922; and October 1, 1922, to September 30, 1923, when station was discontinued.

Gage.—Vertical enamel staff on left bank; read by J. T. Murdock.

Discharge measurements.—Made by wading or from bridge 150 feet downstream.

Channel and control.—Channel winding. Bed composed of sand and cobbles. Banks heavily covered with willows which trail in water. Natural open place on left bank at gage and riffle. Trailing willows on right bank cut away at this place. One channel at all stages. Banks may be overflowed during sudden floods. Cobble-riffle control 10 feet below gage, shifts occasionally. Stage of zero flow at gage height 0.0 foot, determined September 29, 1921.

Extremes of discharge.—Maximum stage recorded during period of record, 1.54 feet at 2.30 p. m. May 26, 1923 (discharge, 54 second-feet); minimum discharge, 8 second-feet at numerous times.

Ice.—Seldom forms at this station.

Diversions.—Small ditches divert water for use at Murdock ranch.

Regulation.—None.

Accuracy.—Records good.

Monthly discharge of Wolf Creek near Hanna, Utah, for 1921–1923

Month	Discharge in second-feet			Run-off in acre-feet
	Maximum	Minimum	Mean	
1921				
August 16–31	25	16	16.9	537
September	18	13	13.9	827
1921–22				
October	13	11	11.7	719
November	11	10	10.2	607
December	10	9	9.8	603
January	9	8	8.6	529
February	8	8	8.0	444
March	9	8	8.1	498
The period				3,400
1922–23				
October	14	13	13.0	799
November	14	11	12.1	720
December	11	9	10.0	615
January	9	8	8.6	529
February	9	8	8.1	450
March	8	8	8.0	492
April	11	8	9.2	547
May	54	8	25.2	1,550
June	44	26	31.5	1,870
July	30	14	23.0	1,410
August	15	11	12.8	787
September	13	9	11.4	678
The year	54	8	14.4	10,400

STRAWBERRY RIVER ABOVE MOUTH OF INDIAN CREEK IN STRAWBERRY VALLEY, UTAH

LOCATION.—In the narrows about 3 miles above mouth of Indian Creek and about one-quarter of a mile below the dam site of the Strawberry Valley project.

DRAINAGE AREA.—132 square miles.

RECORDS AVAILABLE.—September 15 to December 31, 1909 (gage heights published in Water-Supply Paper 269); May 1 to November 15, 1910.

GAGE.—Vertical gage on right bank.

Monthly discharge of Strawberry River above mouth of Indian Creek, in Strawberry Valley, Utah, for 1910

Month	Discharge in second-feet			Run-off in acre-feet
	Maximum	Minimum	Mean	
May	476	128	297	18,300
June	120	40	58.2	3,460
July	39	24	29.1	1,790
August	24	18	22.1	1,360
September	40	18	24.8	1,480
October	32	25	28.1	1,730
November 1–15			24.0	714
The period				28,800

STRAWBERRY RIVER BELOW MOUTH OF INDIAN CREEK IN STRAWBERRY VALLEY, UTAH

LOCATION.—Station originally located above junction of Indian Creek and Strawberry River, where it was maintained from May 12, 1903, to July 12, 1906. On October 14, 1908, station was reestablished at a point about 200 feet below mouth of Indian Creek where it was maintained until September 30, 1909, when it was discontinued, and separate records were started on Indian

Creek and Strawberry River. All these stations are at the lower end of Strawberry Valley, about 25 miles northeast of Thistle, the nearest railway point.

RECORDS AVAILABLE.—May 12, 1903, to July 12, 1906; May 1, 1909, to September 30, 1909. No records of gage heights were obtained in 1908.

GAGE.—Vertical staff 20 feet downstream from cable and on right bank.

DISCHARGE MEASUREMENTS.—Made from car and cable.

Monthly discharge of Strawberry River below mouth of Indian Creek, in Strawberry Valley, Utah, for 1903–1906 and 1909

Month	Discharge in second-feet			Run-off in acre-feet
	Maximum	Minimum	Mean	
1903				
May 12-31	271	186	225	8,900
June	298	63	166	9,880
July	63	35	50	3,070
August 1-25	33	25	28	1,390
The period				23,200
1904				
January	27	27	27	1,660
February	27	27	27	1,550
March	27	27	27	1,660
April	224	27	97	5,770
May	472	230	372	22,900
June	257	74	145	8,630
July	74	48	58	3,570
August	48	34	40	2,460
September	33	27	29	1,730
The period				49,900
1904-5				
October	27	27	27	1,660
November	27	27	27	1,610
December	27	27	27	1,660
April	400	68	192	6,860
May	362	139	225	13,800
June	274	50	129	7,680
July	44	27	34.6	2,130
August	29	23	26.1	1,600
September	45	25	30.7	1,830
1905-6				
October	42	29	32.5	2,000
November	38	31	35.0	2,080
December	35	35	35.0	2,150
January	36	14	28.0	1,720
February	34	25	30.0	1,670
March	24	19	20.4	1,250
April	669	18	228	13,600
May	998	517	738	45,400
June	522	142	305	18,100
July 1-12	129	92	108	2,570
The period				90,500
1909				
May	1,750	20	1,070	65,800
June	1,390	263	768	45,700
July	263	101	164	10,100
August	124	67	97	5,960
September	182	56	78.8	4,690
The period				132,000

STRAWBERRY RIVER AT DUCHESNE, UTAH

LOCATION.—In SW. ¼ NE. ¼ sec. 2, T. 4 S., R. 5 W., Uinta special base and meridian, at Winslow ranch, three-quarters of a mile west of post office at Duchesne, Duchesne County, three-quarters of a mile above mouth of Indian Canyon Creek, a small tributary entering from south, and 1½ miles above confluence of Strawberry and Duchesne Rivers.

DRAINAGE AREA.—1,040 square miles (measured on topographic map).

RECORDS AVAILABLE.—June 11, 1908, to November 30, 1910, and March 16, 1914, to September 30, 1926.

GAGE.—Enameled vertical staff installed June 13, 1922, on downstream side of right abutment of bridge; read by E. S. Winslow.

DISCHARGE MEASUREMENTS.—Made from cable just below bridge or by wading.

CHANNEL AND CONTROL.—Channel straight for several hundred feet above and below gage. Bed of sand and fine gravel. Natural channel about 50 feet wide is constricted at bridge to 36 feet. Banks comparatively low; covered with underbrush; left bank subject to overflow at very high stages. Gravel riffle 200 feet below gage; fairly permanent.

EXTREMES OF DISCHARGE.—1908–1926: Maximum stage recorded, 7.7 feet (old datum) on May 27, 1922 (discharge, 3,230 second-feet); minimum discharge, 30 second-feet November 20, 1914. Records obtained prior to 1914 incomplete.

ICE.—Stage-discharge relation affected by ice every winter.

DIVERSIONS.—Water stored in Strawberry Valley Reservoir (capacity, 250,000 acre-feet), about 40 miles above station, is diverted by tunnel to Spanish Fork drainage basin. Some water is also diverted from upper end of Strawberry Valley to Provo River Basin.

REGULATION.—Since 1912 flow of river has been affected by operation of Strawberry Valley Reservoir.

ACCURACY.—Records good.

Monthly discharge of Strawberry River at Duchesne, Utah, for 1908–1910 and 1914–1926

Month	Discharge in second-feet			Run-off in acre-feet
	Maximum	Minimum	Mean	
1908				
June 11–30	519	253	386	15,300
July	410	128	179	11,000
August	475	106	153	9,410
September	190	95	123	7,320
The period				43,000
1908–9				
October	151	116	135	8,300
November	151	116	136	8,090
December			[a] 100	[a] 6,150
April	970	205	451	26,800
May	2,660	660	2,080	128,000
June	2,950	917	1,950	116,000
July	870	352	541	33,300
August	503	290	365	22,400
September	1,520	228	335	19,900
1909–10				
October	240	194	212	13,000
November	263	154	214	12,700
March 10–31	431	263	331	14,400
April	1,860	265	1,090	64,900
May	1,480	620	1,020	62,700
June	585	260	379	22,600
July	305	172	219	13,500
August	248	135	165	10,100
September	380	122	163	9,700
1910				
October	210	148	165	10,100
November	148	135	142	8,450
The period				18,600

[a] Estimated.

Monthly discharge of Strawberry River at Duchesne, Utah, for 1908–1910 and 1914–1926—Continued

Month	Discharge in second-feet			Run-off in acre-feet
	Maximum	Minimum	Mean	
1914				
March 16–31	290	126	204	6,480
April	737	126	437	26,000
May	1,340	556	1,020	62,700
June	948	285	519	30,900
July	300	189	241	14,800
August	252	124	160	9,840
September	136	112	118	7,020
The period				158,000
1914–15				
October	225	105	138	8,480
November	118	45	93.5	5,560
December			[a] 76.5	[a] 4,700
January			[a] 77	[a] 4,730
February			[a] 83	[a] 4,610
March	142		[a] 112	[a] 6,890
April	336	135	209	12,400
May	367	240	305	18,800
June	345	135	244	14,500
July	130	78	102	6,270
August	82	55	68.5	4,210
September	168	57	83.2	4,950
The year	367		133	96,100
1915–16				
October	95	78	86.2	5,300
November	156	81	103	6,130
December	112		[a] 71.7	[a] 4,410
January			[a] 66.0	[a] 4,060
February			[a] 85.0	[a] 4,890
March	475		[a] 305	[a] 18,800
April	1,250	228	463	27,600
May	1,650	763	1,110	68,200
June	763	299	521	31,000
July	367	182	239	14,700
August	613	114	182	11,200
September	114	96	102	6,070
The year	1,650		279	202,000
1916–17				
October	452	121	172	10,600
November	127		[a] 90.7	[a] 5,400
December			[a] 88.5	[a] 5,440
January			[a] 45.0	[a] 2,770
February			[a] 85.0	[a] 4,720
March	335		[a] 175	[a] 10,800
April	687	194	301	17,900
May	1,410	367	886	54,500
June	1,580	687	1,200	71,400
July	613	238	359	22,100
August	251	135	176	10,800
September	540	135	170	10,100
The year	1,580		313	227,000
1917–18				
October	156	135	146	8,980
November	135	135	135	8,030
December	156	135	137	8,420
January	135		[a] 70.3	[a] 4,320
February			[a] 95.0	[a] 5,280
March	178	117	132	8,120
April	201	119	156	9,280
May	292	183	248	15,200
June	384	141	211	12,600
July	238	55	132	8,120
August	156	42	63.5	3,900
September	225	48	79.9	4,750
The year	384	42	134	97,000

[a] Estimated.

Monthly discharge of Strawberry River at Duchesne, Utah, for 1908–1910 and 1914–1926—Continued

Month	Discharge in second-feet			Run-off in acre-feet
	Maximum	Minimum	Mean	
1918–19				
October	223	65	104	6,400
November	88		[a] 78.5	[a] 4,670
December			[a] 49.7	[a] 3,060
January			[a] 46.0	[a] 2,830
February			[a] 70	[a] 3,890
March			[a] 130	[a] 7,990
April	420	122	219	13,000
May	705	310	495	30,400
June	317	97	176	10,500
July	248	52	82.7	5,080
August	326	36	97.2	5,980
September	350	64	107	6,370
The year	705		138	100,000
1919–20				
October	122	80	91.7	5,640
November	97		[a] 83.8	[a] 4,990
December			[a] 63.6	[a] 3,910
January			[a] 75.0	[a] 4,610
February			[a] 80.0	[a] 4,600
March	179	77	[a] 98.9	[a] 6,080
April	209	77	146	8,690
May	1,550	264	926	56,900
June	1,120	314	584	34,800
July	314	146	198	12,200
August	1,000	129	248	15,200
September	434	91	128	7,620
The year	1,550		228	165,000
1920–21				
October	203	91	113	6,950
November	155	82	108	6,430
December			[a] 87.5	[a] 5,380
January			[a] 90	[a] 5,530
February			[a] 137	[a] 7,610
March		152	[a] 212	[a] 13,000
April	416	156	277	16,500
May	1,410	492	962	59,200
June	1,430	387	970	57,700
July	416	156	271	16,700
August	810	137	332	20,400
September	400	127	167	9,940
The year	1,430		311	225,000
1921–22				
October	197	124	133	8,180
November	133	114	121	7,200
December	174	78	126	7,750
January	135	50	84.4	5,190
February			[a] 99.3	[a] 5,510
March			[a] 202	[a] 12,400
April	460	139	227	13,500
May	3,230	498	1,790	110,000
June	2,440	590	1,280	76,200
July	583	223	317	19,500
August	730	169	261	16,000
September	303	148	169	10,100
The year	3,230	50	402	292,000
1922–23				
October	174	137	148	9,100
November	164	123	149	8,870
December			[a] 120	[a] 7,380
January			[a] 100	[a] 6,150
February			[a] 90	[a] 5,000
March	252		[a] 118	[a] 7,260
April	432	214	298	17,700
May	1,620	442	1,190	73,200
June	1,320	363	742	44,200
July	419	193	298	18,300
August	453	147	202	12,400
September	198	127	144	8,570
The year	1,620		301	218,000

[a] Estimated.

Monthly discharge of Strawberry River at Duchesne, Utah, for 1908–1910 and 1914–1926—Continued

Month	Discharge in second-feet			Run-off in acre-feet
	Maximum	Minimum	Mean	
1923–24				
October	200	123	142	8,730
November	151	113	128	7,620
December			[a] 104	[a] 6,400
January			[a] 100	[a] 6,150
February			[a] 110	[a] 6,330
March	147	79	111	6,820
April	252	86	189	11,250
May	274	137	206	12,700
June	127	52	80.4	4,780
July	93	37	55.8	3,430
August	125	37	44.1	2,710
September	54	37	44.1	2,620
The year	274	37	109	79,500
1924–25				
October	69	48	60.2	3,700
November	82	54	70.5	4,200
December	72		54.7	3,360
January			[a] 60.0	[a] 3,690
February			[a] 65.0	[a] 3,610
March	111		[a] 93.2	[a] 5,730
April	188	103	136	8,090
May	196	106	142	8,730
June	176	83	116	6,900
July	710	37	123	7,560
August	565	37	81.8	5,030
September	90	48	56.1	3,340
The year	710	37	88.3	63,900
1925–26				
October	388	52	79.1	4,860
November	87	58	72.5	4,310
December			[a] 65.4	[a] 4,020
January			[a] 60	[a] 3,690
February			[a] 70	[a] 3,890
March	122		[a] 100	[a] 6,150
April	362	73	215	12,800
May	477	144	268	16,500
June	213	46	96.7	5,750
July	383	35	73.5	4,520
August	855	37	121	7,440
September	47	37	38.5	2,290
The year	855	35	105	76,200

[a] Estimated.

INDIAN CREEK IN STRAWBERRY VALLEY, UTAH

LOCATION.—In T. 4 S., R. 11 W., about half a mile above mouth of creek.

DRAINAGE AREA.—About 50 square miles.

RECORDS AVAILABLE.—April 14, 1905, to July 12, 1906, station was about 1 mile above mouth of creek and 500 feet below Trail Hollow Creek; October 1, 1909, to November 15, 1910, station about half a mile farther upstream in T. 4 S. R. 11 W.

GAGE.—Staff driven vertically into bed of creek.

DISCHARGE MEASUREMENTS.—Made from footbridge.

Monthly discharge of Indian Creek in Strawberry Valley, Utah, for 1905–6 and 1909–10

Month	Discharge in second-feet			Run-off in acre-feet
	Maximum	Minimum	Mean	
1905				
April 14–31	56	13	22.3	752
May	42	17	27.1	1,670
June	28	15	20.9	1,240
July	15	12	13.6	836
August	13	11	12.1	744
September	14	10	11.1	660
The period				5,900
1905–6				
October	11	9	9.8	603
November	11	6.5	8.4	500
December	11	11	11.0	676
January	12	7	9.1	560
February	12	8	10.5	583
March	10	8	8.4	516
April	112	15	44.9	2,670
May	257	75	165.0	10,100
June	94	40	59.0	3,510
July 1–12	40	32	36.8	876
The period				20,600
1909–10				
October	27	23	24.1	1,480
November	23	23	23.0	1,370
December			20.0	1,230
May	110	52	86.7	5,330
June	51	36	41.2	2,450
July	35	27	29.3	1,800
August	26	21	23.3	1,430
September	23	21	22.0	1,310
1910				
October	22	19	20.9	1,280
November 1–15			19.0	565

TRAIL HOLLOW CREEK IN STRAWBERRY VALLEY, UTAH

LOCATION.—Just above mouth of stream.

DRAINAGE AREA.—About 21 square miles.

RECORDS AVAILABLE.—October 1, 1909, to November 15, 1910.

GAGE.—Staff.

DISCHARGE MEASUREMENTS.—Made from log bridge 15 feet above gage during high stage; at low and ordinary stages measurements were made by wading.

Monthly discharge of Trail Hollow Creek in Strawberry Valley, Utah, for 1909–10

Month	Discharge in second-feet			Run-off in acre-feet
	Maximum	Minimum	Mean	
1909–10				
October	3.6	3.4	3.52	216
November			[a] 3.40	[a] 202
December			[a] 3.40	[a] 209
May	23.4	2.0	14.40	885
June	8.1	3.3	4.64	276
July	3.3	2.2	2.74	168
August	2.2	1.6	1.90	117
September	2.0	1.6	1.80	107
1910				
October	1.6	1.3	1.57	96
November 1–15	1.3	1.2	1.21	36

[a] Estimated.

RED CREEK NEAR FRUITLAND, UTAH

LOCATION.—In SE. ¼ sec. 21, T. 3 S., R. 8 W., Uinta special base and meridian, 400 feet above State highway crossing at D. S. Murdock's ranch, 1½ miles above confluence with Currant Creek, and 4 miles southeast of Fruitland, Duchesne County.

DRAINAGE AREA.—89 square miles.

RECORDS AVAILABLE.—November 23, 1917, to September 30, 1922.

GAGE.—Vertical enamel staff on left bank 200 feet east of ranch house and 400 feet upstream from road bridge; read by Mrs. A. S. Murdock.

DISCHARGE MEASUREMENTS.—Made by wading.

CHANNEL AND CONTROL.—One channel at all stages. Banks subject to overflow at extremely high water. Left bank overgrown with willows. Right bank sloping meadow. Stream bed composed of silt and sand.

EXTREMES OF DISCHARGE.—1918–1922: Sudden floods of high discharge occur nearly every summer; quantity not determined. Creek practically dry a part of each summer.

ICE.—Stream freezes over every winter.

DIVERSIONS.—Below all diversions from Red Creek.

REGULATION.—None except by diversion.

ACCURACY.—Records good.

Monthly discharge of Red Creek near Fruitland, Utah, for 1917–1922

Month	Discharge in second-feet			Run-off in acre-feet
	Maximum	Minimum	Mean	
1917–18				
November 23–30	23	14	16.0	254
December			[a] 11.9	[a] 732
January			[a] 11.0	[a] 676
February			[a] 10.0	[a] 555
March	15	9.7	[a] 12.0	[a] 738
April	25	13	19.1	1,140
May	21	12	16.1	990
June	15	3.2	9.10	541
July	5.2	.2	3.41	210
August	10	.1	3.18	196
September	27	3.4	7.60	452
The period				6,480
1918–19				
October	56	8	10.9	670
November	25		[a] 9.50	[a] 565
December			[a] 8.00	[a] 492
January			[a] 6.48	[a] 398
February			[a] 5.57	[a] 309
March			[a] 13.4	[a] 824
April	47	14	27.2	1,620
May	72	18	42.9	2,640
June	16	0	3.33	198
July	250	0	9.03	555
August		3	24.5	1,510
September	14	6	6.70	399
The year	250	0	14.1	10,200
1919–20				
October	14	6	7.23	445
November	15	8	[a] 12.0	[a] 714
December			[a] 6.55	[a] 403
January			[a] 8.06	[a] 496
February			[a] 5.00	[a] 288
March	13	1	[a] 5.10	[a] 314
April	15	7	11.3	672
May	120	19	69.0	4,240
June	61	4	21.3	1,270
July	4	1	2.61	160
August	200	3	14.1	867
September	20	5	7.47	444
The year	200	1	14.2	10,300

[a] Estimated.

