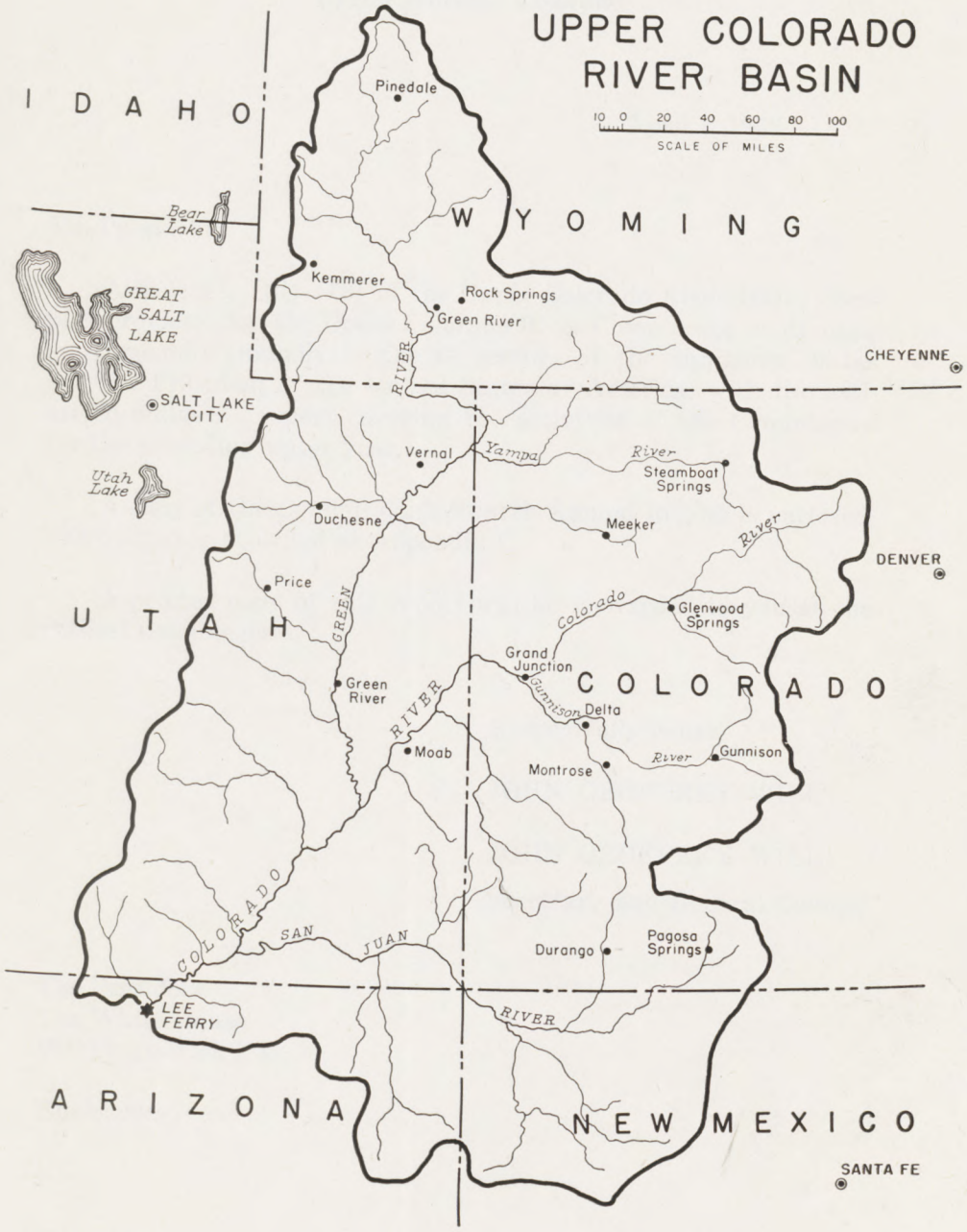
UPPER COLORADO RIVER COMMISSION

FOURTH ANNUAL REPORT

MARCH 30, 1953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SCALE OF MILES
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Pinedale
Bear Lake
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Rock Springs
Green River
GREAT SALT LAKE
SALT LAKE CITY
Utah Lake
CHEYENNE
DENVER
SANTA FE
Vernal
Yampa River
Steamboat Springs
Duchesne
Meeker
Price
GREEN RIVER
Colorado River
Glenwood Springs
Grand Junction
Gunnison River
Green River
Delta
Moab
Montrose
Gunnison
COLORADO RIVER
SAN JUAN RIVER
Durango
Pagosa Springs
LEE FERRY

UPPER COLORADO RIVER COMMISSION

520 Rood Avenue

Grand Junction, Colorado

April 1, 1953

Mr. President:

Article VIII (d) (13) of the Upper Colorado River Basin Compact provides that the Upper Colorado River Commission shall make and transmit annually to the Governors of the signatory States and the President of the United States of America, with the estimated budget, a report covering the activities of the Commission for the preceding water year.

A copy of the Commission's Fourth Annual Report is enclosed. The budget is attached as Appendix C.

A printed copy of this report will be forwarded to you at the earliest possible date.

Respectfully yours,

/s/ JOHN GEOFFREY WILL

JOHN GEOFFREY WILL
Secretary and General Counsel

The President
The White House
Washington 25, D.C.

Enclosure

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This report was, on the same date, transmitted to the Governors of each Upper Basin State.

FRONTISPIECE

LETTER OF TRANSMITTAL

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FOURTH ANNUAL REPORT

UPPER COLORADO RIVER COMMISSION

March 30, 1953

I. INTRODUCTION

Article VIII (d) (13) of the Upper Colorado River Basin Compact provides that the Upper Colorado River Commission shall "make and transmit annually to the Governors of the signatory States and the President of the United States of America, with the estimated budget, a report covering the activities of the Commission for the preceding water year."

Article VIII of the By-Laws of the Upper Colorado River Commission provides as follows:

1. The Commission shall make and transmit annually on or before April 1 to the Governors of the states signatory to the Upper Colorado River Basin Compact and to the President of the United States, a report covering the activities of the Commission for the water year ending the preceding September 30.

2. The annual report shall include, among other things, the following:

(a) The estimated budget;

(b) All hydrologic data which the Commission deems pertinent;

(c) Estimates, if any, of the Commission forecasting water run-off;

(d) Statements as to cooperative studies of water supplies made during the preceding water year;

(e) All findings of fact made by the Commission during the preceding water year;

(f) Such other pertinent matters as the Commission may require.

For data on the activities of the Commission during that part of the preceding water year to March 15, 1952, reference is hereby made to the Commission's Third Annual Report. In order that a

more nearly recent account of the Commission's activities may be gained, the Commission has determined to include in this report an account of the activities of the Commission through March 15, 1953.

II. THE COMMISSION

As of the date of this report, the Commission consists of the following:

Harry W. Bashore	—Commissioner for the United States of America and Chairman of the Commission
John R. Erickson	—Commissioner for the State of New Mexico and Vice Chairman of the Commission
*Jean S. Breitenstein	—Commissioner for the State of Colorado
Joseph M. Tracy	—Commissioner for the State of Utah
L. C. Bishop	—Commissioner for the State of Wyoming

The following have acted as advisers for each Commissioner from time to time:

United States of America:

Legal—

E. W. Fisher, Chief Counsel, Bureau of Reclamation, Washington, D.C.

T. Richard Witmer, Assistant Chief Counsel, Bureau of Reclamation, Washington, D.C.

J. Stuart McMaster, Regional Counsel, Region IV, Bureau of Reclamation, Salt Lake City, Utah

Engineering—

J. R. Riter, Chief, Hydrology Division, Bureau of Reclamation, Denver, Colorado

H. P. Dugan, Head, River Regulation Section, Hydrology Division, Bureau of Reclamation, Denver, Colo.

Cecil B. Jacobson, Area Engineer, Colorado River Storage Project, Bureau of Reclamation, Salt Lake City, Utah

*Succeeded Judge C. H. Stone, deceased.

Colorado:

Legal—

H. Lawrence Hinkley, Deputy Attorney General, Denver, Colorado

Engineering—

Royce J. Tipton, Consultant, Colorado Water Conservation Board, Denver, Colorado

Frank C. Merriell, Engineer, Colorado River Water Conservation District, Grand Junction, Colorado

New Mexico:

Legal—

Fred E. Wilson, Attorney at Law, Albuquerque, New Mexico

Engineering—

John H. Bliss, State Engineer, Santa Fe, New Mexico
I. J. Coury, Member, Interstate Stream Commission, Farmington, New Mexico

Utah:

Legal—

E. R. Callister, Jr., Attorney General, Salt Lake City, Utah

J. A. Howell, Attorney at Law, Ogden, Utah

Engineering—

Joseph M. Tracy, State Engineer, Salt Lake City, Utah

Wyoming:

Legal—

Harry S. Harnsberger, Attorney General, Cheyenne, Wyoming

Howard Black, Deputy Attorney General, Cheyenne, Wyoming

Engineering—

H. T. Person, Dean, School of Engineering, University of Wyoming, Laramie, Wyoming
Earl Lloyd, Deputy State Engineer, Cheyenne, Wyoming

Alternates in absence of Commissioner—

Joe L. Budd, Big Piney, Wyoming
Norman W. Barlow, Cora, Wyoming

III. THE STAFF

The staff of the Upper Colorado River Commission, as of the date of this report, consists of:

John Geoffrey Will, Secretary and General Counsel
Ralph D. Goodrich, Chief Engineer
Ival V. Goslin, Assistant Chief Engineer
Barney L. Whatley, Treasurer
Richard T. Counley, Assistant Treasurer
Mrs. Lois S. Burns, Administrative Assistant
Mrs. Lois P. Crowder, Official Reporter
Mrs. Phyllis D. Taylor, Stenographer

IV. ACTIVITIES OF COMMISSION

During the period, March 15, 1952 to March 16, 1953, the Commission held nine meetings, as follows:

March 17, 1952	—the Regular Meeting Grand Junction, Colorado
May 9, 1952	—a Special Meeting Denver, Colorado
July 19, 1952	—a Special Meeting Pinedale, Wyoming
Sept. 15 & 16, 1952	—the Annual Meeting Santa Fe, New Mexico
November 14, 1952	—a Special Meeting Long Beach, California
January 30, 1953	—a Special Meeting Cheyenne, Wyoming
February 26, 1953	—a Special Meeting Denver, Colorado
March 7, 1953	—a Special Meeting Washington, D.C.
March 16, 1953	—the Regular Meeting Santa Fe, New Mexico

During this period also there were meetings from time to time of the standing committees. These committees and their membership, as of the date of this report, are as follows:

Engineering Committee—

J. R. Riter, Chairman
John H. Bliss
Royce J. Tipton
Frank C. Merriell
H. T. Person
Joseph M. Tracy

Legal Committee—

Fred E. Wilson, Chairman
E. R. Callister, Jr.
J. Stuart McMaster
Harry S. Harnsberger
H. Lawrence Hinkley

Budget Committee—

John H. Bliss, Chairman
Joseph M. Tracy
R. M. Gildersleeve
J. R. Riter
Norman W. Barlow

There were meetings also of the following special committees:

Committee on Rules and Regulations—

E. R. Callister, Jr., Chairman
R. M. Gildersleeve
Earl Lloyd
Fred E. Wilson
J. R. Riter

Finance Committee—

Norman W. Barlow, Chairman
Joseph M. Tracy
John H. Bliss

Committee to Consider What, If Any, Changes Should Be Made in the Draft of Bill to Authorize the Colorado River Storage Project and Participating Projects—

John Geoffrey Will, Chairman
Clinton D. Vernon
I. J. Coury

This committee was enlarged later to include all members of the Legal Committee and all members of the Engineering Committee, and Mr. I. J. Coury, with Clinton D. Vernon as Chairman.