Monthly discharge of Red Creek near Fruitland, Utah, for 1917–1922—Continued

Month	Discharge in second-feet			Run-off in acre-feet
	Maximum	Minimum	Mean	
1920–21				
October	29	11	14.1	867
November	16		[a] 15.5	[a] 922
December			[a] 10.0	[a] 615
January			[a] 8.0	[a] 492
February			[a] 14.3	[a] 794
March		10	[a] 21.4	[a] 1,320
April	18	14	16.6	988
May	104	16	59.7	3,670
June	92	6	41.9	2,490
July	30	2	8.06	496
August	200	0	21.5	1,320
September	29	14	14.9	887
The year	200	0	20.5	14,900
1921–22				
October	14	10	13.8	848
November		10	12.7	756
December			[a] 11.0	[a] 676
January			[a] 8.0	[a] 492
February		2	[a] 5.5	[a] 305
March	42	1	8.6	529
April	76	7	24.7	1,470
May	193	19	96.8	5,950
June	123		64.4	3,830
July	32	7	14.8	910
August		6	27.4	1,680
September	38	13	18.0	1,070
The year			25.6	18,500

[a] Estimated.

ANTELOPE CREEK NEAR MYTON, UTAH

Location.—In SE. ¼ sec. 10, T. 4 S., R. 3 W., Uinta special base and meridian, at crossing of Gray Mountain Canal over creek, 1¼ miles above mouth, and 10 miles west of Myton, Duchesne County.

Drainage area.—Not measured.

Records available.—December 1, 1917, to July 15, 1921, when record was discontinued.

Gage.—Vertical staff on right bank nailed to column of flume of Gray Mountain Canal; read by Anthon Tucker.

Discharge measurements.—Made by wading. High water can be measured from wagon bridge 25 feet above gage.

Channel and control.—Channel is composed of hard clay and is straight for a few feet above and below gage. Banks high and not subject to overflow.

Extremes of discharge.—Maximum discharge not determined. Creek dry a large part of each year.

Ice.—Considerable ice during winter.

Diversions.—Station is below all diversions.

Regulation.—None except that caused by numerous small diversions above.

Accuracy.—Records fair.

Monthly discharge of Antelope Creek near Myton, Utah, for 1917–1921

Month	Discharge in second-feet			Run-off in acre-feet
	Maximum	Minimum	Mean	
1917–18				
December	12	7.1	9.41	579
January	9.2		[a] 7.71	[a] 474
February			[a] 6.87	[a] 381
March	6.2	.2	2.70	166
August	.4	.0	.23	14
September	2.5	.0	.47	28
The period				1,640
1918–19				
October	4.2	.2	.91	56
November	4.2	3.5	3.67	219
December	3.5		[a] 3.22	[a] 198
January		1.7	[a] 2.16	[a] 133
February	1.7	1.7	1.70	94
March	3.5	1.7	2.52	155
April	3.0	0	.40	24
May	.2	0	.10	6
June	.2	.2	.20	12
The year	4.2	0	1.24	896
1919–20				
November	2.3	0	2.00	119
December			[a] 1.5	[a] 92
January			[a] 1.5	[a] 92
February			[a] 1.5	[a] 86
March		0	[a] 1.51	[a] 93
April	1.0	0	.083	5
August	10	0	2.86	176
September	8	1.0	3.36	200
The period	10	0	1.19	863
1920–21				
October	6.2	1.0	3.71	228
November			[a] 5.79	[a] 345
December			[a] 3.00	[a] 184
January			[a] 3.00	[a] 184
February			[a] 4.00	[a] 222
March		1.0	[a] 3.37	[a] 207
April	0	.0	.0	0
May	31	.0	10.4	640
June	19	1.0	12.1	720
July 1–15	31	.0	4.05	120
The period				2,850

[a] Estimated.

LAKE FORK NEAR ALTONAH, UTAH

LOCATION.—In S. ½ sec. 32, T. 1 N., R. 4 W., a quarter of a mile below heading of United States Lake Fork Canal and 4½ miles northwest from Altonah, Duchesne County.

DRAINAGE AREA.—Not measured.

RECORDS AVAILABLE.—October 15, 1917, to July 30, 1920, when record was discontinued. June 4 to September 18, 1917, station maintained three-eighths mile upstream; records not directly comparable as United States Lake Fork Canal diverts water between stations.

GAGE.—Stevens continuous water-stage recorder on right bank; installed October 15, 1917; inspected by W. R. Preece. Also inside and outside vertical staff gages.

DISCHARGE MEASUREMENTS.—Made from cable near gage or by wading.

CHANNEL AND CONTROL.—Channel irregular. Stream bed very rough; composed of boulders and gravel. Low-water channel shifting. No marked control.

Extremes of discharge.—Maximum discharge July 31, 1920, when Moon Lake Reservoir dam broke. Flow past station not determined. Minimum discharge about 1 second-foot October 12, 1920.

Ice.—Stream freezes over each winter.

Diversions.—Above all diversions except Farnsworth Canal, Payne Canal, and United States Lake Fork Canal. Records of these canals for the irrigation season are kept each year.

Regulation.—A number of small lakes on the headwaters have been developed for storage.

Accuracy.—Records fair.

Monthly discharge of Lake Fork Creek near Altonah, Utah, for 1917–1920

Month	Discharge in second-feet			Run-off in acre-feet
	Maximum	Minimum	Mean	
1917–18				
October 15–31	150	130	143	4,820
November	158	132	147	8,750
December			[a] 146	[a] 8,980
January			[a] 110	[a] 6,760
February			[a] 90	[a] 5,000
March			[a] 95	[a] 5,840
April	119	82	95	5,650
May	348	95	208	12,800
June	1,580	220	804	47,800
July	358	130	205	21,600
August	139	110	128	7,870
September	134	112	123	7,320
The period				134,000
1918–19				
October	259	89	155	9,530
November	131	89	108	6,430
December			[a] 87.2	[a] 5,360
January			[a] 76.3	[a] 4,690
February			[a] 60	[a] 3,330
March			[a] 58.8	[a] 3,620
April	181		[a] 88.5	[a] 5,270
May	1,100	153	565	34,700
June	450	185	314	18,700
July	185	65	104	6,400
August	283	41	104	6,400
September	205	12	91.6	5,450
The year	1,100	12	152	110,000
1919–20				
October 1–26	86		30.5	1,570
April 9–30	101	41	74.4	3,250
May	1,340	70	426	26,200
June	1,430	455	809	48,100
July 1–30	420	138	278	16,500

[a] Estimated.

LAKE FORK BELOW FORKS NEAR WHITEROCKS, UTAH

Location.—About 500 feet downstream from the junction of the East and West Forks, on the old Indian trail from Spanish Fork to Whiterocks, Utah, about 30 miles west of Whiterocks.

Drainage area.—331 square miles.

Records available.—May 10, 1907, to November 30, 1910; fragmentary record was obtained during 1904. Chain gage established May 10, 1907, has no relation whatever to the 1904 gage.

Monthly discharge of Lake Fork below forks near Whiterocks, Utah, for 1907–1910

Month	Discharge in second-feet			Run-off in acre-feet
	Maximum	Minimum	Mean	
1907				
May 10–31	1,390	450	779	34,000
June	6,200	760	2,160	129,000
July	9,300	930	3,490	215,000
August	930	490	634	39,000
September	610	255	351	20,900
The period				438,000
1907–8				
October	265	210	245	15,100
November	210	160	189	11,200
December	210		169	10,400
March 15–31			[a] 200	[a] 6,740
April			[a] 237	[a] 14,100
May	610	336	422	25,900
June	3,350	402	1,550	92,200
July	1,280	384	721	44,300
August	1,340	336	529	32,500
September	493	294	351	20,900
1908–9				
October	423	322	377	23,200
November	307	257	280	16,700
December	272	228	251	15,400
January			[a] 182	[a] 11,200
February			[a] 165	[a] 9,160
March			[a] 168	[a] 10,300
April	287	169	212	12,600
May	610	236	393	24,200
June	3,070	550	2,350	140,000
July	2,120	445	1,030	63,300
August	1,080	445	634	39,000
September	1,710	335	668	39,700
The year				405,000
1909–10				
October	445	236	289	17,800
November	236	206	220	13,100
December			[a] 188	[a] 11,600
March	248	160	180	11,100
April	995	196	382	22,700
May	1,770	550	1,040	64,000
June	1,580	316	635	37,800
July	350	204	274	16,800
August	316	160	214	13,200
September	421	141	230	13,700
1910				
October	316	192	231	14,200
November	192	150	172	10,200

[a] Estimated.

LAKE FORK NEAR MYTON, UTAH

Location.—In sec. 21, T. 3 S., R. 2 W., Uinta special base and meridian, 100 yards below highway bridge, half a mile above confluence with Duchesne River, and 3½ miles northwest of Myton, Duchesne County.

Drainage area.—468 square miles (measured on topographic map).

Records available.—July 3, 1900, to December 31, 1900, approximate measurements published in Twenty-second Annual Report, Part IV, page 380; January 1, 1901, to November 30, 1903; June 13, 1907, to November 30, 1910; August 1, 1911, to September 30, 1926.

Gage.—Stevens continuous water-stage recorder installed October 4, 1921; inspected by C. J. Preece and Anton Verhole.

Discharge measurements.—Made from cable or by wading.

CHANNEL AND CONTROL.—Channel fairly straight for several hundred feet above and below gage. Banks high and not subject to overflow. Bed composed of silt and gravel. Gravel riffle about 300 feet below gage; fairly permanent.

EXTREMES OF DISCHARGE.—1900–1903; 1907–1926: Maximum stage, 9.4 feet, June 22 and 23, 1917 (discharge, 4,350 second-feet). Minimum discharge July 24, 1916, probably zero.

ICE.—Stage-discharge relation seriously affected by ice every winter.

DIVERSIONS.—No diversion below station; several canals of the United States Indian Service and some privately owned canals divert water above for irrigation. Some return water from irrigation enters a short distance above station.

REGULATION.—Flow affected by irrigation diversions above.

ACCURACY.—Records fair except estimates for summer floods which are poor.

Monthly discharge of Lake Fork near Myton, Utah, for 1901–1903 and 1907–1926

Month	Discharge in second-feet			Run-off in acre-feet
	Maximum	Minimum	Mean	
1901				
January			[a] 95	[a] 5,840
February			[a] 95	[a] 5,280
March			[a] 100	[a] 6,150
April			[a] 132	[a] 7,860
May			[a] 1,270	[a] 78,200
June			[a] 556	[a] 33,100
July			[a] 250	[a] 15,400
August			[a] 255	[a] 15,700
September			[a] 144	[a] 8,570
The period				176,000
1901–2				
October			[a] 132	[a] 8,120
November			[a] 112	[a] 6,660
December			[a] 110	[a] 6,760
January			[a] 90	[a] 5,530
February			[a] 90	[a] 5,000
March			[a] 97	[a] 5,940
April	130	103	109	6,510
May	2 700	132	718	44,200
June	3,000	418	1,238	73,700
July	406	110	220	13,500
August	141	89	108	6,650
September	105	76	88	5,230
The year				188,000
1902–3				
October	104	94	97	5,994
November	162	96	109	6,512
December			[a] 90	[a] 5,534
April	139	82	108	6,426
May	966	139	459	28,223
June	1,780	687	1,341	79,795
July	687	241	411	25,271
August	205	124	157	9,645
September	136	110	123	7,319
1903				
October	149	122	135	8,301
November	152	137	139	8,271
1907				
June 13–30	2,690	860	1,590	56,800
August 18–31	405	295	354	9,830
September	330	175	230	13,700
1907–8				
October	230	150	176	10,800
November	150	130	142	8,450
December	180	150	163	2,910
March 24–31	124	124	124	1,970
April	235	124	170	10,100
May	407	190	302	18,600
June	2,700	283	1,260	75,000
July	951	224	476	29,300
August	698	201	328	20,200
September	301	124	208	12,400

[a] Estimated.

Monthly discharge of Lake Fork near Myton, Utah, for 1901–1903 and 1907–1926—Continued

Month	Discharge in second-feet			Run-off in acre-feet
	Maximum	Minimum	Mean	
1908–9				
October	283	169	237	14,600
November	212	124	173	10,300
December	180	135	147	9,040
January			[a] 189	[a] 11,600
February			[a] 168	[a] 9,330
March			[a] 169	[a] 10,400
April	190	124	149	8,870
May	415	156	264	16,200
June	2,920	358	2,070	123,000
July	2,080	255	709	43,600
August	990	215	383	23,600
September	1,610	180	507	30,200
The year				311,000
1909–10				
October	228	150	177	10,900
November	190	130	151	8,980
December			[a] 171	[a] 10,500
January			[a] 144	[a] 8,850
February			[a] 146	[a] 8,110
March	178	142	154	9,470
April	735	124	262	15,600
May	1,400	335	762	46,900
June	1,170	155	421	25,100
July	190	30	73.9	4,540
August	134	13	45.2	2,780
September	240	10	80.1	4,770
The year				157,000
1910				
October	240	63	124	7,620
November	115	90	103	6,130
1911				
August	64	1.0	9.6	590
September	70	1.0	7.1	422
1911–12				
October	116	57	70.6	4,340
November	84	57	63.1	3,750
December			[a] 70	[a] 4,300
January			[a] 65	[a] 4,000
February			[a] 70	[a] 4,030
March			[a] 79.5	[a] 4,890
April	99	35	69.9	4,160
May	896	26	144	8,850
June	3,050	729	1,490	88,700
July	872	57	266	16,400
August	92		17.4	1,070
September	17	2	7.92	471
The year				145,000
1912–13				
October	800	5	145	8,920
November	156	84	97.2	5,780
December			[a] 82.5	[a] 5,070
January			[a] 70	[a] 4,300
February			[a] 70	[a] 3,890
March	337		[a] 95.4	[a] 5,870
April	174	96	115	6,840
May	1,550	96	649	39,900
June	2,710	84	546	32,500
July	1,070	30	237	14,600
August	74	12	22.4	1,380
September	922	68	275	16,400
The year				145,000

[a] Estimated.

Monthly discharge of Lake Fork near Myton, Utah, for 1901–1903 and 1907–1926—Continued

Month	Discharge in second-feet			Run-off in acre-feet
	Maximum	Minimum	Mean	
1913–14				
October	305	155	220	13,500
November	305	74	163	9,700
December	198		[a] 146	[a] 9,000
January			[a] 156	[a] 9,590
February			[a] 160	[a] 8,890
March	244	117	160	9,840
April	230	143	176	10,500
May	2,810	143	962	59,200
June	2,880	388	1,400	83,300
July	466	40	204	12,500
August	109	5	32.5	2,000
September	52	5	27.4	1,630
The year	2,880	5	317	230,000
1914–15				
October	143	52	97.2	5,980
November	125	52	88.4	5,260
December	143		[a] 93.5	[a] 5,750
January			[a] 100	[a] 6,150
February			[a] 125	[a] 6,940
March	226	82	138	8,480
April	134	40	85.6	5,090
May	788	26	198	12,200
June	1,840	134	1,030	61,300
July	520	4.5	81.5	5,010
August	6.4	2.5	4.34	267
September	230	5.8	60.3	3,590
The year	1,840	2.5	174	126,000
1915–16				
October	575	74	140	8,610
November	189	54	108	6,430
December			[a] 120	[a] 7,380
January			[a] 120	[a] 7,380
February			[a] 110	[a] 6,330
March			[a] 245	[a] 15,100
April	288	139	186	11,100
May	616	51	235	14,400
June	1,300	30	640	38,100
July	51	0	8.61	529
August	135	2	26.2	1,610
September	16	4	11.4	678
The year	1,300	0	162	118,000
1916–17				
October	368	13	110	6,760
November		18	80.3	4,780
December			[a] 85.0	[a] 5,230
January			[a] 65.0	[a] 4,000
February			[a] 100	[a] 5,550
March	210		[a] 132	[a] 8,120
April	212	71	135	8,030
May	328	56	185	11,400
June	4,350	252	1,940	115,000
July	2,170	37	564	34,700
August	160	9	25.8	1,590
September	174	9	32.8	1,950
The year	4,350	9	287	207,000
1917–18				
October	61	20	30.2	1,860
November	124	61	78.5	4,670
December			[a] 77.4	[a] 4,760
January			[a] 50.0	[a] 3,070
February			[a] 80.0	[a] 4,440
March	124	12	54.9	3,380
April	54	7	23.3	1,390
May	113	3	26.2	1,610
June	1,740	14	595	35,400
July	234	7	67.8	4,170
August	24	2	10.4	640
September	664	4	101	6,010
The year	1,740	2	98.6	71,400

[a] Estimated.

Monthly discharge of Lake Fork near Myton, Utah, for 1901–1903 and 1907–1926—Continued

Month	Discharge in second-feet			Run-off in acre-feet
	Maximum	Minimum	Mean	
1918–19				
October	250	20	88.5	5,440
November	117	54	77.6	4,620
December	135	61	97.1	5,970
January			[a] 89.1	[a] 5,480
February			[a] 110	[a] 6,110
March			[a] 219	[a] 13,500
April	258	46	111	6,610
May	905	20	315	19,400
June	171	12	32.4	1,930
July	19	9	13.4	824
August	38	15	21.5	1,320
September	148	12	38.9	2,310
The year	905	9	102	73,500
1919–20				
October	41	22	33.8	2,080
November	79	40	61.5	3,660
December			[a] 60.2	[a] 3,700
January			[a] 60.0	[a] 3,690
February			[a] 70	[a] 4,030
March			[a] 111	[a] 6,820
April	234	56	117	6,960
May	1,780	26	325	20,000
June	1,600	162	686	40,800
July	80	13	31.5	1,940
August	1,000	17	84.5	5,200
September	80	26	39.3	2,340
The year	1,780	13	139	101,000
1920–21				
October	104	26	65.4	4,020
November	112	65	91.3	5,430
December			[a] 70.0	[a] 4,300
January			[a] 75.0	[a] 4,610
February			[a] 126	[a] 7,000
March	351	43	128	7,870
April	61		[a] 37.4	[a] 2,230
May	635	24	109	6,700
June	3,680	558	2,090	124,000
July	1,500	32	294	12,100
August	180	24	72.8	4,480
September	370	10	85.1	5,060
The year	2,680	10	268	194,000
1921–22				
October	29	9	19.6	1,200
November	114	12	44.7	2,660
December		54	89.0	5,470
January			[a] 115	[a] 7,070
February			[a] 130	[a] 7,220
March			[a] 143	[a] 8,790
April	177	91	130	7,740
May	1,080	142	407	25,000
June	2,880	700	1,858	111,000
July	600	22	127	7,810
August	87	14	36.8	2,260
September	98	13	340	2,070
The year	2,880	9	259	188,000
1922–23				
October	68	18	27.5	1,690
November	132	40	99.0	5,890
December			[a] 117	[a] 7,190
January			[a] 110	[a] 6,760
February			[a] 110	[a] 6,110
March	181		[a] 123	[a] 7,560
April	256	98	147	8,750
May	1,270	84	387	23,800
June	2,500	343	874	52,000
July	820	28	317	19,500
August	84	14	36.3	2,230
September	147	22	51.3	3,050
The year	2,500	14	200	145,000

[a] Estimated.