V. ACTIVITIES OF THE COMMISSION AND ITS STAFF

The principal activities of the Commission and its staff have occurred in three principal spheres, to-wit: (a) activities looking to the preservation and improvement of conditions favorable to the authorization and construction of works for the conservation and utilization of western water resources; (b) activities looking to the solution of problems arising in particular localities; (c) the preparation of a revised draft of bill to authorize the Colorado River Storage Project and Participating Projects that might be supplied to Senators and Members of the House of Representatives; and (d) energetic efforts looking to the dislodging of the Interior Department's report on the Colorado River Storage Project and Participating Projects to the end that such report might go forward to the Con-

gress with a favorable recommendation from the Executive Branch of the Federal Government.

With respect to the first of these spheres of activity, the Commission and its staff have kept in close touch with proposals for change and, in some cases, improvement in national water resources policy. In this connection, we have cooperated with committees of the National Reclamation Association and we have participated in discussions within the National Reclamation Association. We have cooperated with the Land and Water Policy Committee of the National Water Conservation Conference and we have sought to cooperate in the efforts of that conference toward the production of suitable recommendations on national water resources policy.

It has seemed to us that, among the numerous sincere and able groups and organizations participating in the formulation of recommendations on national water resources policy, there has been insufficient regard for the fact that, because of physical differences between sections of our country, it is impossible to lay down a national policy in other than the most general terms, it being understood that details will require working out in ways that will be suitable to the unique physical attributes of different areas. It seems to us, too, that some of the recommendations produced to date reflect the influence of areas that have already achieved a large degree of development and that are, therefore, not as much concerned as are we in the preservation of conditions that will encourage development in those areas where development has been retarded. The Upper Colorado River Basin is a good example of an area, the development of which has been retarded. It ought to have an opportunity to catch up with the rest of the country. Finally, we believe, some groups making recommendations on national water resources policy have confused their objective with their desire to achieve a balanced budget. These two problems are, of course, separate and apart and should be so considered. The latter will have its influence in connection with the programming of construction and the appropriation of funds therefor.

The Interior Department report on the Colorado River Storage Project and Participating Projects has been held up in Washington for many, many months. Many reasons have been advanced by officials of the Department of the Interior for these delays. None of them seem to be really sound. It was not until the end of the calendar year of 1952 that the report on this project was finally sent forward to the Bureau of the Budget, and even then the recommendations made at the time the report was sent forward were

unclear. A new Secretary of the Interior has an opportunity to repair much of the damage done by delays to-date by acting promptly and by promptly sending to the Bureau of the Budget and to the Congress strong recommendations for authorization of the Colorado River Storage Project and Participating Projects. In this connection, the entire Commission and its staff of advisers and the members of the Congressional delegations from the Upper Colorado River Basin States appeared before the Secretary of the Interior on the 9th of March and presented the case for the project.

Much time has been devoted by the Commission and its staff to the consideration of the question whether the Congress should be asked to authorize another Federal Reclamation Project involving the controversial matter of the application of the interest returned on the power investment to the pay-out of irrigation costs, or whether some different policy should be adopted. The Commission finally concluded that it would adopt a formula devised in the Senate of the United States in connection with the Collbran Project, Colorado, with certain modifications. Under the formula adopted by the Upper Colorado River Commission, the power investment would be paid out in 50 years. Interest on the power investment would be paid annually into Miscellaneous Receipts of the Treasury.

A revised bill has been presented to the Congressional delegations from the Upper Colorado River Basin States. It incorporates the decision referred to in the preceding paragraph as well as a number of other improvements.

The Upper Colorado River Commission has ever been sympathetic with the needs of and the rights of the Indians. The Shiprock-South San Juan Project in New Mexico is a case in point. The Commission has agreed that, at the proper time, it will present certain amendments to the bill designed further to improve the situation so far as the development of Indian Projects is concerned. The Commission's sympathy for and interest in the welfare of the Indians is further evidenced by the attitude which it has taken in connection with litigation now pending in the Supreme Court of the United States between Arizona and California. In that connection, the Commission has advised the proper officials of the Department of the Interior, and it will advise other appropriate officials from time to time, of its concern lest insistence upon an attempt to have the Supreme Court in that case settle a theoretical quarrel respecting the extent of the Indian rights in and to the waters of the Colorado River System, should result in delaying development throughout the Basin, including the development of worthy Indian irrigation projects.

An important aspect of the work of the Commission and its staff during the year has consisted in the disseminating of useful information on the subject of the Colorado River Storage Project and Participating Projects. This dissemination of information has been accomplished through the mailing of no less than six pamphlets and brochures to the Commission's mailing list of about 4,000 names. The reaction from the recipients of these pamphlets and brochures has, in general, been complimentary and has convinced us that the information program should be continued at full strength.

The work of the Engineering Staff of the Commission has progressed satisfactorily. As those who read the section on Hydrology in this report and the Engineering Appendices to this report will realize, we are approaching the point where we shall have developed a formula with a demonstrably sound scientific and mathematical basis for the application of the inflow-outflow method of measuring consumptive use. The progress made in this regard is of extreme importance, since we are faced with the duty of ascertaining the consumptive use of the waters of the Upper Colorado River System in the Upper Basin as a whole and in each State thereof, where there are thousands of diversions, thousands of points of return and where it is utterly impracticable to attempt to measure each such diversion and each such return by the establishment of individual gaging stations.

No findings of fact, pursuant to Article VIII of the Upper Colorado River Basin Compact, have been made by the Commission.

The Commission acknowledges with appreciation the assistance that it has had throughout from agencies of the Executive Branch of the Federal Government, particularly the Bureau of Reclamation, the Office of Indian Affairs, and the Geological Survey have been exceedingly helpful from time to time.

VI. HYDROLOGY

Collection of stream flow records has continued in cooperation with the Water Resources Branch of the U.S. Geological Survey and State Offices and all such records are readily available in the Commission's files. The Commission also receives, through the cooperation of the U.S. Weather Bureau, annual and monthly Climatological Data bulletins for Arizona, Colorado, New Mexico, Utah and Wyoming. Through the cooperation of the U.S. Soil Conservation Service, there are supplied reports on snow surveys made in cooperation with other agencies of federal and state governments. These reports cover the States of Utah and Arizona, the

drainage basin of the Colorado River, the Rio Grande and the Platte and Arkansas Rivers. These data, now in the Commission's files, make possible all hydrologic investigations desired in the Engineering Department at the present time.

The table of gaging stations and stream discharges, which appeared in previous Annual Reports, is again given as Appendix G in this Fourth Annual Report. U.S. Geological Survey and certain other reports of gaging stations and stream discharges for the water year 1952 have been added to the previous table in so far as the provisional records for these stations have been received. The provisional records for the years 1949 and 1950 have been omitted since they are published in U.S. Geological Survey Water Supply Papers 1149 (1949) and 1179 (1950).

No forecasts of water supply were made by the Engineering Department of the Commission, since studies of methods and formulas for the forecasting of stream flow in the States of the Upper Basin are being carried on elsewhere.

In spite of every effort to attain the utmost accuracy in all data given or quoted in the Commission's Annual Reports, attention has been called to an error in line 4 of the paragraph in the middle of page 37 of the Third Annual Report. In quoting some forecasts from the publications of Water Supply Forecasts by the U.S. Weather Bureau for the year 1951 the following statement was made: "The forecast for the flow at Lees Ferry as of February 1, 1951 was 16,000,000 acre-feet, and in the issue for March 1, it was only 10,400,000 acre feet." The forecast for February 1, 1951 should have read 10,700,000 acre-feet. The actual discharge for the year 1951 was 9,817,000 acre-feet, which is a difference of less than 9% of the February estimate.

The following forecasts of drainage basin conditions and stream discharges are quoted from the U. S. Weather Bureau's Bulletin issued as of February 1, 1953.

> "The Upper Colorado River watershed received amounts of precipitation during January ranging from much below to much above normal. The western headwaters of the Green River in Wyoming and a portion of the upper Yampa Basin in Colorado were areas which received much above normal precipitation. The lower valleys of the Price River and Huntington Creek in Utah received amounts which averaged less than half of normal. Elsewhere in the basin precipitation for the month was some-

what below normal. For the entire basin seasonal totals to date are still less than normal.

"Colorado River above Cisco: There has been only slight change in the unfavorable water-supply outlook issued last month for the Colorado and its tributaries above Cisco. Forecasts for the Gunnison and Dolores River Basins are slightly lower while those for the tributaries in the area of Granby are somewhat higher. Water-year flows of only 51% to 66% of the 1941-50 average may be expected for the Dolores and Uncompahgre Rivers and for the Collbran Creek. Prospects for the remainder of the area are more promising with median forecasts calling for runoff ranging from 72% to 88% of the 10-year average.

"Green River Basin: As a result of the heavy precipitation which occurred over the extreme western section of Wyoming during January, substantial increases are noted in the forecasts for the upper Green River Basin. However, streamflows for the upper Green Basin are still expected to be much less than the 10-year average. The outlook for the Yampa River Basin is for flows of only 46% to 56% of average. For the White River Basin in Colorado and for the Utah tributaries the outlook is for run-off of 73% to 88% of the 10-year average.

"San Juan River Basin: The current water-supply outlook for the San Juan River Basin is for slightly lower flows than that of a month ago. Water-year streamflows in the basin are expected to range from 60% to 75% of the 10-year average."

Some forecasts for the water year 1952-53, taken from the same bulletin are:

	Forecasts 1,000 ac.-ft.	% of 10 yr. av.	10 yr. av. 1,000 ac.-ft.
Colorado River, Cameo, Colo.	2,500	81	3,070
Colorado River, Lees Ferry, Ariz.	9,100	70	13,030
Colorado River, Grand Canyon, Ariz.	9,400	71	13,320
Roaring Fork, Glenwood Springs, Colorado	800	82	974
Green River, Linwood, Utah	920	56	1,640
Green River, Green River, Utah	2,700	59	4,560
San Juan River, Farmington, New Mexico	1,160	62	1,856
San Juan River, Bluff, Utah	1,250	60	2,080

A forecast for the inflow to Lake Mead is made early in each month from January to May, by the Office of River Control of the U.S. Bureau of Reclamation at Boulder City, Nevada. These forecasts are prepared for use in the operation of Hoover Dam and Lake Mead especially for the purpose of flood control. The first paragraph of the two page forecast dated February 6, 1953, is quoted herewith:

> "1. **Forecast Based on Precipitation:** Accumulated precipitation in the upper Colorado River basin at 13 key stations used for forecasting purposes averaged 65 percent of the 30 year normal for the period October 1952 through January 1953, while precipitation during the month of January itself amounted to about 95 percent of normal. Based on an October through January precipitation averaging 2.85 inches for the 13 stations, the forecast of flow in the Colorado River near Grand Canyon, Arizona, for the period April through July 1953, is as follows:
>
> | | |
> |---|---|
> | Maximum | 8,600,000 acre-feet |
> | Mean | 5,600,000 acre-feet |
> | Minimum | 2,600,000 acre-feet |
>
> "The forecast formula indicates that the probability is nine chances in ten that actual flow at Grand Canyon will fall between the above maximum and minimum amounts.
>
> . . . "The 30-year (1923 through 1952) mean corrected April-July runoff is approximately 8.9 million acre-feet and the 30-year average accumulated precipitation for October through January is 4.37 inches. Actual runoff measured near Grand Canyon, Arizona, during the April-July 1952 period was 14,064,000 acre-feet. This was the maximum recorded April-July runoff for the 30-year period."