Monthly discharge of Lake Fork near Myton, Utah, for 1901–1903 and 1907–1926—Continued

Month	Discharge in second-feet			Run-off in acre-feet
	Maximum	Minimum	Mean	
1923–24				
October	205	101	156	9,590
November	172		116	6,900
December			[a] 80	[a] 4,920
January			[a] 75	[a] 4,610
February			[a] 100	[a] 5,750
March			[a] 892	[a] 5,480
April	192	15	78.5	4,670
May	720	9	206	12,700
June		5	32.0	1,900
July	15	4	7.6	467
August	12	4	6.5	400
September	18	4	9.4	559
The year	720	4	79.8	57,900
1924–25				
October	23	9	11.9	732
November	76	14	44.8	2,670
December			[a] 65	[a] 4,000
January			[a] 71.5	[a] 4,400
February			[a] 75	[a] 4,170
March		4	[a] 34.9	[a] 2,150
April	9	5	6.8	405
May	531	8	152	9,350
June	562	18	174	10,400
July	167	12	49.2	3,030
August	250	18	51.6	3,170
September	190	53	84.5	5,030
The year	562	4	68.3	49,500
1925–26				
October	287	42	163	10,000
November	174	104	147	8,750
December			[a] 128	[a] 7,870
January			[a] 100	[a] 6,150
February			[a] 125	[a] 6,940
March	104	37	64.1	3,940
April	120		62.2	3,700
May	920	15	216	13,300
June	323	9	95.4	5,680
July	53	3	18.2	1,120
August	85	4	23.3	1,430
September	24	3	13.7	815
The year	920	3	96.3	69,700

[a] Estimated.

UINTA RIVER NEAR WHITEROCKS, UTAH

LOCATION.—In SE. ¼ sec. 31, T. 2 N., R. 1 W., Uinta special base and meridian, 200 feet below Pole Creek Bridge on road to Government sawmill, in Duchesne County, 10 miles northeast of Whiterocks, Uintah County. Pole Creek enters on left a short distance above station.

DRAINAGE AREA.—Not measured.

RECORDS AVAILABLE.—Fragmentary records September, 1899, to 1904, and August 13, 1907, to November 30, 1910. November 5, 1917, to September 30, 1920, when station was discontinued.

GAGE.—Stevens continuous water-stage recorder on right bank; installed November 5, 1917; inspected by J. F. Wilkin. Also inside and outside vertical enamel staff gages.

DISCHARGE MEASUREMENTS.—Made by wading or from highway bridge.

CHANNEL AND CONTROL.—Channel very rough, steep, and wide. Bed composed of boulders and gravel. Banks low but probably not subject to overflow. Low-water channel meanders over stream bed and probably forms two channels at gage at extreme low water.

Extremes of discharge.—1917–1920: Maximum stage recorded, 6.32 feet at midnight May 29, 1920 (discharge, 1,300 second-feet); minimum stage, 3.80 feet February 6, 1918 (discharge, 45 second-feet).

Ice.—Stream freezes over each winter.

Diversions.—Above all diversions except Cedar View Canal which diverts from the right side a quarter of a mile above station.

Regulation.—None.

Accuracy.—Records fair.

Monthly discharge of Uinta River near Whiterocks, Utah, for 1899–1904, 1907–1910 and 1917–1920

Month	Discharge in second-feet			Run-off in acre-feet
	Maximum	Minimum	Mean	
1899–1900				
September			[a] 165	[a] 9,820
October			[a] 162	[a] 9,960
November			[a] 130	[a] 7,740
December			[a] 120	[a] 7,380
January			[a] 112	[a] 6,890
February			[a] 112	[a] 6,220
March			[a] 125	[a] 7,690
April			[a] 138	[a] 8,210
May			[a] 650	[a] 40,000
June			[a] 597	[a] 35,500
July			[a] 223	[a] 13,700
August			[a] 184	[a] 11,300
September			[a] 157	[a] 9,340
The year				174,000
1900–1901				
October			[a] 154	[a] 9,470
November			[a] 138	[a] 8,210
December			[a] 145	[a] 8,920
January			[a] 140	[a] 8,610
February			[a] 140	[a] 7,780
March			[a] 150	[a] 9,220
April			[a] 179	[a] 10,700
May			[a] 684	[a] 42,100
June			[a] 355	[a] 21,100
July			[a] 251	[a] 15,400
August			[a] 242	[a] 14,900
September			[a] 193	[a] 11,500
The year				168,000
1901–2				
October			[a] 163	[a] 10,000
November			[a] 142	[a] 8,450
December			[a] 147	[a] 9,040
January	144	123	136	8,360
February	143	123	127	7,080
March	178	123	144	8,840
April	185	129	154	9,160
May	1,200	160	555	34,100
June	1,000	579	665	39,600
July	430	190	262	16,100
August	200	167	181	11,100
September	177	160	167	9,920
The year				172,000
1902–3				
October	166	140	152	9,360
November	147	125	139	8,270
December			[a] 125	[a] 7,690
January	103	71	86	5,290
February	104	81	95	5,280
March	165	97	122	7,500
April	190	125	148	8,810
May	778	190	430	26,400
June	1,260	583	894	53,200
July	583	277	382	23,500
August	276	178	232	14,300
September	240	182	209	12,400
The year				182,000

[a] Estimated.

Monthly discharge of Uinta River near Whiterocks, Utah, for 1899–1904, 1907–1910, and 1917–1920—Continued

Month	Discharge in second-feet			Run-off in acre-feet
	Maximum	Minimum	Mean	
1903				
October	189	153	176	10,800
November	153	153	153	9,100
December	195	144	145	8,920
1907				
August 13–31			[a] 373	[a] 14,100
September			[a] 308	[a] 18,300
1907–8				
October			[a] 250	[a] 15,400
November			[a] 174	[a] 10,400
March 15–31			[a] 146	[a] 4,920
April			[a] 172	[a] 10,200
May			[a] 348	[a] 21,400
June			[a] 910	[a] 54,100
July			[a] 636	[a] 39,100
August			[a] 444	[a] 27,300
September			[a] 327	[a] 19,500
1908–9				
October			[a] 325	[a] 20,000
November			[a] 236	[a] 14,000
December			[a] 202	[a] 12,400
January			[a] 187	[a] 11,500
February			[a] 98.7	[a] 5,480
March			[a] 131	[a] 8,060
April			[a] 183	[a] 10,900
May			[a] 338	[a] 20,800
June			[a] 1,430	[a] 85,100
July			[a] 667	[a] 41,000
August			[a] 494	[a] 30,400
September			[a] 546	[a] 32,500
The year				292,000
1909–10				
October			[a] 267	[a] 16,400
November			[a] 191	[a] 11,400
December			[a] 165	[a] 10,100
January			[a] 150	[a] 9,220
February			[a] 145	[a] 8,050
March			[a] 157	[a] 9,650
April			[a] 323	[a] 19,200
May			[a] 683	[a] 42,000
June			[a] 417	[a] 24,800
July			[a] 362	[a] 22,300
August			[a] 282	[a] 17,300
September			[a] 264	[a] 15,700
The year				206,000
1910				
October			[a] 213	[a] 13,100
November			[a] 154	[a] 9,160
1917–18				
November 5–30	131	112	122	6,290
December	118		99.6	6,120
January			70.0	4,300
February			68.0	3,780
March	70		64.5	3,970
April	85	54	72.0	4,280
May	562	90	312	19,200
June	988	304	681	40,500
July	738	242	389	23,900
August	262	125	199	12,200
September	299	105	142	8,450
The period				133,000

[a] Estimated.

Monthly discharge of Uinta River near Whiterocks, Utah, for 1899–1904, 1907–1910, and 1917–1920—Continued

Month	Discharge in second-feet			Run-off in acre-feet
	Maximum	Minimum	Mean	
1918–19				
October	294	135	184	11,300
November	138		111	6,600
December			75	4,600
January			60	3,700
February			55	3,100
March			62	3,800
April			84	5,000
May			452	27,800
June			313	18,600
July		146	183	11,300
August	312		173	10,600
September	225	127	162	9,600
The year			160	116,000
1919–20				
October	189	103	137	8,420
November	129	80	102	6,070
December			66	4,060
January			50	3,070
February			50	2,880
March			65	4,000
April			75	4,460
May	1,160		434	26,700
June	990	464	664	39,500
July	453	251	336	20,700
August	288	181	235	14,400
September	205		155	9,220
The year	1,160		198	143,000

UINTA RIVER NEAR FORT DUCHESNE, UTAH

Location.—In W. ½ sec. 35, T. 2 S., R. 1 E., Uinta special base and meridian, 100 feet below heading of Fort Duchesne Canal and 2 miles south of Fort Duchesne, Uinta County.

Drainage area.—Not measured.

Records available.—September 14, 1899, to December 3, 1904; April 9, 1907, to November 30, 1910; May 11, 1917, to September 30, 1920; fragmentary. Station discontinued.

Gage.—Vertical staff on left bank May 11 to June 11, 1917, at about same site as recorder station later established. Vertical staff at Fort Duchesne June 27 to July 13, 1917. October 23, 1917, to September 30, 1920, Stevens continuous recorder on right bank 100 feet below heading of Fort Duchesne Canal. Recorder supplemented by vertical staff gage in stilling well and inclined staff gage on river bank 10 feet downstream.

Discharge measurements.—Made from cable or by wading near gage.

Channel and control.—Channel very rough, composed of heavy gravel cobbles, subject to considerable change during high water.

Extremes of discharge.—1917–1920: It is estimated that discharge exceeded 7,500 second-feet in June, 1917. River dry a part of each summer.

Ice.—Stream is affected by ice each winter.

Diversions.—Station is below all diversions from Uinta River.

Regulation.—None.

Accuracy.—Records fair.

Monthly discharge of Uinta River near Fort Duchesne, Utah, for 1899–1904, 1907–1910, and 1917–1920

Month	Discharge in second-feet			Run-off in acre-feet
	Maximum	Minimum	Mean	
1899–1900				
September 14–30			[a] 78	[a] 4,640
October			[a] 83	[a] 5,010
November			[a] 111	[a] 6,600
December			[a] 114	[a] 7,010
January			[a] 125	[a] 7,690
February			[a] 125	[a] 6,940
March	193	85	123	7,560
April	128	85	99	5,890
May	2,340	95	924	56,800
June	1,270	140	431	25,600
July	140	25	67	4,120
August	62	20	36	2,210
September	125	25	62	3,690
The period				144,000
1900–1901				
October	110	70	98	6,030
November	140	90	105	6,250
December	140	55	90	5,530
January			[a] 135	[a] 8,300
February			[a] 135	[a] 7,500
March	295	77	132	8,120
April	184	87	117	6,960
May	4,520	218	1,190	73,000
June	485	184	261	15,500
July	201	97	140	8,610
August	485	87	168	10,300
September	184	97	121	7,200
The year				163,000
1901–2				
October	184	97	116	7,130
November	137	109	117	6,960
December			[a] 130	[a] 7,990
January			[a] 125	[a] 7,690
February			[a] 130	[a] 7,220
March	180	56	118	7,250
April	160	70	98	5,860
May	2,000	92	662	40,700
June	1,640	280	622	37,000
July	308	54	158	9,730
August	60	24	43	2,680
September	232	30	54	3,220
The year				143,000
1902–3				
October	92	66	79	4,450
November	153	60	102	6,050
December			85	5,200
March 29–31			186	1,110
April	259	94	125	7,430
May	1,330	108	461	28,300
June	2,730	561	1,440	85,700
July	524	159	343	21,100
August	159	70	102	6,270
September	259	70	121	7,200
1903–4				
October	205	123	149	9,160
November	205	108	133	7,910
December			73	1,740
March	130	46	89	5,490
April	170	67	99	5,890
May	1,980	161	966	59,400
June	918	304	627	37,300
July	304	148	207	12,700
August	219	93	149	9,160
September	181	107	137	8,150
1904				
October	215	145	182	11,200
November	184	136	168	10,000
December 1–3	127	121	123	732
The period				21,900

[a] Estimated.

Monthly discharge of Uinta River near Fort Duchesne, Utah, for 1899–1904, 1907–1910, and 1917–1920—Continued

Month	Discharge in second-feet			Run-off in acre-feet
	Maximum	Minimum	Mean	
1907				
April 9–30	535	168	361	15,800
May	1,870	180	635	39,000
June	3,040	810	1,860	111,000
July	3,510	903	1,860	114,000
August	945	240	487	29,900
September	370	190	253	15,100
The period				325,000
1907–8				
October	240	170	188	11,600
November	148	120	139	8,270
December			102	3,030
March 14–31	174	103	134	4,940
April	220	103	152	9,040
May	635	153	342	21,000
June	2,360	213	857	51,000
July	435	91	242	14,900
August	392	117	243	14,900
September	563	118	216	12,800
1908–9				
October	358	238	293	18,000
November	276	192	228	13,600
December			[a] 191	[a] 11,700
January			[a] 151	[a] 9,280
February			[a] 125	[a] 6,940
March			[a] 149	[a] 9,160
April	255	160	187	11,100
May	582	175	319	19,600
June	4,470	412	1,940	115,000
July	1,090	192	430	26,400
August	614	175	272	16,700
September	1,540	282	740	44,000
The year	4,470		419	301,000
1909–10				
October	310	210	246	15,100
November	255	175	201	12,000
December			[a] 168	[a] 10,300
January			[a] 151	[a] 9,280
February			[a] 149	[a] 8,280
March	225	147	195	12,000
April	818	147	295	17,600
May	1,290	307	541	33,300
June	527	36	143	8,510
July	94	1	25.0	1,540
August	147	19	41.9	2,580
September	216	19	93.8	5,580
The year				136,000
1910				
October	241	79	144	8,850
November	147	94	126	7,500
1917				
May 11–31			336	14,000
June			[a] 4,000	[a] 240,000
July			803	20,700
The period				275,000
1917–18				
October 22–31	90	69	83.4	1,490
November	140	88	108	6,430
December 1–17	118	93	108	3,650
March			41.3	1,390
April			23.0	1,370
May	328		47.7	2,930
June	1,190	4	492	29,300
July	1,240		145	8,920
August	8		.5	31
September	213		15.8	940

[a] Estimated.

Monthly discharge of Uinta River near Fort Duchesne, Utah, for 1899–1904, 1907–1910, and 1917–1920—Continued

Month	Discharge in second-feet			Run-off in acre-feet
	Maximum	Minimum	Mean	
1918–19				
October	238	33	91.8	5,640
November		59	97.1	5,780
April			[a] 40	[a] 2,380
May			[a] 60	[a] 3,690
June	30		[a] 2	[a] 119
September	126		7.7	458
1919–20				
October			[a] 35	[a] 2,150
March 22–31	118	74	84.7	1,680
April	86		50.4	3,000
May	2,540	28	501	30,800
June	2,160	70	839	49,900
July	69		11.7	719
August	30		12.1	744
September			[a] 35	[a] 2,080

[a] Estimated.

UINTA RIVER AT OURAY SCHOOL, UTAH

LOCATION.—At highway bridge 5 miles below station at Fort Duchesne.

RECORDS AVAILABLE.—November 1, 1899, to December 9, 1904.

DRAINAGE AREA.—967 square miles.

GAGE.—Original gage a vertical board fastened to east side of south crib of bridge; new gage rod, with zero 1 foot below datum of old gage, installed April 20, 1904.

CHANNEL.—Rocky; filled in with sediment during part of year.

DISCHARGE MEASUREMENTS.—At high stages made from bridge; at ordinary stages by wading about 200 feet below.

WINTER FLOW.—Stage-discharge relation affected by ice.

ACCURACY.—Estimates only fair.

Monthly discharge of Uinta River at Ouray School, Utah, for 1899–1904

Month	Discharge in second-feet			Run-off in acre-feet
	Maximum	Minimum	Mean	
1899–1900				
November			[a] 124	[a] 7,380
December			[a] 113	[a] 6,950
January			[a] 100	[a] 6,150
February			[a] 100	[a] 5,550
March	179	56	97	5,960
April	232	64	88	5,240
May	1,500	92	689	42,400
June	1,120	179	451	26,800
July	156	28	65	4,000
August	40	19	32	1,970
September	242	37	89	5,300
The period				118,000
1900–1901				
October	156	113	122	7,500
November	200	64	128	7,620
January			[a] 120	[a] 7,380
February			[a] 120	[a] 6,660
March		92	116	7,130
April	151	92	116	6,900
May	3,450	215	1,137	69,900
June	598	181	309	18,400
July	192	58	114	7,010
August	953	52	164	10,100
September	192	100	121	7,200

[a] Estimated

Monthly discharge of Uinta River at Ouray School, Utah, for 1899–1904—Continued

Month	Discharge in second-feet			Run-off in acre-feet
	Maximum	Minimum	Mean	
1901–2				
October	181	108	123	7,560
November	142	116	126	7,500
December			[a] 115	[a] 7,070
January			[a] 110	[a] 6,760
February			[a] 110	[a] 6,110
March			[a] 100	[a] 6,150
April	146	76	92	5,460
May	2,653	84	740	45,500
June	2,120	246	651	39,000
July	327	47	132	8,150
August	65	30	40	2,470
September	470	34	72	4,280
The year				146,000
1902–3				
October	94	78	89	5,460
November	154	57	97	5,780
December	104	57	[a] 83	[a] 5,130
April	248	80	115	6,840
May	1,395	88	447	27,500
June	2,750	490	1,498	89,100
July	710	150	313	19,200
August	132	58	78	4,800
September	202	58	114	6,780
1903–4				
October	328	114	144	8,850
November	180	80	124	7,380
December 1–12			117	2,780
March 15–31	105	64	70.5	2,380
April	164	62	83.2	4,950
May	2,510	137	972	59,770
June	964	270	677	34,300
July	298	100	174	10,700
August	270	58	141	8,670
September	204	89	120	7,140
1904				
October	148	126	140	8,610
November	126	77	94.7	5,640
December 1–9	144	80	101	1,820
The period				16,100

[a] Estimated.

WHITEROCKS RIVER NEAR WHITEROCKS, UTAH

LOCATION.—In sec. 18, T. 2 N., R. 1 E., Uinta special base and meridian, 8 miles north of Whiterocks, Uintah County. United States Whiterocks Canal diverts from left side and Farm Creek Canal from right side 2 miles below station.

DRAINAGE AREA.—118 square miles.

RECORDS AVAILABLE.—August 1, 1921, to August 12, 1925, at present site; fragmentary. November 8, 1917, to June 2, 1921, at a point about 2 miles downstream below diversion of United States Whiterocks Canal and above Farm Creek Canal. 1899 to 1904 and 1907 to 1910 somewhere in vicinity of present site. Records are comparable.

GAGE.—Stevens continuous water-stage recorder on left bank; installed August 4, 1921; inspected by C. J. Preece.

DISCHARGE MEASUREMENTS.—Made by wading or from cable a quarter of a mile above gage.

CHANNEL AND CONTROL.—Narrow box canyon. Stream bed is steep and rough, composed of boulders and gravel. Channel is subject to change by erosion during high water.

EXTREMES OF DISCHARGE.—1918–1925: Maximum stage recorded, 5.40 feet at 9 p. m. June 20 and 7 p. m. June 21, 1922 (discharge, 2,750 second-feet). Minimum discharge less than 14 second-feet in the winter of 1920–21.

ICE.—Stream freezes over each winter.

DIVERSIONS.—After August 1, 1921, above all diversions.

REGUALTION.—None.

ACCURACY.—Records fair.

Monthly discharge of Whiterocks River near Whiterocks, Utah, for 1899–1904, 1907–1910, and 1917–1925

Month	Discharge in second-feet			Run-off in acre-feet
	Maximum	Minimum	Mean	
1899–1900				
October			[a] 80	[a] 4,920
November			[a] 66	[a] 3,930
December			[a] 63	[a] 3,870
January			[a] 47	[a] 2,890
February			[a] 48	[a] 2,670
March			[a] 50	[a] 3,070
April			[a] 44	[a] 2,620
May			[a] 400	[a] 24,600
June			[a] 253	[a] 15,100
July			[a] 82	[a] 5,040
August			[a] 62	[a] 3,810
September			[a] 55	[a] 3,270
The year				75,800
1900–1901				
October			[a] 44	[a] 2,700
November			[a] 59	[a] 3,510
December			[a] 55	[a] 3,380
January			[a] 50	[a] 3,070
February			[a] 50	[a] 2,780
March			[a] 50	[a] 3,070
April			[a] 74	[a] 4,400
May			[a] 507	[a] 31,200
June			[a] 179	[a] 10,600
July			[a] 101	[a] 6,210
August			[a] 128	[a] 7,870
September			[a] 95	[a] 5,650
The year				84,400
1901–2				
October			[a] 75	[a] 4,610
November			[a] 63	[a] 3,750
December			[a] 61	[a] 3,750
January	54	41	48	2,920
February	47	39	41	2,300
March	55	44	48	2,960
April	71	46	57	3,420
May	1,100	76	471	28,900
June	900	166	348	20,700
July	200	77	109	6,680
August	76	62	67	4,090
September	67	49	57	3,410
The year				87,500
1902–3				
October	59	47	53	3,260
November	63	38	48	2,830
December	52	39	44	2,700
January	40	29	34	2,090
February	42	37	41	2,280
March	48	42	43	2,640
April	96	45	56	3,330
May	655	96	260	16,000
June	1,146	324	658	39,200
July	324	108	198	12,200
August	108	82	93	5,720
September	105	76	89	5,300
The year				97,600

[a] Estimated.

Monthly discharge of Whiterocks River near Whiterocks, Utah, for 1899–1904, 1907–1910, and 1917–1925—Continued

Month	Discharge in second-feet			Run-off in acre-feet
	Maximum	Minimum	Mean	
1903–4				
October	79	68	76	4,670
November	68	67	67	4,000
December	67	59	60	3,690
March			a 40	a 2,400
April			a 45	a 2,700
1907				
April 11–30			a 204	a 8,090
May			a 274	a 16,800
June			a 800	a 47,600
July			a 735	a 45,200
August			a 203	a 12,500
September			a 127	a 7,560
The period				138,000
1907–8				
October			a 91.6	a 5,630
November			a 84.0	a 5,000
December			a 80.0	a 2,380
March 15–31			a 77.8	a 2,620
April			a 79.2	a 4,710
May			a 220	a 13,500
June			a 524	a 31,200
July			a 208	a 12,800
August			a 198	a 12,200
September			a 156	a 9,280
1908–9				
October			a 187	a 11,500
November			a 95.8	a 5,700
December			a 72.6	a 4,460
January			a 56.9	a 3,500
February			a 52.4	a 2,910
March			a 55.6	a 3,420
April			a 75.1	a 4,470
May			a 217	a 13,300
June			a 908	a 54,000
July			a 269	a 16,500
August			a 249	a 15,300
September			a 434	a 25,800
The year				161,000
1909–10				
October			a 131	a 8,060
November			a 71.9	a 4,280
December			a 61.4	a 3,780
January			a 65.2	a 4,010
February			a 67.0	a 3,720
March			a 58.9	a 3,620
April			a 162	a 9,640
May			a 414	a 25,500
June			a 210	a 12,500
July			a 134	a 8,240
August			a 123	a 7,560
September			a 150	a 8,920
The year				100,000
1910				
October			a 91.6	a 5,630
November			a 67.5	a 4,020
1917–18				
November 8–30	53	41	47.3	2,160
December			a 37.5	a 2,310
January			a 32	a 1,970
February			a 34	a 1,890
March			a 31.5	a 1,940
April	33	28	29.8	1,770
May	399	33	164	10,100
June	471	118	313	18,600
July	453	100	208	12,800
August	106	40	74.8	4,600
September	170	43	63.6	3,780
The period				61,900

a Estimated.

Monthly discharge of Whiterocks River near Whiterocks, Utah, for 1899–1904, 1907–1910, and 1917–1925—Continued

Month	Discharge in second-feet			Run-off in acre-feet
	Maximum	Minimum	Mean	
1918–19				
October	134	59	82.3	5,060
November	69	36	49.8	2,960
December			[a] 35	[a] 2,150
January			[a] 30	[a] 1,840
February			[a] 30	[a] 1,670
March			[a] 32	[a] 1,970
April			54.1	3,220
May	387	146	256	15,700
June	132	24	39.7	2,360
July	41	21	23.8	1,460
August	42	21	25.1	1,540
September	100	24	43.0	2,560
The year	387	21	58.8	42,500
1919–20				
October	83	48	65.4	4,020
November	66		56.2	3,340
December			[a] 40	[a] 2,460
January			[a] 25	[a] 1,540
February			[a] 30	[a] 1,730
March			[a] 49.2	[a] 3,030
April			[a] 37.8	[a] 2,250
May	1,290		354	21,800
June	1,070	182	519	30,900
July	179	43	89.2	5,480
August	81	31	44.9	2,760
September			30	1,790
The year	1,290		112	81,100
1920–21				
October			[a] 25	[a] 1,540
November			[a] 19	[a] 1,130
December			[a] 14	[a] 860
January			[a] 14	[a] 860
February			[a] 15	[a] 830
March			[a] 16	[a] 980
April	20	17	18	1,070
May 1–11	90	19	59.4	1,300
August	280	131	173	10,600
September	256	96	149	8,870
1921–22				
October	102	70	81.1	4,990
November 1–18	73	40	62.3	2,230
May	1,060		544	33,400
June	2,200	580	1,380	82,100
July	530	225	309	19,000
August	280	152	196	12,100
September	195	98	121	7,200
1922–23				
May	1,330		50	30,800
June		455	923	54,900
July	538	176	315	19,400
August	182	91	138	8,480
September	120	67	90.3	5,370
The period				119,000
1923–24				
October	120	59	84.3	5,180
November	67		57.5	3,420
May 13–31	452	144	281	10,600
June	163	79	121	7,200
July	106	57	72.9	4,480
August	76	47	57.0	3,500
September	73	42	50.1	2,980
1924–25				
October	45	39		2,610
November	44	34		2,290
April	59	26		2,390
May	550	78		19,300
June	520	161		15,600
July	191	87		8,180
August 1–12	110	81		2,090

[a] Estimated.

NORTH FORK OF WHITE RIVER NEAR BUFORD, COLO.

LOCATION.—About sec. 9, T. 1 S., R. 91 W., at Genier ranch, 1½ miles east of Buford, Rio Blanco County. Nearest important tributary enters 3½ miles downstream. From 1903 to 1906 station situated just below mouth of Marvine Creek, 5 miles upstream. Flow at two points comparable.

DRAINAGE AREA.—240 square miles at lower station; 198 square miles at upper station.

RECORDS AVAILABLE.—July 29, 1903, to October 31, 1906; May 24, 1910, to December 7, 1915. From July 1, 1919, to October 9, 1920, gaging station maintained at Buford.

GAGE.—Vertical staff.

DISCHARGE MEASUREMENTS.—Made from bridge.

CONTROL.—Practically permanent.

COOPERATION.—Complete records since 1910 furnished by State engineer.

Monthly discharge of North Fork of White River at Buford, Colo., for the years ending September 30, 1903–1906, 1910–1915, and 1919–20

Month	Discharge in second-feet			Run-off in acre-feet
	Maximum	Minimum	Mean	
1903				
July 29–31	355	280	330	1,960
August	280	205	263	16,200
September	392	205	263	15,600
The period				33,800
1903–4				
October	340	205	252	15,500
November			[a] 190	[a] 11,300
December			[a] 180	[a] 11,100
January			[a] 175	[a] 10,800
February			[a] 170	[a] 9,780
March			[a] 180	[a] 11,100
April	850	175	396	23,600
May	1,030	475	841	51,700
June	1,090	575	794	47,200
July	550	310	383	23,600
August	310	250	272	16,700
September	300	225	247	14,700
The year			341	247,000
1904–5				
October	275	210	230	14,100
November			[a] 190	[a] 11,300
December			[a] 180	[a] 11,100
January			[a] 180	[a] 11,100
February			[a] 170	[a] 9,440
March			[a] 160	[a] 9,840
April	402	144	200	11,900
May	1,610	286	756	46,500
June	1,950	676	1,330	79,100
July	622	275	375	23,100
August	330	180	219	13,500
September	225	157	176	10,500
The year			346	251,000
1905–6				
October	157	157	157	9,650
November			[a] 150	[a] 8,930
December			[a] 150	[a] 9,220
January			[a] 145	[a] 8,920
February			[a] 145	[a] 8,050
March			[a] 145	[a] 8,920
April	450	135	225	13,400
May	1,500	265	927	57,000
June	1,840	762	1,130	67,200
July	788	340	507	31,200
August	380	295	325	20,000
September	340	287	300	17,900
The year			359	260,000

[a] Estimated.

Monthly discharge of North Fork of White River at Buford, Colo., for the years ending September 30, 1903–1906, 1910–1915, and 1919–20—Continued

Month	Discharge in second-feet			Run-off in acre-feet
	Maximum	Minimum	Mean	
1906				
October	295	248	257	15,800
1910				
May 24–31	1,100	710	850	13,500
June	1,220	435	775	46,100
July	415	266	343	21,100
August	301	235	251	15,500
September	301	208	247	14,700
The year				111,000
1910–11				
October	250	208	218	13,400
November	235	185	210	12,500
December			[a] 208	[a] 12,800
January			[a] 180	[a] 11,100
February	220	187	199	11,100
March	208	187	194	11,900
April	656	198	314	18,700
May	1,130	408	747	46,000
June	1,130	448	766	45,600
July	488	262	345	21,200
August	262	220	234	14,400
September	315	198	214	12,800
The year			320	232,000
1911–12				
October	468	187	236	14,500
November	233	198	214	12,700
December	352	178	215	13,200
January	272	190	232	14,300
February	210	180	192	11,000
March	200	190	191	11,800
April	285	190	221	13,200
May	3,150	285	1,320	81,400
June	2,970	790	1,400	83,100
July	1,280	525	733	45,100
August	525	285	358	22,000
September	330	248	275	16,400
The year			550	339,000
1912–13				
October	272	222	251	15,400
November	272	222	242	14,400
December			[a] 210	[a] 12,900
January			[a] 200	[a] 12,300
February			[a] 180	[a] 10,000
March			[a] 180	[a] 11,100
April	748		[a] 320	[a] 19,000
May	850	395	624	38,400
June	780	275	457	27,200
July	330	210	247	15,200
August	210	185	195	12,000
September	192	178	188	11,200
The year			275	199,000
1913–14				
October	201	178	186	11,400
November			190	11,300
December			[a] 175	[a] 10,800
January			[a] 165	[a] 10,100
February			[a] 165	[a] 9,160
March	185	166	[a] 174	[a] 10,700
April	395	178	261	15,500
May	1,900	300	1,010	[a] 62,000
June		760	[a] 1,200	[a] 71,400
July	760	342	463	28,500
August	342	265	285	17,500
September	280	222	242	14,400
The year			377	273,000

[a] Estimated.

Monthly discharge of North Fork of White River at Buford, Colo., for the years ending September 30, 1903–1906, 1910–1915, and 1919–20—Continued

Month	Discharge in second-feet			Run-off in acre-feet
	Maximum	Minimum	Mean	
1914–15				
October	265	222	236	14,500
November			220	13,100
December			[a] 170	[a] 10,500
January			[a] 160	[a] 9,840
February			[a] 170	[a] 9,440
March	165	165	[a] 165	[a] 10,100
April	730	180	351	20,900
May	670	345	477	29,300
June	760	460	610	36,200
July	510	210	293	18,000
August	228	165	187	11,500
September	228	165	183	10,900
The year			268	194,000
1915				
October	195	150	180	11,100
November	210	150	178	10,600
December 1–7	210	180	206	2,860
1919				
July	264	163	201	12,400
August	186	121	150	9,220
September	190	130	155	9,220
1919–20				
October	172	130	153	9,410
November	155	155	155	9,220
December			[a] 150	[a] 9,220
January			[a] 150	[a] 9,220
February			[a] 150	[a] 8,630
March	155	155	155	9,530
April	203	155	168	10,000
May	2,110	244	1,110	68,200
June	1,400	960	1,200	71,400
July	870	365	549	33,800
August	365	223	289	17,800
September	223	183	214	12,700
The year			371	169,000
1920				
October 1–9			232	4,140

[a] Estimated.

WHITE RIVER NEAR MEEKER, COLO.

LOCATION.—In sec. 30, T. 1 N., R. 93 W., at Rees ranch, 3½ miles east of Meeker, Rio Blanco County. Nearest tributary, Curtis Creek, enters above station. Prior to October 20, 1913, station was one-half mile southeast of Meeker. From April 12, 1904, to October 31, 1906, station was 2½ miles below present station.

DRAINAGE AREA.—634 square miles.

RECORDS AVAILABLE.—October 1, 1901, to October 31, 1906; October 1, 1909, to September 30, 1926.

GAGE.—Recording gage since 1910; staff gage originally.

DISCHARGE MEASUREMENTS.—Made from private road bridge.

CONTROL.—Practically permanent.

DIVERSIONS.—Station moved in 1913 to point above intake of power canal constructed in that year.

COOPERATION.—Since 1910 complete records have been furnished by State engineer.

Monthly discharge of White River near Meeker, Colo., for 1901–1906 and 1909–1926

Month	Discharge in second-feet			Run-off in acre-feet
	Maximum	Minimum	Mean	
1901–2				
October			[a] 400	[a] 24,600
November			[a] 360	[a] 21,400
December			[a] 350	[a] 21,500
January			[a] 340	[a] 20,900
February			[a] 330	[a] 19,000
March			[a] 330	[a] 20,300
April	800	315	442	26,300
May	2,320	890	1,630	100,000
June	1,730	415	906	53,900
July	565	250	398	24,500
August	315	250	282	17,300
September	395	280	329	19,600
The year			508	369,000
1902–3				
October	395	315	324	19,900
November			[a] 310	[a] 18,400
December			[a] 300	[a] 18,400
January			[a] 290	[a] 17,800
February			[a] 290	[a] 16,100
March			[a] 350	[a] 21,500
April	710	375	468	27,800
May	2,240	620	1,200	73,800
June	2,400	1,290	1,980	118,000
July	1,180	440	678	41,700
August	440	315	373	22,900
September	710	395	490	29,200
The year			588	426,000
1903–4				
October	565	440	493	30,300
November			[a] 400	[a] 23,800
December			[a] 350	[a] 21,500
January			[a] 340	[a] 20,900
February			[a] 330	[a] 18,300
March			[a] 350	[a] 21,500
April	1,570	335	745	44,300
May	2,510	1,000	1,760	108,000
June	2,190	878	1,570	93,400
July	842	395	559	34,400
August	515	375	413	25,400
September	530	375	409	24,300
The year			643	466,000
1904–5				
October	465	375	404	24,800
November			[a] 360	[a] 21,400
December			[a] 350	[a] 21,500
January			[a] 340	[a] 20,900
February			[a] 340	[a] 18,900
March			[a] 350	[a] 21,500
April	712	370	443	26,400
May	2,800	640	1,490	91,600
June	3,370	1,090	2,440	145,000
July	1,020	407	572	35,200
August	520	357	405	24,900
September	435	357	382	22,700
The year			655	475,000
1905–6				
October	400	357	376	23,100
November			[a] 320	[a] 19,000
December			[a] 300	[a] 18,400
January			[a] 280	[a] 17,200
February			[a] 280	[a] 15,600
March			[a] 300	[a] 18,400
April	1,120	410	628	37,400
May	3,390	718	2,100	129,000
June	3,710	1,460	2,530	151,000
July	1,400	510	836	51,400
August	500	288	371	22,800
September	470	258	345	20,500
The year			723	524,000

[a] Estimated.

Monthly discharge of White River near Meeker, Colo., for 1901–1906 and 1909–1926—Continued

Month	Discharge in second-feet			Run-off in acre-feet
	Maximum	Minimum	Mean	
1906				
October	331	243	292	18,000
1909–10				
October			[a] 425	[a] 26,100
November			[a] 375	[a] 22,300
December			[a] 350	[a] 21,500
January			[a] 350	[a] 21,500
February			[a] 350	[a] 19,400
March			[a] 375	[a] 23,100
April			[a] 500	[a] 29,800
May	2,580	900	1,220	[a] 75,000
June	2,850	611	1,660	98,800
July	611	308	435	26,700
August	414	288	354	21,800
September	458	338	357	21,200
The year			560	407,000
1910–11				
October	374	338	351	21,600
November	355	292	335	19,900
December			[a] 325	[a] 20,000
January	505	275	338	20,800
February	470	275	337	18,700
March	545	275	371	22,800
April	1,170	350	594	35,300
May	2,360	770	1,460	89,800
June	3,030	628	1,840	109,000
July	820	325	515	31,700
August	375	275	318	19,600
September	405	260	311	18,500
The year			592	428,000
1911–12				
October	870	375	449	27,600
November	435	375	428	25,500
December			[a] 375	[a] 23,100
January			[a] 350	[a] 21,500
February			[a] 335	[a] 19,300
March	630	325	437	26,800
April	545	325	401	23,800
May	4,200	435	1,840	113,000
June	4,650	1,500	2,950	176,000
July	2,540	630	1,220	74,800
August	630	375	464	28,600
September	405	295	329	19,600
The year			800	579,000
1912–13				
October	505	295	348	21,400
November	435	245	316	18,800
December			[a] 310	[a] 19,100
January			[a] 300	[a] 18,400
February			[a] 290	[a] 16,100
March			[a] 350	[a] 21,500
April	[a] 960		[a] 562	[a] 33,400
May	2,080	670	1,150	70,700
June	1,830	762	1,140	67,800
July	700	420	576	35,400
August	395	300	351	21,600
September	445	345	390	23,200
The year			506	367,000
1913–14				
October	395	250	342	21,000
November			[a] 300	[a] 17,900
December			[a] 240	[a] 17,800
January			[a] 290	[a] 17,800
February			[a] 300	[a] 16,700
March			[a] 360	[a] 22,100
April			[a] 580	[a] 34,500
May			[a] 1,820	[a] 112,000
June	2,830	1,530	2,270	135,000
July	1,460	400	729	44,800
August	440	285	386	23,700
September	400	120	293	17,500
The year			663	481,000

[a] Estimated.