As stated in the Third Annual Report, the U.S. Weather Bureau Forecast Bulletin which contains forecasts for several points on the main stem of the Colorado River and for one or more points on over thirty tributary streams is believed to be the best source of data for the use of the Commission for judging the probable seasonal flow of streams in the Upper Colorado River Basin.

Additional material which is available to assist in judging the probable relative amount of the summer flow in the Colorado River

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NOTE: Mean forecast as of March 1 is 4,800,000 acre-feet instead of 5,600,000, maximum 7,800,000 acre-feet and minimum 1,800,000 acre-feet.

basin is found in the monthly reports on the measurements of snow courses distributed by the U.S. Soil Conservation Service.

Reports received to date show that 17,975,000 acre-feet of water passed Lee Ferry during the water year October 1, 1951 to September 30, 1952 and that for the ten-year period 1943 through 1952 the total discharge of the Colorado River at Lee Ferry was 125,198,000 acre-feet.

The investigation of reservoir losses which was mentioned in the Third Annual Report has been continued during the past year. Formulas have been devised for estimating the evaporation losses from reservoirs in the Upper Basin at possible reservoir sites where no climatological data are available. They depend only upon the average elevation of the water surface and the latitude at the proposed site. Cooperative investigations by several federal agencies or departments have been carried on for several years at Lake Hefner in Oklahoma. An Interim Report (U.S.G.S. Circular 103) was prepared as of March 1951 and a more complete report of these investigations is expected at an early date. These cooperative investigations are now continuing at Lake Mead. A more detailed report on reservoir evaporation is found in Appendix E.

Studies have also continued on the Inflow-Outflow Method in an endeavor to arrive at a better selection and combination of stream flow and weather records to be set up in an equation to give the most probable virgin flow of the Green River at Linwood, Utah. Many equations were derived and compared by standard methods of statistical mathematics so that the reliability and errors which may result from their use will be known. The results obtained to date are given in Appendix F.

With the employment of an Assistant Chief Engineer, it is planned to extend the inflow-outflow studies to obtain additional formulas based on the twenty years of records now available so as to cover the drainage basins in each state and at Lee Ferry as rapidly as possible.

Two college professors and one graduate student worked during the 1952 summer vacation on special studies of the Engineering Department. Professor Richard Pugh, Assistant Professor of Civil Engineering at the New Mexico A & M College, was assigned to the study of the initial effects of the large trans-mountain diversions from the Upper Colorado River Basin by the Colorado-Big Thompson project. Mr. Robert K. Thomas, a graduate student at the Colorado A & M College at Fort Collins, Colorado, was assigned

to studies of the inflow-outflow method. Professor Daryl B. Simons, of the Engineering faculty of the University of Wyoming at Laramie, was assigned to a study of reservoir evaporation losses. The results of these studies were given to the Commission in Report No. 15 and two supplements thereto by the Chief Engineer. This report and the two supplements were not included as an appendix since they were submitted as progress reports only. Considerable additional study has been given to these investigations with consequent revisions and improvement. A review of the effect of trans-basin diversions and storage due to the operation of the Colorado-Big Thompson Project is included as Appendix D.

Summary

The collection of U. S. Geological Survey Water Supply data, Weather Bureau data, and Snow Survey Reports has continued as in previous years and the table of stream discharges at selected gaging stations has been extended to include provisional records for 1952.

Brief statements are quoted as to watershed conditions with forecasts of probable stream discharges for the water year 1953 at eight of the principal points on the Colorado River and tributaries.

Studies of reservoir evaporation, formulas for the application of the Inflow-Outflow Method and the effect of the storage and diversion of water by the Colorado-Big Thompon Project which were the subjects discussed in the Chief Engineer's Report No. 15 have been continued with the able help of Mr. Ival V. Goslin, Assistant Chief Engineer, who joined the engineering staff in January. Progress in these investigations is given in three of the appendices.