Monthly discharge of White River near Meeker, Colo., for 1901–1906 and 1909–1926—Continued

Month	Discharge in second-feet			Run-off in acre-feet
	Maximum	Minimum	Mean	
1914–15				
October	605	285	386	23,700
November			[a] 330	[a] 19,600
December			[a] 320	[a] 19,700
January			[a] 300	[a] 18,400
February			[a] 300	[a] 16,700
March			[a] 320	[a] 19,700
April	1,060	260	572	34,000
May	1,180	610	888	54,600
June	1,660	840	1,200	71,600
July	800	275	439	27,000
August	330	260	295	18,100
September	370	290	329	19,600
The year			473	343,000
1915–16				
October	370	330	340	20,900
November	420	275	330	19,600
December	510	290	379	23,300
January			[a] 325	[a] 20,000
February			[a] 325	[a] 18,700
March			[a] 408	[a] 25,100
April	1,440	370	619	36,800
May	2,680	830	1,450	89,200
June	2,680	1,670	2,080	124,000
July	1,440	540	807	49,600
August	750	370	517	31,800
September	645	370	427	25,400
The year			668	484,000
1916–17				
October	790	330	509	31,300
November	395	290	340	20,200
December			[a] 300	[a] 18,400
January			[a] 300	[a] 18,400
February			[a] 300	[a] 16,700
March			[a] 366	[a] 22,500
April	710	332	446	26,500
May	2,230	510	1,210	74,400
June	4,660	1,590	3,100	184,000
July	3,630	780	1,800	111,000
August	890	403	586	36,000
September	540	440	478	28,400
The year			812	588,000
1917–18				
October	510	386	445	27,400
November	440	332	356	21,200
December	420	340	376	23,100
January	385	315	352	21,600
February	395	325	362	20,100
March	460	350	390	24,000
April	570	360	455	27,100
May	2,150	510	1,480	91,000
June	3,650	1,020	2,300	137,000
July	1,100	360	687	42,200
August	485	320	382	23,500
September	410	290	335	19,900
The year			660	478,000
1918–19				
October	410	340	363	22,300
November	380	320	356	21,200
December			[a] 320	[a] 19,700
January			[a] 320	[a] 19,700
February			[a] 330	[a] 18,300
March			[a] 330	[a] 20,300
April			[a] 790	[a] 47,000
May	1,930	1,180	1,510	92,800
June	1,240	390	777	46,200
July	463	285	352	21,600
August	345	205	279	17,200
September	415	285	343	20,400
The year			506	367,000

[a] Estimated.

Monthly discharge of White River near Meeker, Colo., for 1901–1906 and 1909–1926—Continued

Month	Discharge in second-feet			Run-off in acre-feet
	Maximum	Minimum	Mean	
1919–20				
October	390	325	355	21,800
November	365	285	338	20,100
December	305	255	287	17,600
January			[a] 326	[a] 20,000
February			[a] 334	[a] 19,200
March	469	277	328	20,200
April	487	277	357	21,200
May	3,280	625	1,960	121,000
June	3,990	2,420	3,130	186,000
July	2,340	535	1,130	69,500
August	715	415	493	30,300
September	475	365	414	24,600
The year	3,990		788	572,000
1920–21				
October	475	365	400	24,600
November	535	475	487	29,000
December			[a] 410	[a] 25,200
January			[a] 355	[a] 21,800
February			[a] 345	[a] 19,200
March	415	285	339	20,800
April	505	325	427	25,400
May	3,970	475	2,110	130,000
June	6,070	3,100	4,090	243,000
July	3,000	710	1,520	93,500
August	830	520	669	41,100
September	630	500	556	33,100
The year	6,070		978	707,000
1921–22				
October	583	371	471	29,000
November	486	356	410	24,400
December			[a] 383	[a] 23,600
January			[a] 350	[a] 21,500
February			[a] 370	[a] 20,500
March			[a] 400	[a] 24,600
April	649	384	502	29,900
May	2,720	614	1,540	94,700
June	2,720	1,220	2,160	129,000
July	1,240	398	645	39,700
August	434	349	379	23,300
September	461	384	413	24,600
The year	2,720		671	485,000
1922–23				
October	476	332	396	24,300
November	456	330	383	22,800
December			[a] 360	[a] 22,100
January			[a] 320	[a] 19,700
February			[a] 300	[a] 16,700
March			[a] 400	[a] 24,600
April	750	500	587	34,900
May	2,650	758	1,770	109,000
June	2,590	1,280	1,920	114,000
July	1,170	463	734	45,100
August	495	326	413	25,400
September	412	270	340	20,200
The year	2,650		661	479,000
1923–24				
October	458	364	414	25,500
November	458	386	414	24,600
December			[a] 360	[a] 22,100
January			[a] 340	[a] 20,900
February			[a] 310	[a] 17,800
March			[a] 340	[a] 20,900
April	594	357	445	26,500
May	2,100	408	1,480	91,000
June	3,320	768	1,740	104,000
July	707	318	448	27,500
August	326	303	316	19,400
September	433	310	340	20,200
The year				420,000

[a] Estimated.

Monthly discharge of White River near Meeker, Colo., for 1901–1906 and 1909–1926—Continued

Month	Discharge in second-feet			Run-off in acre-feet
	Maximum	Minimum	Mean	
1924–25				
October	463	342	370	22,800
November	429	365	392	23,300
May	2,220	1,200	1,600	98,400
June	2,280	1,040	1,540	91,600
July	1,260	363	674	41,400
August	634	355	426	26,200
September	820	429	509	30,300
1925–26				
October	649	368	427	26,300
November	397	347	369	22,000
April	1,680		809	48,100
May	2,470	944	1,740	107,000
June	2,860	1,080	1,930	115,000
July	1,320	482	736	45,300
August	524	374	454	27,900
September	413	356	379	22,600

WHITE RIVER NEAR RANGELY, COLO.

Location.—In sec. 35, T. 2 N., R. 102 W., at highway bridge, 1½ miles northwest of Rangely, Rio Blanco County. Nearest tributary, Douglas Creek, enters 2½ miles upstream.

Drainage area.—3,270 square miles.

Records available.—April 15, 1904, to October 31, 1905; May 1 to November 30, 1918.

Gage.—Chain on bridge. Vertical staff during 1904 and 1905.

Discharge measurements.—Made from highway bridge.

Control.—Slightly shifting.

Cooperation.—Complete records for 1918 furnished by State engineer.

Monthly discharge of White River near Rangely, Colo., for 1904–5 and 1918

Month	Discharge in second-feet			Run-off in acre-feet
	Maximum	Minimum	Mean	
1904				
April 15–30	1,110	375	607	36,100
May	2,370	950	1,530	93,900
June	2,070	870	1,580	94,100
July	830	225	552	33,900
August	795	285	427	26,300
September	760	345	401	23,900
The period				308,000
1904–5				
October	480	345	399	24,500
April	645	413	506	30,100
May	4,110	645	1,750	108,000
June	4,750	1,610	3,150	188,000
July	1,450	489	748	45,000
August	605	502	561	34,500
September	1,690	381	674	41,400
1905				
October	1,550	435	636	39,100
1918				
May	1,700	500	1,230	75,000
June	3,950	1,140	2,260	134,000
July	1,300	532	858	52,800
August	1,220	442	981	60,300
September	1,060	324	602	35,800
October	1,300	442	785	48,300
November	580	360	455	27,000
The period				433,000

MARVINE CREEK NEAR BUFORD, COLO.

LOCATION.—At footbridge near mouth of creek, 10 miles northeast of Buford, Rio Blanco County.

DRAINAGE AREA.—30 square miles.

RECORDS AVAILABLE.—July 28, 1903, to September 30, 1906.

GAGE.—Vertical staff.

DISCHARGE MEASUREMENTS.—Made from footbridge.

Monthly discharge of Marvine Creek near Buford, Colo., for 1903–1906

Month	Discharge in second-feet			Run-off in acre-feet
	Maximum	Minimum	Mean	
1903				
July 28–31	152	139	149	1,180
August	139	112	122	7,500
September	125	98	106	6,310
The period				15,000
1903–4				
October	120		[a] 100	[a] 6,150
November			[a] 90	[a] 5,360
December			[a] 85	[a] 5,230
January			[a] 85	[a] 5,230
February			[a] 85	[a] 4,890
March			[a] 90	[a] 5,530
April	172		[a] 115	[a] 6,840
May	256	148	207	12,700
June	316	148	223	13,300
July	184	107	136	8,360
August	136	88	113	6,950
September	136	88	97.5	5,800
The year	316		119	86,300
1904–5				
October	100		[a] 90.9	[a] 5,530
November			[a] 85	[a] 5,060
December			[a] 80	[a] 4,920
January			[a] 75	[a] 4,610
February			[a] 70	[a] 3,890
March			[a] 70	[a] 4,300
April	98		[a] 76	[a] 4,520
May	183	98	127	7,810
June	377	199	272	16,200
July	211	126	153	9,410
August	145	110	120	7,380
September	122	103	109	6,490
The year	377		101	80,100
1905–6				
October	116		105	6,460
November			[a] 95	[a] 5,650
December			[a] 90	[a] 5,530
January			[a] 85	[a] 5,230
February			[a] 85	[a] 4,720
March			[a] 85	[a] 5,230
April	150		[a] 105	[a] 6,250
May	229	116	191	11,700
June	358	199	268	15,900
July	235	123	167	10,300
August	146	128	137	8,420
September	158	134	141	8,390
The year	358		129	93,800

[a] Estimated.

SOUTH FORK OF WHITE RIVER NEAR BUFORD, COLO.

Location.—About sec. 7, T. 2 S., R. 9 W., at highway bridge, 8 miles southeast of Buford, Rio Blanco County. On July 1, 1919, station reestablished in sec. 21, T. 1 S., R. 91 W., 5 miles downstream.

Drainage area.—140 square miles at upper station; 148 square miles at lower station.

Records available.—July 26, 1903, to October 31, 1906; June 1, 1910, to November 30, 1915; July 1, 1919, to November 30, 1920.

Gage.—Vertical staff.

Discharge measurements.—Made from bridge.

Control.—Fairly permanent.

Diversions.—Practically none above station.

Cooperation.—Complete records since 1910 furnished by State engineer.

Monthly discharge of South Fork of White River at Buford, Colo., for the years ending September 30, 1903–1906, 1910–1915, and 1919–20

Month	Discharge in second-feet			Run-off in acre-feet
	Maximum	Minimum	Mean	
1903				
July 26-31	290	260	273	3,250
August	260	200	215	13,200
September	275	186	226	13,400
The period				29,800
1903-4				
October	269	215	240	14,800
November			[a] 130	[a] 7,740
December			[a] 120	[a] 7,380
January			[a] 100	[a] 6,150
February			[a] 100	[a] 5,750
March			[a] 110	[a] 6,760
April	392	158	251	14,900
May	1,820	328	834	51,300
June	1,420	488	872	51,900
July	460	234	307	18,900
August	228	190	208	12,800
September	234	177	191	11,400
The year			289	210,000
1904-5				
October	210	165	182	11,200
November			[a] 110	[a] 6,550
December			[a] 100	[a] 6,150
January			[a] 90	[a] 5,530
February			[a] 90	[a] 5,000
March			[a] 100	[a] 6,150
April	265	130	175	10,400
May	975	250	497	30,600
June	2,820	550	1,570	93,400
July	510	235	324	19,900
August	241	169	200	12,300
September	199	160	167	9,940
The year			299	217,000
1905-6				
October	160	121	157	9,650
November			[a] 110	[a] 6,550
December			[a] 90	[a] 5,530
January			[a] 85	[a] 5,230
February			[a] 85	[a] 4,720
March			[a] 100	[a] 6,150
April			[a] 150	[a] 8,930
May	1,220		665	40,900
June	3,740	960	1,880	112,000
July	950	245	486	29,900
August	305	265	290	17,800
September	305	270	278	16,500
The year			364	264,000

[a] Estimated.

Monthly discharge of South Fork of White River at Buford, Colo., for the years ending September 30, 1903–1906, 1910–1915, and 1919–20—Continued

Month	Discharge in second-feet			Run-off in acre-feet
	Maximum	Minimum	Mean	
1906				
October	288	235	243	14,900
1910				
June	2,300	397	1,120	66,800
July	397	175	248	15,200
August	200	128	164	10,100
September	150	108	125	7,440
The period				99,600
1910–11				
October	128	108	109	6,700
November	108	90	101	6,010
December	90	90	[a] 90	[a] 5,530
January			[a] 85	[a] 5,230
February			[a] 85	[a] 4,720
March	90	75	89	5,470
April	255	90	145	8,640
May	1,320	165	602	37,000
June	2,150	511	1,420	84,300
July	511	208	325	20,000
August	186	90	129	7,930
September	107	107	107	6,370
The year			274	198,000
1911–12				
October	279	125	144	8,880
November			[a] 110	[a] 6,550
December			[a] 90	[a] 5,530
January			[a] 85	[a] 5,230
February			[a] 85	[a] 4,890
March	110	90	95	5,850
April	194	90	106	6,330
May	1,270	131	450	27,700
June	2,440	800	1,720	102,000
July	1,340	306	662	40,700
August	283	152	203	12,500
September	152	131	132	7,880
The year			322	234,000
1912–13				
October	131	120	127	7,840
November			[a] 100	[a] 5,950
December			[a] 95	[a] 5,840
January			[a] 90	[a] 5,530
February			[a] 85	[a] 4,720
March			[a] 125	[a] 7,690
April	294	216	246	14,600
May	1,640	260	696	42,800
June	1,640	366	688	40,900
July	342	205	262	16,100
August	205	131	158	9,720
September	152	131	137	8,150
The year			234	170,000
1913–14				
October	152	131	144	8,850
November	142	110	[a] 115	[a] 6,840
December			[a] 100	[a] 6,150
January			[a] 90	[a] 5,530
February			[a] 90	[a] 5,000
March	200	118	136	8,380
April	210	118	148	9,400
May	1,420	190	601	36,900
June	1,870	795	1,450	86,300
July	915	260	457	28,100
August	260	180	199	12,200
September	180	140	163	9,680
The year			308	223,000

[a] Estimated.

Monthly discharge of South Fork of White River at Buford, Colo., for the years ending September 30, 1903–1906, 1910–1915, and 1919–20—Continued

Month	Discharge in second-feet			Run-off in acre-feet
	Maximum	Minimum	Mean	
1914–15				
October	240	140	189	11,600
November	140		135	8,030
December			[a] 100	[a] 6,150
January			[a] 90	[a] 5,530
February			[a] 85	[a] 4,720
March			[a] 90	[a] 5,530
April	375	110	166	9,870
May	660	214	392	24,100
June	1,130	495	753	44,800
July	507	125	227	13,900
August	168	110	134	7,940
September	125	110	114	6,820
The year			206	149,000
1915				
October	125	110	111	6,820
November	110	95	100	5,950
1919				
July	253	156	191	11,700
August	154	103	122	7,500
September	150	110	119	7,080
The period				26,300
1919–20				
October	135	98	113	6,950
November	122	75	106	6,310
December			[a] 95	[a] 5,840
January			[a] 90	[a] 5,530
February			[a] 85	[a] 4,890
March	135	65	109	6,700
April	165	110	130	7,740
May	1,200	200	532	32,700
June	1,820	1,200	1,440	85,700
July	1,140	320	612	37,600
August	390	193	276	17,000
September	200	135	150	8,930
The year	1,820		312	226,000
1920				
October	200	150	169	10,400
November	219	135	174	10,400

[a] Estimated.

FISH CREEK AT SCOFIELD, UTAH

LOCATION.—In sec. 10, T. 12 S., R. 7 E., three-quarters of a mile above railroad siding at Hale, 5 miles northeast of Scofield, Carbon County, and 10 miles above point where Fish Creek and White River unite to form Price River.

DRAINAGE AREA.—163 square miles (measured on United States Forest Service map, 1920).

RECORDS AVAILABLE.—November 17, 1917, to September 30, 1921, when station was discontinued; fragmentary.

GAGE.—Stevens 8-day water-stage recorder on left bank 85 feet below railroad bridge; installed November 17, 1917; inspected by J. E. Jensen. Also inside and outside vertical enamel staff gages.

DISCHARGE MEASUREMENTS.—Made by wading, from railroad bridge near gage, from road bridge 1 mile upstream.

CHANNEL AND CONTROL.—One channel at all stages. Right bank is a high rock cliff; left bank lower but probably not subject to overflow. Railroad embankment a few feet back from left bank can not be overflowed. Stream bed gravel and sand. Riffle a short distance below gage.

Extremes of discharge.—1918–1921: Maximum stage recorded, 10.4 feet about May 24, 1920, from high-water mark in gage house (discharge, about 1,000 second-feet). Minimum discharge not determined.

Ice.—Stream freezes over each winter.

Diversions.—No information. Probably some small diversions for irrigation above station.

Regulation.—None after the failure on June 24, 1917, of the Mammoth Reservoir Dam on Gooseberry Fork, a tributary to Fish Creek. This reservoir had a capacity of about 10,000 acre-feet and was used by the Price River Irrigation Co. to store water for irrigation near Price, Utah.

Accuracy.—Records given are good.

Monthly discharge of Fish Creek near Scofield, Utah, for 1917–1921

Month	Discharge in second-feet			Run-off in acre-feet
	Maximum	Minimum	Mean	
1917–18				
November 17–30	29	18	24.9	692
December	24		[a] 16.5	[a] 1,010
January			[a] 8.58	[a] 528
February			[a] 15.0	[a] 833
March	85		[a] 34.4	[a] 2,120
April	132	37	69.1	4,110
May	335	150	268	16,500
June	230	35	115	6,840
July	99	20	38.5	2,370
August	29	16	19.6	1,200
September	60	15	21.4	1,270
The period				37,500
1918–19				
October	45		26.2	1,610
April	335	83	163	9,700
May	474	178	344	21,200
June	153	24	63.1	3,750
July	29	16	18.7	1,150
August	26	13	16.4	1,010
September	28	13	17.5	1,040
1919–20				
October	22	16	17.4	1,070
May		211	519	31,900
June	664		248	14,800
July	63	24	36.6	2,250
August	45	21	26.7	1,640
September	27	21	23.5	1,400
1920–21				
October	31	19	23.8	1,460
November	31	14	22.3	1,330
August	54	33	39.0	2,400
September	67	27	33.0	1,960

[a] Estimated.

PRICE RIVER NEAR HELPER, UTAH

Location.—In SE. ¼ sec. 36, T. 13 S., R. 9 E., at highway bridge, three-quarters of a mile above diversion dam of Price River Irrigation Co., 2 miles south of Helper, Carbon County, and 3 miles below Spring Creek.

Drainage area.—530 square miles (measured on topographic map).

Records available.—February 20, 1904, to September 30, 1926.

Gage.—Chain gage on highway bridge installed May 29, 1922; inspected by D. S. Rowley.

Discharge measurements.—Made from highway bridge or by wading.

Channel and control.—Bed of stream composed of gravel and sand. One channel at all stages. Control is a riffle of gravel and cobbles.

EXTREMES OF DISCHARGE.—1904–1926: Summer floods occur nearly every year and often greatly exceed any recorded stage. Maximum stage recorded for which discharge was determined, 8.43 feet at 9 p. m. June 25, 1917, determined by leveling from hub set at high-water mark (discharge determined from extension of rating curve, 8,500 second-feet). Minimum discharge, 4 second-feet during December, 1905, January, 1906, and August 8, 1925.

ICE.—Stage-discharge relation affected by ice nearly every winter.

DIVERSIONS.—Main diversions from Price River are below station.

REGULATION.—Practically none.

ACCURACY.—Records good.