APPENDIX A

A BILL

To authorize the Secretary of the Interior to construct, operate, and maintain the Colorado River Storage Project and participating projects, and for other purposes.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That, in order to initiate the comprehensive development of the water resources of the Upper Colorado River Basin, the Congress, in the exercise of its constitutional authority to provide for the general welfare, to regulate commerce among the States, and to make all needful rules and regulations respecting property belonging to the United States, and for the purposes, among others, of regulating the flow of the Colorado River, storing water for beneficial consumptive use, making it possible for the States of the Upper Basin to utilize, consistently with the obligation undertaken by the States of the Upper Division in Article III of the Colorado River Compact, the apportionments made to and among them in the Colorado River Compact and the Upper Colorado River Basin Compact, respectively, providing for the control of floods and for the improvement of navigation, and generating hydroelectric power, hereby authorizes the Secretary of the Interior (1) to construct, operate, and maintain the following initial units of the Colorado River Storage Project, consisting of dams, reservoirs, power plants, transmission facilities and appurtenant works: Echo Park, Flaming Gorge, Glen Canyon, Navajo and Curecanti: **Provided, However,** That the Curecanti dam shall be constructed to a height which will impound not less than 940,000 acre-feet of water or will create a reservoir of such greater capacity as can be obtained by a high water line located at 7,520 feet above mean sea-level; and (2) to construct, operate, and maintain the following additional reclamation projects (including power generating and transmission facilities related thereto), hereinafter referred to as participating projects: Central Utah, Emery County, Gooseberry, Florida, San Juan-Chama, Shiprock-South San Juan Indian Irrigation, Hammond, LaBarge, Lyman, Paonia (including the Minnesota unit, a dam and reservoir on Muddy Creek just above its confluence with the North Fork of the Gunnison River, and other necessary works), Pine River Extension, La Plata, Seedskadee, Silt and Smith Fork: **Provided,** That no appropriation for or construction of the San Juan-Chama Project or the Shiprock-South San Juan Indian Irrigation Project shall be made or begun until coordinated reports thereon shall have been submitted to the affected States pursuant to the Act of December 22, 1944 (58 Stat. 887),

and approved by the Congress: **Provided, Further,** That no appropriation for or construction of any part of the Central Utah Project, beyond the initial phase thereof, shall be made or begun until a report thereon shall have been submitted to the affected States pursuant to the Act of December 22, 1944 (58 Stat. 887) and approved by the Congress. The benefits of the Act of July 1, 1932 (47 Stat. 564) are hereby extended and shall apply to all Indian lands served by each of the foregoing participating projects.

SEC. 2. Except as otherwise provided in this Act, in constructing, operating, and maintaining the units of the Colorado River Storage Project and the participating projects listed in section 1 of this Act, the Secretary shall be governed by the Federal Reclamation Laws (Act of June 17, 1902, 32 Stat. 388, and Acts amendatory thereof or supplementary thereto): **Provided,** That (a) irrigation repayment contracts entered into pursuant to those laws may, except as otherwise provided for the Paonia and Eden Projects, provide for repayment of the obligation assumed thereunder over a period of not more than fifty years exclusive of any development period authorized by law; (b) contracts relating to municipal water supply may be made without regard to the limitations of the last sentence of Section 9(c) of the Reclamation Project Act of 1939; (c) in constructing, operating and maintaining the Shiprock-South San Juan Indian Irrigation Project, the Secretary shall be governed by the laws relating to the development of irrigation projects on Indian reservations where applicable; and (d), as to Indian lands within, under or served by either or all participating projects, payment of construction costs shall be subject to the Act of July 1, 1932 (47 Stat. 564). Said units and projects shall be subject to the apportionments of the use of water between the Upper and Lower Basins of the Colorado River and among the States of the Upper Basin fixed in the Colorado River Compact and the Upper Colorado River Basin Compact, respectively, and to the terms of the treaty with the United Mexican States.

SEC. 3. The Colorado River Storage Project and participating projects shall be treated and accounted for as one project; the capital investment in the commercial power features of said project shall be returnable within a period not exceeding fifty years from the date of completion of such features unless, in the judgment of the Secretary, concurred in by the Federal Power Commission, a longer period is deemed justified; interest on the unamortized balance of the investment in the commercial power features of the said project shall be returnable at a rate not less than the average rate paid by the United States on its long term loans outstanding at the date of authorization of the said project; interest

at such rate shall be paid annually out of the net revenues of the commercial power features thereof into Miscellaneous Receipts of the Treasury; and the return of that part of the costs of the project [including, but without limitation, those portions of the reimbursable construction costs of the Paonia Project (including the Minnesota unit, a dam and reservoir on Muddy Creek just above its confluence with the North Fork of the Gunnison River, and other necessary works) and of the irrigation features of the Eden Project, as authorized in the Act of June 28, 1949 (63 Stat. 277), which are, in the case of the Paonia Project, beyond the ability of the water users to repay within the period prescribed in the Act of June 25, 1947 (61 Stat. 181), and, in the case of the Eden Project, in excess of the amount prescribed in the Act of June 28, 1949] allocated to irrigation but returnable from net power revenues, authorization for which said allocation and return under the Federal Reclamation Laws is hereby confirmed, shall begin on a date not later than the date upon which the return of the capital investment in the commercial power features of the said project has been completed.

SEC. 4. The hydroelectric power plants authorized by this Act to be constructed, operated, and maintained by the Secretary shall, to the fullest practicable extent consistent with the purposes of this Act, the Colorado River Compact and the Upper Colorado River Basin Compact, be operated in conjunction with other Federal power plants, present and potential, so as to produce the greatest practicable amount of power and energy that can be sold at firm power and energy rates. Neither the impounding nor use of water solely for the generation of power and energy at such plants shall preclude the use and consumption of water of the Upper Colorado River System for domestic or agricultural purposes; and the Secretary, upon the application of any party proposing to make any such use (which application is concurred in by the appropriate officials of the State or States in which such use is proposed to be made), after notice given by said party to all other interested parties and opportunity for public hearing on the issues involved and unless good cause be shown why such application should not be granted, shall release to the extent required for such use any right that the United States may have to impound and use water solely for the generation of power and energy as aforesaid. The Secretary is hereby authorized to enter into such contracts or agreements as, in his opinion, are feasible based upon a recognition and evaluation of the benefits arising from integrated operation of other hydroelectric power plants and of the works herein authorized. Electric power generated at plants authorized by this Act and disposed of for use outside the States of the Upper Colorado River Basin shall be replaced from other sources, as determined by the Secretary, when required to

satisfy needs in the States of the Upper Colorado River Basin, at rates not to exceed those in effect for power generated at plants authorized by this Act. Contracts for the sale of power for use outside the States of the Upper Colorado River Basin shall contain such provisions as the Secretary shall determine to be necessary to effectuate the purposes of this Act, including the provision that if and when the Secretary finds (a) that such power can not practicably be replaced from other sources at rates not exceeding those in effect for power generated by plants authorized by this Act, and (b) that such power is required to satisfy needs in the States of the Upper Colorado River Basin, then such contracts shall be subject to termination or to modification to the extent deemed necessary by the Secretary to meet power requirements in the States of the Upper Colorado River Basin.