Monthly discharge of Price River near Helper, Utah, for 1904–1926

Month	Discharge in second-feet			Run-off in acre-feet
	Maximum	Minimum	Mean	
1904				
February 20–29	70	16	38	754
March	70	27	44	2,700
April	288	63	162	9,640
May	433	230	335	16,000
June	259	97	183	7,260
July	100	44	57.6	3,540
August	63	27	38.7	2,380
September	63	9	38.1	2,270
The period	433	9		44,500
1904–5				
October	63	20	29.5	1,810
November	35	14	21.2	1,260
December	63	9	17.8	1,090
January	30	18	21.1	1,300
February	60	24	36.3	2,020
March	69	37	49.8	3,060
April	305	6	71.5	4,250
May	678	150	379	23,300
June	563	44	254	15,110
July	44	18	25.8	1,590
August	44	9	18.8	1,160
September	1,740	9	87.8	5,220
The year	1,740	9	84.2	61,200
1905–6				
October	44	18	26.3	1,620
November	30	9	20.5	1,220
December	18	4	12.0	738
January	18	4	7.1	437
February	30	9	16.5	916
March	182	4	38.6	2,370
April	563	60	290	17,300
May	1,530	305	949	58,400
June	740	150	446	26,500
July	1,220	78	191	11,700
August	354	44	113	6,950
September	60	30	42.0	2,510
The year				131,000
1906–7				
October	30	30	30	1,840
November	60	18	27.5	1,640
December	30	18	19.5	1,200
January	60	18	23.8	1,460
February	60	18	40.6	2,250
March	150	18	72.0	4,430
April 1–11	455	122	244	5,320
June 23–30	736	468	554	8,790
July	468	140	242	14,900
August	680	54	141	8,670
September	114	54	67.6	4,020
The period				54,500

Monthly discharge of Price River near Helper, Utah, for 1904-1926—Continued

Month	Discharge in second-feet			Run-off in acre-feet
	Maximum	Minimum	Mean	
1907-8				
October	54	54	54	3,320
November	54	42	46	2,740
December	54	42	44.3	2,720
January	50	35	40.3	2,480
February	68	35	40.7	2,340
March	910	35	248	15,200
April	418	50	268	15,900
May	326	204	256	15,700
June	242	89	169	10,100
July	242	23	50.9	3,130
August	570	7	56.8	3,490
September	50	7	17.5	1,040
The year				78,200
1908-9				
October	68	23	33.6	2,070
November	50	23	37.8	2,250
December	35	14	29.2	1,800
January			[a] 14.0	[a] 861
February		8	[a] 13	[a] 722
March	120	24	59.1	3,630
April	729	95	364	21,700
May	1,460	455	1,030	63,300
June	1,660	357	925	55,000
July	311	95	167	10,300
August	357	72	146	8,980
September	1,090	72	142	8,450
The year				179,000
1909-10				
October	95	53	71.6	4,400
November	53	53	53.0	3,150
December	53	24	47.7	2,930
January	519	24	155	9,530
February	53	24	40.5	2,250
March	1,470	24	318	19,600
April	1,470	370	794	47,200
May	1,350	307	801	49,300
June	307	53	136	8,090
July	95	37	43.5	2,670
August	228	14	33.8	2,080
September	607	24	62.7	3,730
The year				155,000
1910-11				
October	252	37	67.7	4,160
November	53	24	38.8	2,310
December	125	24	47.6	2,930
January	210	20	42.5	2,610
February	137	40	56.9	3,160
March	534	40	202	12,400
April	384	170	225	13,400
May	810	318	558	34,300
June	420	82	236	14,000
July	234	59	81.6	5,020
August	59	25	36.7	2,260
September	1,350	25	128	7,620
The year				104,000
1911-12				
October	170	82	89.5	5,500
November	82	40	73.1	4,350
December	107	40	64.2	3,950
January			25	[a] 1,540
February			30	[a] 1,730
March			35	[a] 2,150
April	320	42	121	7,200
May	896	99	451	27,700
June	990	138	444	26,400
July	153	77	120	7,380
August	123	39	64.5	3,970
September	176	36	49.9	2,970
The year				94,800

[a] Estimated.

Monthly discharge of Price River near Helper, Utah, for 1904–1926—Continued

Month	Discharge in second-feet			Run-off in acre-feet
	Maximum	Minimum	Mean	
1912–13				
October	990	29	72.7	4,470
November	42	18	29.5	1,760
December	29	18	27.4	1,680
January	24	9	17.2	1,060
February	24	9	18.2	1,010
March	943	16	72.8	4,480
April	2,020	176	500	29,800
May	650	348	480	29,500
June	548	110	238	14,200
July	2,100	68	193	11,900
August	191	24	65.0	4,000
September	1,140	29	88.3	5,250
The year	2,100	9	----------	109,000
1913–14				
October	55	39	46.8	2,880
November	71	16	48	2,860
December	41	21	29.1	1,790
January	41	23	31.9	1,960
February	57	30	40	2,220
March	295	29	127	7,810
April	704	170	471	28,000
May	1,680	477	1,160	71,300
June	896	150	465	27,700
July	571	126	208	12,800
August	285	79	117	7,190
September	63	45	50.6	3,010
The year	1,680	16	234	170,000
1914–15				
October	326	50	71.8	4,410
November	50	21	39.5	2,350
December	40	28	35.9	2,210
January	38	26	29.1	1,790
February	52	26	40.0	2,220
March	155	40	73.7	4,530
April	418	106	207	12,300
May	394	252	326	20,000
June	338	116	209	12,400
July	160	77	128	7,870
August	89	26	57.2	3,520
September	444	25	50	2,980
The year	444	21	106	76,600
1915–16				
October	34	27	31.2	1,920
November	85	24	38.1	2,270
December	36	21	31.2	1,920
January	36	28	33.5	2,060
February	45	27	35.2	2,020
March	582	30	175	10,800
April	1,000	210	494	29,400
May	1,370	550	851	52,300
June	685	143	372	22,100
July	800	139	195	12,000
August	276	67	141	8,670
September	130	55	66	3,930
The year	1,370	21	206	149,000
1916–17				
October	360	45	84	5,160
November	49	30	[a] 39.4	[a] 2,340
December	41	----------	[a] 34.8	[a] 2,140
January	40	30	33.4	2,050
February	117	----------	[a] 54.1	[a] 3,000
March	143	----------	[a] 71.2	[a] 4,380
April	1,220	88	363	21,600
May	1,570	360	922	56,700
June	3,350	365	1,070	63,700
July	800	95	178	10,900
August	76	44	54.7	3,360
September	185	41	53.2	3,170
The year	3,350	30	246	178,000

[a] Estimated.

Monthly discharge of Price River near Helper, Utah, for 1904–1926—Continued

Month	Discharge in second-feet			Run-off in acre-feet
	Maximum	Minimum	Mean	
1917–18				
October	50	43	46.1	2,830
November	48	29	37.4	2,230
December	50	28	41.3	2,540
January	46	24	40.3	2,480
February	52	34	41.6	2,310
March	167	38	85.7	5,270
April	175	77	115	6,840
May	348	147	286	17,600
June	231	38	124	7,380
July	966	22	93.5	5,750
August	69	14	26.8	1,650
September	430	14	56.6	3,370
The year	966	14	83.2	60,200
1918–19				
October	187	31	58.9	3,620
November	61	27	44.6	2,650
December	61	40	50.2	3,090
January	58	23	34.3	2,110
February	58	16	34.9	1,940
March	424	27	95.2	5,850
April	600	172	313	18,600
May	946	253	558	34,300
June	231	40	103	6,130
July	45	28	36.4	2,240
August	424	20	45.6	2,800
September	1,500	20	137	8,150
The year	1,500	16	126	91,500
1919–20				
October	41	33	38.0	2,340
November	38	19	[a] 27.3	[a] 1,620
December	38		[a] 28.8	[a] 1,770
January	40		[a] 27.7	[a] 1,700
February	50	22	29.4	1,690
March	130	19	36.9	2,270
April	459	20	104	6,190
May	2,000	281	1,090	67,000
June	1,220	152	458	27,300
July	147	36	77.1	4,740
August	1,000	26	131	8,060
September	350	34	63.1	3,750
The year	2,000		177	128,000
1920–21				
October	75	39	46.8	2,880
November	79	30	[a] 45.0	[a] 2,680
December			[a] 25.0	[a] 1,540
January			[a] 25.0	[a] 1,540
February			[a] 33.1	[a] 1,840
March	293	96	180	11,100
April	306	177	260	15,500
May	1,950	330	1,280	78,700
June	1,800	181	782	46,500
July	362	48	104	6,400
August		45	[a] 140	[a] 8,600
September	858	54	107	6,370
The year			252	184,000
1921–22				
October	86	48	57.0	3,500
November	54		[a] 48.8	[a] 2,900
December			[a] 47.6	[a] 2,930
January			[a] 40.0	[a] 2,460
February			[a] 38.0	[a] 2,110
March	158		[a] 68.6	[a] 4,220
April	762	83	226	13,400
May	3,100	730	1,640	101,000
June	1,940	195	814	48,400
July	254	74	135	8,300
August	225	54	95.1	5,850
September	115	37	54.4	3,240
The year	3,100		272	198,000

[a] Estimated.

Monthly discharge of Price River near Helper, Utah, for 1904–1926—Continued

Month	Discharge in second-feet			Run-off in acre-feet
	Maximum	Minimum	Mean	
1922-23				
October	69	30	37.9	2,330
November	63	29	43.6	2,590
December	61		[a] 43.1	[a] 2,650
January	49		[a] 40.9	[a] 2,510
February	95		[a] 45.1	[a] 2,500
March	133	24	48.9	3,010
April	917	116	414	24,600
May	1,660	508	1,280	78,700
June	1,100	176	520	30,900
July	250	88	144	8,850
August	136	40	73.4	4,510
September	88	38	59.2	3,520
The year	1,660		230	167,000
1923-24				
October	88	50	60.3	3,710
November	64	29	45.1	2,680
December	44		[a] 26.1	[a] 1,600
January			[a] 30	[a] 1,840
February	85		[a] 49.3	[a] 2,840
March	54	31	43.3	2,660
April	564	40	236	14,000
May	234	108	169	10,400
June	122	16	46.7	2,780
July	50	10	17.7	1,090
August	500	7	39.2	2,410
September	300	8	40.9	2,430
The year	564	7	66.8	48,400
1924-25				
Ocotber	41	7	20.6	1,270
November	39	9	24.4	1,450
December	37		[a] 22.7	[a] 1,400
January			[a] 26.3	[a] 1,620
February	54		[a] 37.5	[a] 2,080
March	177	30	73.0	4,490
April	182	88	127	7,560
May	296	83	195	12,000
June	600	30	101	6,010
July	150	18	44.6	2,740
August	1,300	4	128	7,870
September	1,000	24	66.8	3,970
The year	1,300	4	72.5	52,500
1925-26				
October	500	20	57.3	3,520
November	76	16	22.9	1,360
December	33		[a] 18.8	[a] 1,160
January			[a] 15.7	[a] 965
February	40		[a] 30.1	[a] 1,670
March	410	44	104	6,400
April	641	65	241	14,300
May	537	132	336	20,700
June	129	49	93.6	5,570
July	150	27	86.2	5,300
August	84	15	35.4	2,180
September	27	9	11.1	660
The year	641	9	88.0	63,800

[a] Estimated.

PRICE RIVER AT WOODSIDE, UTAH

Location.—At Denver & Rio Grande Western Railroad bridge crossing Price River at Woodside, in secs. 9 and 16, T. 18 S., R. 14 E., Salt Lake base and meridian, 8 miles below a proposed diversion dam for an irrigation project, and 15 miles above junction with Green River.

Records available.—October 1, 1909, to December 31, 1910. Gage heights for 1911 published in Water-Supply Paper 309.

Drainage area.—1,500 square miles.

GAGE.—Distance from a fixed point on the bridge to water surface is measured daily.

CHANNEL.—Composed largely of quicksand.

DIVERSIONS.—A few small tributaries enter Price River between the dam site and the station.

DISCHARGE MEASUREMENTS.—Made from upper side of railroad bridge.

WINTER FLOW.—Stage-discharge relation probably affected by ice during winter.

ACCURACY.—Because of the shifting character of the stream bed and because only two measurements were made during 1911, estimates of daily and monthly discharge can not be made.

COOPERATION.—Data for this station supplied by Horace W. Sheley, consulting engineer, Salt Lake City, Utah. The location of station and methods of collecting data and making estimates have been approved by the United States Geological Survey.

Monthly discharge of Price River at Woodside, Utah, for 1909–10

Month	Discharge in second-feet			Run-off in acre-feet
	Maximum	Minimum	Mean	
1909–10				
October	95	64	74	4,600
November	135	64	80	4,800
December			[a] 73	[a] 4,400
January			[a] 70	[a] 4,300
February			[a] 70	[a] 4,200
March	2,870	270	792	48,700
April	1,880	465	918	54,600
May	1,710	480	1,102	67,800
June	1,300	37	187	11,100
July	1,600	0	114	7,000
August	450	0	41	2,500
September	1,700	0	221	13,200
The year				227,000
1910				
October	2,750	59	207	12,700
November	370	38	128	7,600
December	150	68	92	5,600

[a] Estimated.

HUNTINGTON CREEK NEAR HUNTINGTON, UTAH

LOCATION.—In SE. ¼ sec. 6, T. 17 S., R. 8 E., at Cunha ranch, 7 miles northwest of Huntington, Emery County. Below all main tributaries except Fish Creek.

DRAINAGE AREA.—188 square miles (measured on United States Forest Service map, 1920).

RECORDS AVAILABLE.—May 3. 1909, to September 30, 1926; fragmentary.

GAGE.—Stevens continuous water-stage recorder on right bank installed September 11, 1917; reinstalled to same datum on left bank 25 feet upstream September 25, 1925; inspected by Joseph Cunha.

DISCHARGE MEASUREMENTS.—Made by wading or from bridge at gage.

CHANNEL AND CONTROL.—Bed composed of gravel and sand. Control of coarse gravel; fairly permanent. Point of zero flow at gage height, 1.1 or 1.2 feet; determined September 17, 1924.

EXTREMES OF DISCHARGE.—1909–1926: Maximum discharge, 1,340 second-feet at 9.30 p. m. May 25, 1920, and at 11 p. m. May 25, 1922. Discharge may have been greater in 1921. Minimum discharge recorded, 12 second-feet March 20–23, 1912.

ICE.—Stage-discharge relation seriously affected by ice.
DIVERSIONS.—A small storage reservoir on Huntington Creek above the station controls distribution of flow to a slight extent.
ACCURACY.—Records fair.

Monthly discharge of Huntington Creek near Huntington, Utah, for 1909–1926

Month	Discharge in second-feet			Run-off in arce-feet
	Maximum	Minimum	Mean	
1909				
May 3-31	672	160	467	26,900
June	1,040	550	741	44,100
July	308	142	191	11,700
August	177	46	107	6,580
September	800	37	102	6,070
The period	1,040	37		95,400
1909–10				
October	74	26	35.0	2,150
November	42	29	38.8	2,310
December			[a] 34.8	[a] 2,140
January	56	26	45.9	2,820
February	90	26	52.3	2,900
March	165	26	81.1	4,990
April	680	107	326	19,400
May	1,070	204	655	40,300
June	232	87	164	9,760
August	47	29	32.6	2,000
September	112	38	56.4	3,360
1910–11				
October	58	38	39.9	2,450
November	34	34	34.0	2,020
December	38	29	32.9	2,020
January			[a] 30	[a] 1,840
February			[a] 40	[a] 2,220
March	58	38	49.4	3,040
April	221	47	79.3	4,720
May	344	251	296	18,200
June	386	143	275	16,400
July	167	86	121	7,440
August	71	38	62.5	3,840
September	47	29	36.8	2,190
The year				66,400
1911–12				
October			[a] 25	[a] 1,540
November			[a] 25	[a] 1,490
December			[a] 20	[a] 1,230
January			[a] 18	[a] 1,110
February			[a] 20	[a] 1,150
March	35	12	24	1,480
April	70	27	43	2,560
May	766	44	269	16,500
June	966	178	488	29,000
July	600	63	127	7,800
August	143	71	85	5,230
September	58	38	48	2,860
The year				72,000
1912–13				
October	58	18	36	2,210
November	20		[a] 12	[a] 714
December			[a] 10	[a] 615
January			[a] 25	[a] 1,540
February			[a] 30	[a] 1,670
March			[a] 41.2	[a] 2,530
April	398	46	157	9,340
May	588	120	376	23,100
June	358	140	218	13,000
July	164	88	126	7,750
August	85	61	70.9	4,360
September	133	42	69.6	4,140
The year	588			71,000

[a] Estimated.

Monthly discharge of Huntington Creek near Huntington, Utah, for 1909–1926—Continued

Month	Discharge in second-feet			Run-off in acre-feet
	Maximum	Minimum	Mean	
1913–14				
October	58	39	[a] 46.8	[a] 2,880
November	56		[a] 43.2	[a] 2,570
December			[a] 48.0	[a] 2,950
January			[a] 52	[a] 3,200
February			[a] 42.3	[a] 2,350
March	65	32	52.8	3,250
April	224	59	134	7,970
May	1,100	151	764	47,000
June	1,010	162	474	28,200
July	188	116	145	8,920
August	140	73	102	6,270
September	73	48	55.7	3,310
The year	1,100		164	119,000
1914–15				
October	77	45	56.7	3,490
November	47	33	40.7	2,420
December			[a] 30.3	[a] 1,860
January			[a] 34.6	[a] 2,130
February	36	26	31.8	1,770
March	54	33	43.9	2,700
April	326	51	125	7,440
May	404	129	224	13,800
June	396	136	236	14,000
July	160	91	124	7,620
August	91	38	63.4	3,[illegible]00
September	63	37	41.8	2,490
The year	404		87.9	63,600
1915–16				
October	46	37	41	2,520
November	58		[a] 39.2	[a] 2,330
December			[a] 38.9	[a] 2,390
January			[a] 38.6	[a] 2,370
February			[a] 35.8	[a] 2,060
March	70		[a] 54.6	[a] 3,360
April	468	62	128	7,620
May	894	240	549	33,800
June	734	175	480	28,600
July	166	110	141	8,670
August	180	82	118	7,250
September	74	52	54.5	3,240
The year	894		141	104,000
1916–17				
October	106	35	56.2	3,460
November	40	30	35.9	2,140
December			[a] 35.4	[a] 2,180
January			[a] 25.0	[a] 1,540
February			[a] 30.0	[a] 1,670
March	80		[a] 44.8	[a] 2,750
April	175	66	92.6	5,510
May	810	116	418	25,700
June		462	[a] 779	[a] 46,400
July	458	120	227	14,000
August	129	74	101	6,210
September	94	55	67.7	4,030
The year				116,000
1918–19				
October			[a] 45	[a] 2,800
November 1–21	57	24	48.0	2,000
April	480		[a] 150	[a] 9,000
May	600		[a] 475	[a] 29,000
1920				
April	63	25	42.3	2,520
May	1,150	84	569	35,000
June	896	205	452	26,900
The period				64,400
1920–21				
October	54	30	43.6	2,680
November	58	36	44.9	2,670
March 19–31			[a] 58.1	[a] 1,500
April		45	[a] 88.8	[a] 5,280
May		256	636	39,100
June		322	766	45,600
July	302		184	11,300
August	248	96	155	9,530
September	228	60	94.9	5,650

[a] Estimated.

Monthly discharge of Huntington Creek near Huntington, Utah, for 1909–1926—Continued

Month	Discharge in second-feet			Run-off in acre-feet
	Maximum	Minimum	Mean	
1921–22				
October	74		[a] 62.8	3,860
November	60		[a] 51.3	[a] 3,050
December			[a] 40	[a] 2,460
January			[a] 45	[a] 2,770
February			[a] 45	[a] 2,500
March			[a] 50.9	[a] 3,130
April	168		77.5	4,610
May	1,040	188	520	32,000
June	918	250	553	32,900
July	234	146	173	10,600
August		62	123	7,560
September	116	30	51.8	3,080
The year	1,040	30	150	109,000
1922–23				
October		14	[a] 17.5	[a] 1,080
November			[a] 29.4	[a] 1,750
December			[a] 45.6	[a] 2,800
January			[a] 48.4	[a] 2,980
February			[a] 45	[a] 2,500
March			[a] 50	[a] 3,070
April	135	53	82.3	4,900
May	759	99	502	30,900
June	476	190	329	19,600
July	264	120	181	11,100
August	131	58	92.4	5,680
September	59	44	52.5	3,120
The year	759	14	124	89,500
1923–24				
October	52	40	47.1	2,900
November	45	40	42.0	2,500
December			[a] 40	[a] 2,460
January			[a] 35	[a] 2,150
February			[a] 30	[a] 1,730
March			[a] 30	[a] 1,840
April	136		[a] 75.1	[a] 4,470
May	250	114	192	11,800
June	145	53	986	5,870
July	88	43	64.0	3,940
August	45	27	352	2,160
September	100	25	40.3	2,400
The year	250		60.9	44,200
1924–25				
October	37	29	32.4	1,990
November			[a] 33.0	[a] 1,960
December			[a] 25.5	[a] 1,570
January			[a] 27.6	[a] 1,700
February			[a] 28.4	[a] 1,580
March	46		[a] 35.3	[a] 2,170
April	174	41	104	6,190
May	270	138	209	12,900
June	161	100	122	7,260
July	126	82	96.5	5,930
August	93	37	67.4	4,140
September	46	31	35.2	2,090
The year	270		68.3	49,500
1925–26				
October	55	31	34.6	2,130
November	36	20	30.8	1,830
December			[a] 35	[a] 2,150
January			[a] 35	[a] 2,150
February			[a] 35	[a] 1,940
March	54		[a] 41.7	[a] 2,560
April	349	37	132	7,860
May	515	171	327	20,100
June	293	89	149	8,870
July	115	60	91.5	5,630
August	73	30	50.1	3,080
September	40	29	32.0	1,900
The year	515	20	83.2	60,100

[a] Estimated.

HUNTINGTON CREEK NEAR CASTLE DALE, UTAH

LOCATION.—In sec. 33, T. 18 S., R. 9. E., half a mile below bridge on road to Green River, 5 miles above mouth of Cottonwood Creek, and 6 miles east of Castle Dale, Emery County.

DRAINAGE AREA.—325 square miles (measured on topographic maps).

RECORDS AVAILABLE.—July 1, 1911, to August 13, 1921, when station was discontinued; fragmentary. (Gage heights only published July 27 to August 13, 1921, Water-Supply Paper 529.)

GAGE.—Stevens continuous water-stage recorder on right bank; inspected by Rex Peterson; installed May 2, 1913, at same datum as vertical staff gage which it replaced.

DISCHARGE MEASUREMENTS.—Made by wading or from cable just below gage.

CHANNEL AND CONTROL.—Bed composed of sand and small gravel. Banks fairly high; subject to erosion but not to overflow. Original artificial control which was formed by 2 by 12 inch planks, placed edgewise in a trench and anchored to pipes driven into stream bed, has been obliterated.

EXTREMES OF DISCHARGE.—1911–1921: Maximum stage recorded, 11.3 feet, September 8, 1913, when dam above station broke (discharge estimated, 1,750 second-feet). Minimum stage recorded, 0.95 foot, September 10, 1915 (discharge, 2.5 second-feet).

ICE.—Stage discharge relation seriously affected by ice each winter.

DIVERSIONS.—The station is below all diversions in Castle Valley.

REGULATION.—Flow affected by irrigation in Huntington district.

ACCURACY.—Records given are good.

Monthly discharge of Huntington Creek near Castle Dale, Utah, for 1911–1917 and 1919–1921

Month	Discharge in second-feet			Run-off in acre-feet
	Maximum	Minimum	Mean	
1911				
July	117	7.5	34.5	2,120
August	234	5	21.0	1,290
September	301	3.5	18.2	1,080
The period				4,490
1911–12				
October	41	10	14.3	879
November	16	10	11.8	702
December			[a] 10.0	[a] 615
January	10	5	7.1	437
February	8	4	5.8	334
March	31	5	16.1	990
April	38	10	27.2	1,620
May	725	6	158	9,720
June	695	82	340	20,200
July	150	10	32.9	2,020
August	175	8	30.1	1,850
September	47	10	13.8	821
The year	725	4		40,200
1912–13				
October 1–4	16	15	15.8	125
May	315	72	179	11,000
June	154	28	66.2	3,940
July			[a] 15.0	[a] 922
August			[a] 9.65	[a] 593
September	580		[a] 37.6	[a] 2,240

[a] Estimated.

Monthly discharge of Huntington Creek near Castle Dale, Utah, for 1911–1917 and 1919–1921—Continued

Month	Discharge in second-feet			Run-off in acre-feet
	Maximum	Minimum	Mean	
1913–14				
October			[a] 18.5	[a] 1,140
November	35	18	22.4	1,330
December	26	18	21.5	1,320
January			[a] 38	[a] 2,340
February			[a] 40.1	[a] 2,230
March			[a] 42.9	[a] 2,640
April	123	29	70.4	4,190
May	738	40	[a] 455	[a] 28,000
June	679	57	307	18,300
July	143	24	[a] 48.4	[a] 2,980
August			[a] 48.7	[a] 2,990
September	77	7	11.3	672
The year	738	7	94.0	68,100
1914–15				
October			[a] 26	[a] 1,600
November	34	13	23.2	1,380
December			[a] 28	[a] 1,720
January			[a] 32	[a] 1,970
February			[a] 30	[a] 1,670
March			[a] 35	[a] 2,150
April	204	26	92.7	5,520
May	144	37	71.2	4,380
June	180	13	55.1	3,280
July	12	5	7.68	472
August	4.8	2.8	3.70	228
September	15	2.6	4.82	287
The year	204	2.6	34.0	24,700
1915–16				
October	9	6	8.13	500
November	128	8	30.7	1,830
December			[a] 27.0	[a] 1,660
January			[a] 27.0	[a] 1,660
February			[a] 40.0	[a] 2,300
March			[a] 78.9	[a] 4,850
April	268	45	105	6,250
May	487	110	250	15,400
June	430	30	206	12,300
July	24	11	16.1	990
August	222		47.2	2,900
September	17	12	13.7	815
The year	487	6	70.8	51,500
1916–17				
October	481	22	74.3	4,570
November	39		[a] 32.4	[a] 1,930
December			[a] 32.1	[a] 1,970
January			[a] 20	[a] 1,230
February			[a] 30	[a] 1,670
March			[a] 40	[a] 2,460
April	132	26	48.9	2,910
May	703	54	269	16,500
June	903	223	522	31,100
July	198	15	52.0	3,200
August	25	10	16.6	1,020
September	126	7	24.3	1,450
The year	903	7	96.8	70,000
1917				
October	36	20	25.0	1,540
November	32	25	27.7	1,650
1919				
April	306	42	126	7,500
May	443	96	207	12,700
June	56	14	21.9	1,300
July	31	11	13.4	824
August	48	6	12.6	775
The period				23,100

[a] Estimated.

Monthly discharge of Huntington Creek near Castle Dale, Utah, for 1911–1917 and 1919–1921—Continued

Month	Discharge in second-feet			Run-off in acre-feet
	Maximum	Minimum	Mean	
1920				
March	60	28	41.2	2,530
April	47	29	36.3	2,160
May	839	38	344	21,200
June	515	25	166	9,880
July	34	17	22.0	1,350
August	85	13	26.2	1,610
September	14	10	11.6	690
The period				39,400
1920–21				
October	71	11	18.2	1,120
November	40	25	28.2	1,680
March 11–31	44	23	33.3	1,390
April	54	16	30.5	1,810
May	705	17	236	14,500
June	868	67	447	26,600
July 1–27	317		70.8	3,790

SAN RAFAEL RIVER NEAR GREEN RIVER, UTAH

Location.—In sec. 27, T. 22 S., R. 14 E., at county bridge near Tomlinson ranch, on road from Green River to Hanksville, 16 miles southwest of Green River, Emery County.

Drainage area.—1,690 square miles (measured on topographic map).

Records available.—May 5, 1909, to September 30, 1918. Gage heights for 1919–20 published in Water-Supply Paper 509. Station was discontinued July 10, 1920.

Gage.—Steel tape gage on downstream side of bridge, installed September 10, 1919. Prior to that date vertical staff on downstream side of right abutment of bridge. Datum of vertical staff was 6.18 feet higher than datum of tape gage. Read by W. E. Watson and P. F. Herron.

Discharge measurements.—Made from highway bridge at gage or by wading.

Channel and control.—Bed composed of mud and quicksand; shifting. Control not well defined. Banks fairly high but left bank subject to overflow during extreme floods.

Extremes of discharge.—Not determined for 1919 and 1920.

1909–1918: Maximum stage recorded, 12.6 feet October 8, 1916 (discharge, 7,300 second-feet); water standing in pools during August and September, 1910, and August 13 to September 8, 1915.

Ice.—Stage-discharge relation seriously affected by ice.

Diversions.—Below practically all diversions from San Rafael River. The main diversions in basin are made from the tributaries, for irrigation in Castle Valley.

Regulation.—None.

Accuracy.—Discharge measurements obtained are insufficient to determine a rating, as stage-discharge relation is frequently changed by shifting sand and by driftwood lodging against pile bents of bridge. The only reliable gage-height records obtained during 1919–20 were readings of tape gage September 10, 1919, to July 10, 1920.

Monthly discharge of San Rafael River near Green River, Utah, for 1909–1918

Month	Discharge in second-feet			Run-off in acre-feet
	Maximum	Minimum	Mean	
1909				
May 5-31	1,660	221	721	38,600
June	3,610	1,090	2,450	146,000
July	1,310	200	523	32,200
August	3,730	180	745	45,800
September	4,720	150	655	39,000
The period				302,000
1909–10				
October	140	110	128	7,870
November	360	130	162	9,640
March	2,330	320	729	44,800
April	1,880	310	748	44,500
May	2,100	690	1,200	73,800
June	900	57	307	18,300
July	492	8	110	6,760
August	390	0	44.3	2,720
September	3,040	0	235	14,000
1910–11				
October	2,250	46	222	13,600
November	310	36	98.8	5,880
December	150	68	101	6,210
January	1,550	102	224	13,800
February	649	137	196	10,900
March	261	108	164	10,100
April	272	119	163	9,700
May	835	128	492	30,300
June	939	214	608	36,200
July	238	54	98.8	6,080
August	614	50	88.0	5,410
September	2,070	50	152	9,040
The year	2,250		217	157,000
1911–12				
October	2,580	59	356	21,900
November			[a] 64.1	[a] 3,810
December			[a] 60.0	[a] 3,690
January			[a] 50	[a] 3,070
February			[a] 70	[a] 4,030
March			[a] 100	[a] 6,150
April	178	61	95.7	5,690
May	2,270	56	406	25,000
June	3,510	600	1,570	93,400
July	645	20	223	13,700
August	532		74.7	4,590
September			59.7	3,550
The year				189,000
1912–13				
October	2,890		[a] 384	[a] 23,600
November	1.680		199	11,800
December			[a] 46.6	[a] 2,870
January			[a] 40	[a] 2,460
February			[a] 50	[a] 2,780
March	205	88	136	8,360
April	1,060	80	338	20,100
May	1,980	500	1,080	66,400
June	1,490	54	464	27,600
July	460	39	136	8,360
August	580	2	52.8	3,250
September	2.560	8	237	14,100
The year	2.560	2	264	192,000
1913–14				
October	228	43	72.5	4,460
November	645	46	125	7,440
December	120		[a] 65.1	[a] 4,000
January			[a] 55	[a] 3,380
February			[a] 65	[a] 3,610
March			[a] 90	[a] 5,530
April	702	82	251	14,900
May	3,140	114	1,630	100,000
June	3,580	145	1,650	98,200
July	1,300	95	294	18,100
August	255	18	45.1	2,770
September	95	16	25.2	1,500
The year	3.580	16	364	264,000

[a] Estimated.

Monthly discharge of San Rafael River near Green River, Utah, for 1909–1918—Con.

Month	Discharge in second-feet			Run-off in acre-feet
	Maximum	Minimum	Mean	
1914–15				
October	400	38	159	9,780
November	50	38	41.2	2,450
December	82		[a] 60.9	[a] 3,740
January			[a] 48	[a] 2,950
February			[a] 47	[a] 2,610
March	780	77	208	12,800
April	580	100	197	11,700
May	728	122	380	23,400
June	1,030	114	449	26,700
July	158	8	38.0	2,340
August	15	0	1.20	74
September	665	0	34.1	2,030
The year	1,030	0	139	101,000
1915–16				
October	12	3	7.52	462
November	700	11	123	7,320
December	97		[a] 68.6	[a] 4,220
January			[a] 58.0	[a] 3,570
February			[a] 80.9	[a] 4,650
March	1,080	70	379	23,300
April	472	104	207	12,300
May	1,140	258	541	33,300
June	1,410	271	932	55,500
July	786	77	196	12,100
August	1,780	90	343	21,100
September	90	65	71.3	4,240
The year	1,780	3	251	182,000
1916–17				
October	7,300	77	848	52,100
November	129	38	81.1	4,830
December	164	14	87.2	5,360
January			[a] 20	[a] 1,230
February	437		[a] 100	[a] 5,550
March	293	59	131	8,060
April	619	71	194	11,500
May	1,870	246	855	52,600
June	4,170	895	2,250	134,000
July	1,000	119	370	22,800
August	258	65	109	6,700
September	1,570	77	219	13,000
The year	7,300		438	318,000
1917–18				
October	98	44	64.8	3,980
November	90	54	79.0	4,700
December	104	35	63.9	3,930
January	77		[a] 56.0	[a] 3,440
February	211		[a] 73.7	[a] 4,090
March	152	27	109	6,700
April	1,440	27	107	6,370
May	472	27	141	8,670
June	1,290	77	588	35,000
July	3,200	90	552	33,900
August	592	27	125	7,690
September	1,440	20	129	7,680
The year	3,200	20	174	126,000

[a] Estimated.

COTTONWOOD CREEK NEAR ORANGEVILLE, UTAH

LOCATION.—In SW. ¼ sec. 10, T. 18 S., R. 7 E., at Sitterud ranch, 5 miles northwest of Orangeville, Emery County.

DRAINAGE AREA.—200 square miles (measured on United States Forest Service map, 1920).

RECORDS AVAILABLE.—May 1, 1909, to September 30, 1926; fragmentary.

GAGE.—Stevens continuous water-stage recorder installed August 11, 1921, on left bank near ranch house; inspected by George Sitterud.

DISCHARGE MEASUREMENTS.—Made from cable 500 feet downstream or by wading.

CHANNEL AND CONTROL.—Bed rough, shifting. Banks fairly high but have been overflowed by sudden floods, to which the stream is subject. Control of gravel and sand.

EXTREMES OF DISCHARGE.—1909–1926: Maximum stage recorded, 9.1 feet about 10 p. m. August 22, 1922 (discharge estimated by extension of rating curve, 2,500 second-feet). Minimum discharge recorded, 5 second-feet September 21, 1910.

ICE.—Stage-discharge relation affected by ice every winter.

DIVERSIONS.—Two or three small ditches divert water above station, but all the main ditches take out below.

REGULATION.—None.

ACCURACY.—Records fair.

Monthly discharge of Cottonwood Creek near Orangeville, Utah, for 1909-1926

Month	Discharge in second-feet			Run-off in acre-feet
	Maximum	Minimum	Mean	
1909				
May			416	25,600
June	1,280	406	842	50,100
July	513	93	218	13,400
August	1,200	80	438	26,900
September	500	56	104	6,190
The period				122,000
1909–10				
October	56	36	45.3	2,790
November			[a] 38.7	[a] 2,300
January			[a] 30	[a] 1,840
February			[a] 30	[a] 1,670
April	620	120	285	17,000
May	1,030	460	607	37,300
June	650	180	328	19,500
July	175	45	91.1	5,600
August	210	30	47.1	2,900
September	1,140	5	81.8	4,870
1910–11				
October	25	25	25	1,540
November	35	25	32	1,900
December			[a] 30	[a] 1,840
January			[a] 30	[a] 1,840
February	64	34	39.1	2,170
March	260	29	96.3	5,920
April	192	29	82.4	4,900
May	646	114	492	30,200
June	700	175	456	27,100
July	160	46	83.2	5,120
August	85	31	40.1	2,470
September	275	31	41.4	2,460
The year				87,500
1911–12				
October	37	21	28.1	1,730
November	37	21	26.4	1,570
December			[a] 25	[a] 1,540
January			[a] 14	[a] 861
February			[a] 11.6	[a] 667
March	50	15	24.9	1,530
April	138	19	41.8	2,490
May	776	24	251	15,400
June	1,630	235	881	52,400
July	1,880	48	219	13,500
August	97	39	60	3,690
September	70	31	38.1	2,270
The year				97,600

[a] Estimated.

Monthly discharge of Cottonwood Creek near Orangeville, Utah, for 1909-1926—Continued

Month	Discharge in second-feet			Run-off in acre-feet
	Maximum	Minimum	Mean	
1912-13				
October	48	31	33.0	2,030
November	39	24	30.1	1,790
December			[a] 20	[a] 1,230
January			[a] 25	[a] 1,540
February			[a] 25	[a] 1,390
March	100		[a] 29.9	[a] 1,840
April	314	48	127	7,560
May	1,200	148	711	43,700
June	1,030	165	401	23,900
July	232	70	111	6,820
August	70	35	50.5	3,110
September	1,980	28	104	6,190
The year				101,000
1913-14				
October	34	28	29	1,780
November	28	14	26.4	1,570
December			[a] 28.5	[a] 1,750
January			[a] 26.9	[a] 1,650
February			[a] 28.1	[a] 1,560
March	59	26	36.3	2,230
April	146	34	98.6	5,870
May	1,320	87	726	44,600
June	1,440	278	694	41,300
July	824	112	210	12,900
August	150	46	63.8	3,920
September	192	38	43.9	2,610
The year	1,440	14	168	122,000
1914-15				
October	56	34	35.7	2,200
November	34	20	25.6	1,520
December			[a] 19.3	[a] 1,190
January			[a] 16	[a] 984
February			[a] 14.9	[a] 828
March	26	16	21	1,290
April	192	26	73.2	4,360
May	616	96	269	16,500
June	954	184	509	30,300
July	202	57	109	6,700
August	57	34	43.3	2,660
September	57	24	30.8	1,830
The year	954		97.2	70,400
1915-16				
October	25	25	25	1,540
November	36	25	25.8	1,540
December	34	18	31.1	1,920
January			[a] 27	[a] 1,670
February			[a] 25	[a] 1,440
March	73	25	44	3,010
April	260	32	95.8	5,700
May	690	143	405	24,900
June	950	250	626	37,200
July	235	110	164	10,100
August	110	40	66.2	4,070
September	40	30	36.2	2,150
The year	950	18	104	95,200
1916-17				
October	686	18	65.8	4,050
November			[a] 19.5	[a] 1,160
December			[a] 24.0	[a] 1,480
January			[a] 12.0	[a] 738
February			[a] 13.1	[a] 728
March		8	[a] 14.2	[a] 873
April	71	8	27.7	1,650
May	262	27	128	7,870
June	1,880	149	921	54,800
July	847	118	288	17,700
August	118	45	67.6	4,160
September	79	38	41.9	2,490
The year	1,880	8	135	97,700

[a] Estimated.