SEC. 5. In order to achieve such comprehensive development as will assure the consumptive use in the States of the Upper Colorado River Basin of waters of the Colorado River System the use of which is apportioned to the Upper Colorado River Basin by the Colorado River Compact and to each State thereof by the Upper Colorado River Basin Compact, it is the intent of the Congress to authorize the construction, operation, and maintenance of further units of the Colorado River Storage Project, of additional phases of participating projects authorized in this Act, and of new participating projects as additional information becomes available and additional needs are indicated. It is hereby declared to be the purpose of the Congress to authorize as participating projects only projects (including units or phases thereof)

(1) for the use, in one or more of the States designated in Article III of the Upper Colorado River Basin Compact, of waters of the Upper Colorado River system the consumptive use of which is apportioned to those States by that article;

(2) whose total benefits exceed their total costs including, but without limitation, costs attributable to the direct use of the facilities of the Colorado River Storage Project or any other project and an appropriate share of the costs of the Colorado River Storage Project;

(3) which are able, with their anticipated revenues from irrigation, based on the irrigators' ability to pay, to meet the operation, maintenance, and replacement costs allocated to irrigation and to pay within a period of fifty years following a suitable development period at least part of the construction cost allocated to irrigation;

(4) which have available, to aid them, an appropriate district, preferably of the water-conservancy type, which is satisfactory to the Secretary, one purpose of which shall be to provide revenues for the project over and above those paid by the irrigators, to assist in repayment of construction costs allocated to irrigation;

(5) for which pertinent data sufficient to determine their probable engineering and economic justification and feasibility shall be available.

It is likewise declared to be the policy of the Congress that a new project, unit, or phase thereof shall be authorized as a participating project only when and to the extent that all sources of revenue directly available to said project, unit, or phase are insufficient to return its reimbursable costs during a 50-year payout period.

SEC. 6. There is hereby established in the Treasury a special fund, designated the "Upper Colorado River Development Fund," to which shall be transferred at the end of each fiscal year, beginning with the initial year of commercial power production by the Colorado River Storage Project 7½ percentum of the net power revenues for that year after such net revenues exceed five million dollars annually, but not to exceed one million dollars in any one fiscal year. The moneys so transferred shall be available upon appropriation (such appropriation to remain available until expended) for expenditure by the Secretary, without prejudice to the use by him for the same purposes of other appropriated moneys, for studies and investigations relating to the development, conservation, and utilization of the waters of the Upper Colorado River Basin, all expenditures from said fund to be non-reimbursable and non-returnable under the reclamation laws. Funds appropriated for carrying out the authorizations contained in section 1 of this Act shall also be available for carrying out the studies and investigations set forth in this section.

SEC. 7. There is hereby established in the Treasury, from the receipts of the Colorado River Storage Project, a continuing fund of $1,000,000 to the credit of and subject to expenditure by the Secretary to defray emergency expenses and to insure continuous operation of the project.

SEC. 8. The Secretary shall report to the Congress as of the close of each fiscal year beginning with the fiscal year 1955 upon the status of the revenues from and the cost of constructing, operat-

ing, and maintaining the Colorado River Storage Project and the participating projects. The Secretary's report shall be prepared in such manner as accurately to reflect the Federal investment allocated to power, to irrigation, and to other purposes and the progress of return and repayment thereon, and the estimated rate of progress, year by year, in accomplishing full repayment.

SEC. 9. The Secretary is authorized and directed to plan, construct, operate, and maintain public recreational facilities on lands withdrawn or acquired for the development of the Colorado River Storage Project or of the participating projects, except on lands in Indian reservations, to conserve the scenery, the natural, historic, and archeologic objects, and the wildlife on said lands, and to provide for public use and enjoyment of the same and of the water areas created by these projects by such means as are consistent with the primary purposes of said projects; and to mitigate losses of and improve conditions for the propogation of fish and wildlife in connection with the development of the Colorado River Storage Project and of the participating projects. The Secretary is authorized to acquire lands and to withdraw public lands from entry or other disposition under the public land laws for the construction, operation, and maintenance of recreational facilities in connection with the said projects, and to dispose of them to Federal, State, and local governmental agencies by lease, transfer, exchange, or conveyance, upon such terms and conditions as will best promote their development and operation in the public interest. The costs, including the operation and maintenance costs, of all said undertakings shall be nonreimbursable and nonreturnable under the reclamation laws, and funds appropriated for carrying out the authorization contained in section 1 of this Act shall, without prejudice to the availability of other appropriated moneys for the same purposes, also be available for carrying out the investigations and programs authorized in this section.

SEC. 10. The Secretary is hereby authorized to undertake the investigations and programs of cooperating Federal agencies outlined in paragraphs 33 to 39, inclusive, of the report of the Regional Director, Region 4, Bureau of Reclamation, dated December 15, 1950, and entitled "Colorado River Storage Project and Participating Projects, Upper Colorado River Basin." The cost thereof shall be nonreimbursable and nonreturnable under the reclamation laws, and funds appropriated for carrying out the authorizations contained in section 1 of this Act shall, without prejudice to the availability of other appropriated moneys for the same purposes, also be available for carrying out the investigations and programs authorized in this section.