Monthly discharge of Cottonwood Creek near Orangeville, Utah, for 1909-1926—Continued

Month	Discharge in second-feet			Run-off in acre-feet
	Maximum	Minimum	Mean	
1917-18				
October	45	19	29.9	1,840
November	25	16	21.5	1,280
December			[a] 20	[a] 1,230
January			[a] 18	[a] 1,110
February			[a] 20	[a] 1,110
March	38		[a] 29.3	[a] 1,800
April	97	27	47.6	2,830
May	491	97	267	16,400
June	770	166	430	25,600
July	321	60	126	7,750
August	245	32	56.9	3,500
September	60	25	44.7	2,660
The year	770		92.6	67,100
1918-19				
October	58	29	39.4	2,420
November	34		[a] 26.1	[a] 1,550
December			[a] 15	[a] 922
January			[a] 16.5	[a] 1,010
February			[a] 15	[a] 833
March			[a] 20	[a] 1,240
April	245	30	101	6,010
May	900	310	626	38,500
June	420	100	221	13,200
July	92	42	60.4	3,710
August	84	28	35.9	2,210
September	500	26	62.3	3,710
The year	900		104	75,300
1919-20				
October	26	8	22.4	1,380
November	20	15	19.6	1,170
December	26		[a] 16.9	[a] 1,040
January	15		[a] 10.9	[a] 670
February	20	11	15.2	874
March	20	8	15.2	935
April	40	11	20	1,190
May	1,250	34	507	31,200
June	1,200	330	702	41,800
July	340	90	152	9,350
August	262	32	76	4,670
September	36	23	29.4	1,750
The year	1,250		132	96,000
1920-21				
October	36	14	25.3	1,560
November	27	6	18.0	1,070
December			[a] 20	[a] 1,230
January			[a] 17.4	[a] 1,070
February	32		[a] 18.2	[a] 1,010
March	36	14	26.5	1,630
April	82	27	47.2	2,810
May	760	125	318	19,600
June	1,880	515	1,060	63,100
July	485	190	273	8,690
The period				102,000
1921-22				
October	78	45	56.9	3,500
November	54		[a] 45.7	[a] 2,720
December			[a] 35	[a] 2,150
January			[a] 30	[a] 1,840
February			[a] 35	[a] 1,940
March		42	[a] 51.2	[a] 3,150
April	209		78.8	4,690
May	1,090	186	457	28,100
June	1,100	494	779	46,400
July	474	193	275	16,900
August	490	47	177	10,900
September	141	28	38.8	2,310
The year	1,100		172	125,000

[a] Estimated.

Monthly discharge of Cottonwood Creek near Orangeville, Utah, for 1909-1926—Continued

Month	Discharge in second-feet			Run-off in acre-feet
	Maximum	Minimum	Mean	
1922-23				
October	30	23	27.1	1,670
November	43		27.0	1,610
April	101	36	64.6	3,840
May	940	88	457	28,100
June	890	550	664	39,500
July	530	79	319	19,600
August	180	46	685	4,210
September	60	36	42.7	2,540
1923-24				
October	44	28	36.3	2,230
November	37	30	32.8	1,950
March	28		22.8	1,400
April	98	29	65.7	3,910
May	504	114	315	19,400
June	326	66	166	9,880
July	143	25	50.1	3,080
August	40	17	23.0	1,410
September	94	15	23.7	1,410
1924-25				
October	26	14	17.3	1,060
November	15		[a] 10.6	[a] 631
December			[a] 9.1	[a] 560
January			[a] 10	[a] 615
February			[a] 15	[a] 833
March	30		[a] 22.5	[a] 1,380
April	140	26	82.9	4,930
May	497	150	350	21,500
June	253	102	178	10,600
July	144	44	74.9	4,610
August	96	31	40	2,460
September	96	16	29.5	1,760
The year	497		70.3	50,900
1925-26				
October	55	16	22.3	1,370
November	22	11	15.1	898
December			[a] 15	[a] 922
January			[a] 15	[a] 922
February			[a] 20	[a] 1,110
March			[a] 25.5	[a] 1,570
April	258	20	94.6	5,630
May	627	205	363	22,300
June	354	70	163	9,700
July			[a] 42.9	[a] 2,640
August	75	15	24.8	1,520
September	68	13	22.1	1,320
The year	627		69.0	49,900

[a] Estimated.

FERRON CREEK (UPPER STATION) NEAR FERRON, UTAH

Location.—Close to line between secs. 1 and 2, T. 20 S., R. 6 E., a quarter of a mile below house at Peterson ranch, 1½ miles above gristmill, and 5 miles northwest of Ferron, Emery County.

Drainage area.—140 square miles (measured on United States Forest Service map, 1920).

Records available.—May 6, 1911, to September 30, 1923, when station was discontinued.

Gage.—Inclined staff on right bank; read by Joseph Peterson; installed September 13, 1911. Datum lowered 1.00 foot September 4, 1919.

Discharge measurements.—Made by wading or from cable 15 feet upstream from gage.

CHANNEL AND CONTROL.—Banks high and not subject to overflow. Bed composed of sand and gravel. Current swift and has tendency to cut channel deeper. Stage of zero flow at gage height, −0.5 foot as determined August 12, 1921.

EXTREMES OF DISCHARGE.—1911–1923. Maximum stage recorded, 10.0 feet at 3 p. m. July 25, 1920 (discharge probably 2,000 second-feet); minimum discharge recorded, 1 second-foot, March 22 and 23, 1912.

ICE.—Stage-discharge relation seriously affected by ice every winter.

DIVERSIONS.—Above all diversions except a small ditch for the Peterson ranch.

REGULATION.—None.

ACCURACY.—Records good.

Monthly discharge of Ferron Creek (upper station) near Ferron, Utah, for 1911–1923

Month	Discharge in second-feet			Run-off in acre-feet
	Maximum	Minimum	Mean	
1911				
May 6–31	380	212	286	14,700
June	408	114	258	15,100
July	102	63	73.3	4,510
August	164	20	46.7	2,870
September	106	17	17.3	1,030
The period				38,200
1911–12				
October	27	6	14.3	879
November	45	2	18.1	1,080
December			[a] 11.7	[a] 719
January			[a] 8	[a] 492
February			[a] 7	[a] 403
March	18	1	9.9	609
April	64	7	21.8	1,300
May	650	13	238	14,600
June	800	242	468	27,800
July	216	69	116	7,130
August	66	26	40.7	2,500
September	35	14	20.7	1,230
The year				58,700
1912–13				
October	45	10	20.1	1,240
November	26	12	17.3	1,030
December			[a] 13.4	[a] 824
January			[a] 8	[a] 492
February			[a] 8	[a] 444
March			[a] 12	[a] 738
April	157	12	53.8	3,200
May	370	107	257	15,800
June	360	123	208	12,400
July	154	42	75.2	4,620
August	41	21	27.4	1,680
September	650	14	41.0	2,440
The year				44,900
1913–14				
October	24	5	13.4	824
November	16	7	11.0	655
December			[a] 9	[a] 553
January			[a] 9	[a] 553
February	11	6	8.72	484
March	20	7	14.6	898
April	101	17	51.0	3,030
May	658	38	469	28,800
June	882	175	393	23,400
July	830	44	137	8,420
August	317	30	51.9	3,190
September	31	24	26.7	1,590
The year	882	5	100	72,400

[a] Estimated.

Monthly discharge of Ferron Creek (upper station) near Ferron, Utah, for 1911–1923—Continued

Month	Discharge in second-feet			Run-off in acre-feet
	Maximum	Minimum	Mean	
1914–15				
October	25	15	20.3	1,250
March 22–31	17	11	15.3	303
April	170	11	55.3	3,290
May	377	46	15.3	9,410
June	605	132	311	18,500
July	139	39	70.8	4,350
August	39	25	30.8	1,890
September	49	11	20.1	1,200
1915–16				
April 2–30	203	16	72.8	4,190
May	340	110	215	13,200
June	540	188	387	23,000
July	250	65	112	6,890
August	310	39	94.0	5,780
September	59	21	29.6	1,760
The period				54,800
1916–17				
October	310	18	70.2	4,320
November	30	17	22.5	1,340
December			[a] 20.1	[a] 1,240
January			[a] 10	[a] 615
February			[a] 16	[a] 889
March			[a] 22.5	[a] 1,380
April	277	12	91.9	5,470
May	589	85	260	16,000
June	829	234	598	35,600
July	419	58	176	10,800
August	179	28	47.9	2,950
September	188	22	32.8	1,950
The year	829		114	82,600
1917–18				
October	21	13	15.9	978
November	20	12	13.6	809
December			[a] 12	[a] 738
January			[a] 11	[a] 676
February			[a] 10	[a] 555
March	35		[a] 19.9	[a] 1,220
April	56	6	27.7	1,650
May	382	52	173	10,600
June	510	78	247	14,700
July	246	48	69.4	4,270
August	205	30	46.8	2,880
September	308	13	42.2	2,510
The year	510		57.4	41,600
1918–19				
October	43	8	15.9	978
November	13		[a] 8.8	[a] 524
December			[a] 7	[a] 430
January			[a] 6.48	[a] 398
February			[a] 8	[a] 444
March	31		[a] 8.71	[a] 536
April	203	12	81.7	4,860
May	589	159	322	19,800
June	220	50	117	6,960
July	65	31	41.2	2,530
August	160	19	34.2	2,100
September	75	14	22.3	1,330
The year	589		56.5	40,900
1919–20				
October	18	6	12.4	762
November	20	5	12.5	744
December			[a] 10	[a] 615
January			[a] 7	[a] 430
February			[a] 9	[a] 518
March	18		[a] 12.1	[a] 744
April	123	6	34.1	2,030
May	900	60	335	20,600
June	589	111	325	19,300
July	500	30	70.8	4,350
August	86	24	35.7	2,200
September	113	15	23.0	1,370
The year	900		74.2	53,700

[a] Estimated.

Monthly discharge of Ferron Creek (upper station) near Ferron, Utah, for 1911–1923—Continued

Month	Discharge in second-feet			Run-off in acre-feet
	Maximum	Minimum	Mean	
1920–21				
October	20	10	15.4	947
November	20	8	12.6	750
December			[a] 11	[a] 676
January	16	10	13.7	842
February		10	16.7	928
March	25	8	16.8	1,030
April	90	16	31.7	1,890
May	424	100	226	13,900
June	1,070	332	639	38,000
July	291	65	154	9,470
August	150	44	71	4,370
September	70	28	37.3	2,220
The year	1,070	8	104	75,000
1921–22				
October	84	21	29.3	1,800
November	29		[a] 20.8	[a] 1,240
December	29		[a] 18.6	[a] 1,140
January			[a] 9.7	[a] 596
February			[a] 20	[a] 1,110
March			[a] 25.6	[a] 1,570
April	130	19	42.3	2,520
May	641	95	339	20,800
June	692	131	382	22,700
July	121	41	61	3,750
August	70	32	41.6	2,560
September	55	26	299	1,780
The year	692		85.1	61,600
1922–23				
October	24	20	23.4	1,440
November	38	20	24.9	1,480
December			[a] 13	[a] 799
January			[a] 10	[a] 615
February			[a] 10	[a] 555
March	22		[a] 13.8	[a] 848
April	36	16	22.9	1,360
May	572	23	301	18,500
June	515	173	296	17,600
July	175	68	113	6,950
August	150	51	67.8	4,170
September	57	36	43.1	2,560
The year	572		78.6	56,900

[a] Estimated.

FERRON CREEK NEAR FERRON, UTAH

LOCATION.—At Westenskow's ranch, half a mile below head gates of North and South Canals and 2½ miles above town of Ferron, Utah; probably in sec. 7, T. 20 S., R. 7 E., Salt Lake base and meridian.

RECORDS AVAILABLE.—May 1, 1909, to September 30, 1911.

DRAINAGE AREA.—153 square miles.

GAGE.—Gage readings are obtained by measuring down to the water surface from a fixed point on the footbridge.

CHANNEL.—Practically permanent at medium stages.

DISCHARGE MEASUREMENTS.—Made from a footbridge at gage during high water and by wading at low water.

POINT OF ZERO FLOW.—On September 12 it was determined that there would be no flow past the station if the stage were to fall below about 4 feet. Control may change.

WINTER FLOW.—Ice forms at times during winter.

DIVERSIONS.—Two large canals, the North and South, with a combined capacity of 100 second-feet, divert water above the station, and many small ditches divert water both above and below the station.

ACCURACY.—The discharge curve is fairly well defined, but the estimates can be considered only fair because of diversions made above gage.

COOPERATION.—Maintained in cooperation with the State of Utah.

Monthly discharge of Ferron Creek near Ferron, Utah, for 1909–1911

Month	Discharge in second-feet			Run-off in acre-feet
	Maximum	Minimum	Mean	
1909				
May	298	41	146	8,980
June	766	133	372	22,100
July	143	6	27.6	1,700
August 23–31	1,690	16	207	3,700
September	3,000	32	131	7,800
The period				44,300
1909–10				
October	32	13	20.3	1,250
November			[a] 12.7	[a] 756
December			[a] 4.0	[a] 246
January	19	0	5.58	343
February	51	6.5	17.0	944
March	170	19	75.8	4,660
April	270	51	123	7,320
May	190	110	155	9,530
June	170	4.0	46.0	2,740
July	150	.2	7.91	486
August	42	.2	1.55	95
September	520	.2	54.0	3,210
The year				31,600
1910–11				
October	450	.2	15.9	978
November	.4	.1	.19	11
December	.4	.4	.4	25
January			[a] 2.5	[a] 154
February			[a] 3.5	[a] 194
March	96	1.0	25.5	1,570
April	114	.5	30.1	1,790
May	210	49	118	7,260
June	190	1.0	107	6,370
July	21	0	9.0	55
August	250	0	9.9	609
September	200	0	17.4	1,040
The year				19,000

[a] Estimated.

FERRON CREEK NEAR CASTLE DALE, UTAH

LOCATION.—In sec. 35, T. 19 S., R. 8 E., 8 miles below Ferron, 7 miles south of Castle Dale, and 2 miles below head of Paradise Canal.

DRAINAGE AREA.—235 square miles (measured on topographic map).

RECORDS AVAILABLE.—June 12, 1911, to September 30, 1914, when station was discontinued.

GAGE.—Inclined staff on left bank; read by Delon Olsen.

DISCHARGE MEASUREMENTS.—Made from cable or by wading.

CHANNEL AND CONTROL.—Gravel and sand; shifting at high water.

WINTER FLOW.—Stage-discharge relation seriously affected by ice; discharge estimated from discharge measurements, observer's notes, and records of temperature and precipitation.

DIVERSIONS.—Below all diversions except Fred Anderson ditch. (See Water-Supply Paper 389, p. 190.)

REGULATION.—Flow is affected at times by manipulation of head gates of canals above station.

ACCURACY.—Rating curves fairly well defined; channel shifts; gage readings infrequent; records fair.

Monthly discharge of Ferron Creek near Castle Dale, Utah, for 1911–1914

Month	Discharge in second-feet			Run-off in acre-feet
	Maximum	Minimum	Mean	
1911				
June 12–30	320	11.5	97.7	3,680
July	51	.2	4.2	258
August	176	.0	8.6	529
September	338	.2	16.7	994
The period				5,460
1911–12				
October	19	3.0	12.0	738
November	33		12.6	750
December			[a] 1.5	[a] 92
January			[a] 5	[a] 307
February			[a] 5	[a] 288
March	22	4	13.1	806
April	25	.5	11.2	666
May	347	8	138	8,480
June	635	78	280	16,700
July	118	6	33.6	2,070
August	28	0	4.6	283
September	8	6	6.6	393
The year				31,600
1912–13				
October	16	8	12.2	750
November	16	10	13.0	774
December			[a] 8.4	[a] 516
January			[a] 9	[a] 553
February			[a] 10	[a] 555
March			[a] 12	[a] 738
April	98	10	38.9	2,310
May	326	10	138	8,480
June	158	2	48.5	2,890
July	179	1	17.6	1,080
August	44	0	3.9	240
September	423	4	39.3	2,340
The year				21,200
1913–14				
October	25	6	14.0	861
November	16	6	9.5	565
December			[a] 8.2	[a] 504
January			[a] 12	[a] 738
February			[a] 12	[a] 666
March	35	8	14.4	885
April	69	8	28.8	1,710
May	720	20	272	16,700
June	915	47	313	18,600
July	836	21	121	7,440
August	21	4	8.7	535
September	47	4	8.8	524
The year	915	4	68.8	49,700

[a] Estimated.

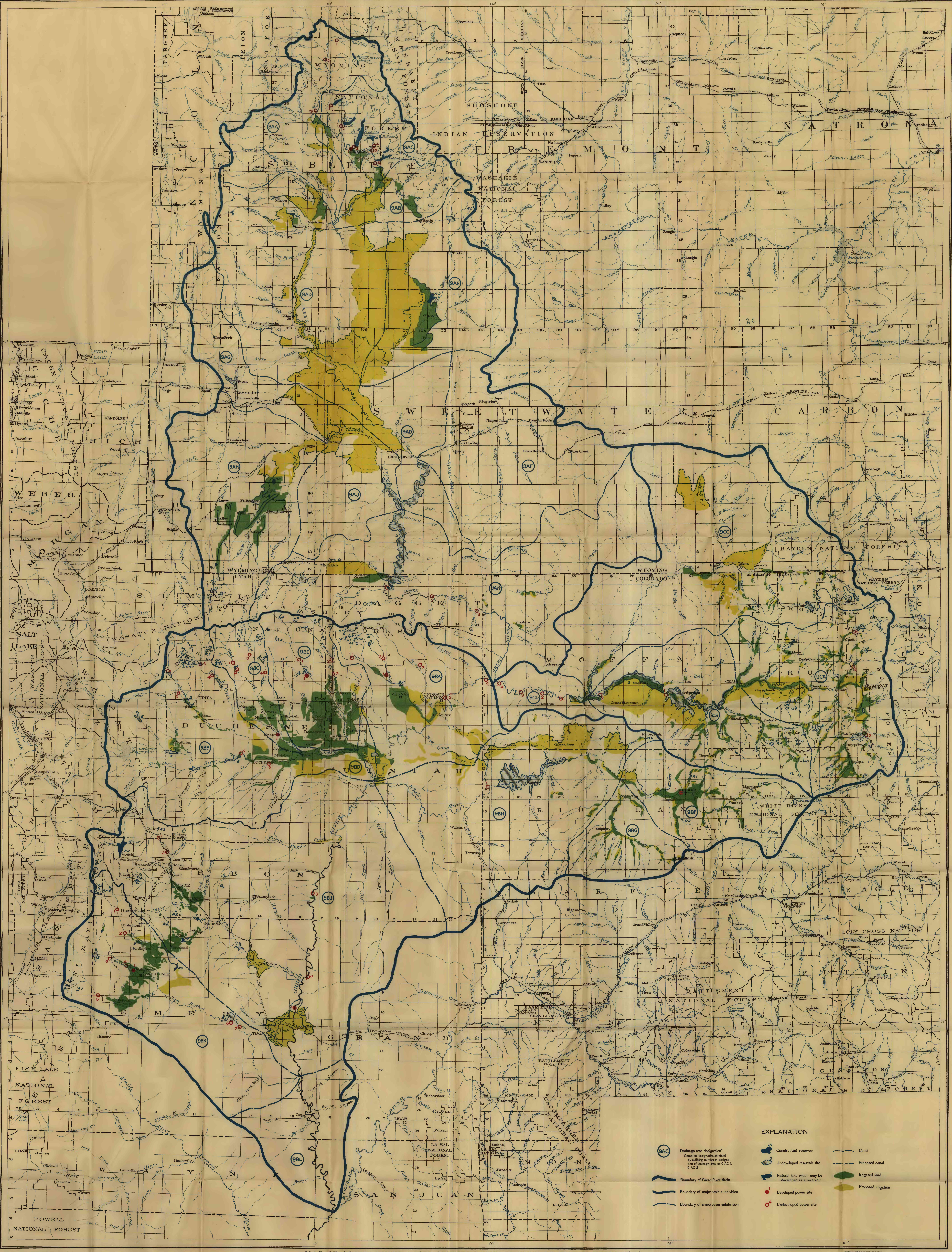
INDEX

V

W

Y

O



Base from U. S. Geological Survey maps of Colorado, Utah, and Wyoming; Scale 1:500,000

MAP OF GREEN RIVER BASIN SHOWING UTILIZATION OF WATER RESOURCES

Prepared by Ralf R. Woolley