SEC. 11. Nothing contained in this Act shall be construed to alter, amend, or repeal the Boulder Canyon Project Act (45 Stat. 1057) or the Boulder Canyon Project Adjustment Act (54 Stat. 774).

SEC. 12. Construction of the projects herein authorized shall proceed as rapidly as is consistent with budgetary requirements and the economic needs of the country.

SEC. 13. There are hereby authorized to be appropriated, out of any moneys in the Treasury not otherwise appropriated, such sums as may be required to carry out the purposes of this Act.

SEC. 14. As used in this Act:

The terms "Colorado River Basin," "Colorado River Compact," "Colorado River System," "Lee Ferry," "States of the Upper Division," "Upper Basin," and "domestic use" shall have the meaning ascribed to them in Article II of the Upper Colorado River Basin Compact;

The term "States of the Upper Colorado River Basin" shall mean the States of Arizona, Colorado, New Mexico, Utah and Wyoming;

The term "Upper Colorado River Basin" shall have the same meaning as the term "Upper Basin";

The term "Upper Colorado River Basin Compact" shall mean that certain compact executed on October 11, 1948, by commissioners representing the States of Arizona, Colorado, New Mexico, Utah and Wyoming, and consented to by the Congress of the United States of America by Act of April 6, 1949 (63 Stat. 31);

The term "treaty with the United Mexican States" shall mean that certain treaty between the United States of America and the United Mexican States signed at Washington, District of Columbia, February 3, 1944, relating to the utilization of the waters of the Colorado River and other rivers, as amended and supplemented by the protocol dated November 14, 1944, and the understandings recited in the Senate resolution of April 18, 1945, advising and consenting to ratification thereof.

APPENDIX B

DALBY & McNULTY
Certified Public Accountants
First National Bank Building
Grand Junction, Colorado

August 30, 1952

Walter E. Dalby, C. P. A.
John E. McNulty, C. P. A.

Upper Colorado River Commission
Grand Junction, Colorado

We have examined the balance sheets of the General Fund and the Property and Equipment Fund of the Upper Colorado River Commission as of June 30, 1952, and the related statement of revenue and expense for the year then ended. Our examination was made in accordance with generally accepted auditing standards, and accordingly included such tests of the accounting records and such other auditing procedures as we considered necessary in the circumstances.

In our opinion, the accompanying balance sheets and revenue and expense statement present fairly the financial position of the Upper Colorado River Commission at June 30, 1952, and the results of its operations for the year then ended.

(Signed) DALBY & McNULTY

Certified Public Accountants

BALANCE SHEET — GENERAL FUND

UPPER COLORADO RIVER COMMISSION

June 30, 1952

ASSETS

CASH			
Office cash fund		$ 4.68	
Demand deposit		38,517.57	$38,522.25
RETURNABLE DEPOSIT			
United Air Lines			425.00
ACCOUNT RECEIVABLE			
Arising from overpayment of income tax withheld from employees			11.45
			$38,958.70

LIABILITIES, RESERVES, AND FUND BALANCE

ACCOUNTS PAYABLE			
For supplies and expenses			$ 1,595.70
RESERVES			
For encumbrances		$ 5,567.75	
For fiscal year 1952-1953 assessments received prior to June 30, 1952		9,360.00	
For contingencies		1,124.12	16,051.87
UNAPPROPRIATED FUND BALANCE			
Balance at July 1, 1951		$ 1,773.75	
Add:			
Excess provision for encumbrances for the fiscal year ended June 30, 1951	$ 25.70		
Excess of revenues over expenditures for the fiscal year ended June 30, 1952	19,511.68	19,537.38	21,311.13
			$38,958.70

REVENUE AND EXPENSE STATEMENT

UPPER COLORADO RIVER COMMISSION

For the fiscal year ended June 30, 1952

	BUDGET AMOUNT	ACTUAL AMOUNT	ACTUAL AMOUNT OVER-UNDER*
Revenues:			
Assessments	$68,800.00	$68,800.00	$ —0—
Sale of reports	—0—	93.75	93.75
Sale of property	—0—	75.00	75.00
TOTAL REVENUES	$68,800.00	$68,968.75	$ 168.75
Expenses:			
Personal services:			
Administrative salary	$13,750.00	$13,749.96	$ .04*
Engineering salaries	17,083.30	13,624.96	3,458.34*
Clerical salaries	5,490.00	4,828.59	661.41*
Social security tax	—0—	287.26	287.26
	$36,323.30	$32,490.77	$ 3,832.53*
Capital outlay	$ 2,752.10	$ 1,770.65	$ 981.45*
Office supplies	2,000.00	1,628.72	371.28*
Information:			
Exhibits	$ 2,000.00	$ —0—	$ 2,000.00*
Publications	5,624.60	673.15	4,951.45*
	$ 7,624.60	$ 673.15	$ 6,951.45*
Travel	$12,000.00	$ 8,919.39	$ 3,080.61*
Current expenses:			
Reporting	$ 2,700.00	$ 640.87	$ 2,059.13*
Telephone and telegraph	1,200.00	844.74	355.26*
Printing	2,500.00	1,357.90	1,142.10*
Accounting	500.00	335.00	165.00*
Insurance and bonds	700.00	546.60	153.40*
Economic study	500.00	—0—	500.00*
Engineering services	—0—	152.50	152.50
Miscellaneous	—0—	96.78	96.78
	$ 8,100.00	$ 3,974.39	$ 4,125.61*
TOTAL EXPENSES	$68,800.00	$49,457.07	$19,342.93*
EXCESS OF REVENUES OVER EXPENSES		$19,511.68	$19,511.68*

CASH RECEIPTS AND DISBURSEMENTS

UPPER COLORADO RIVER COMMISSION

For the fiscal year ended June 30, 1952

Balance of cash and demand deposit at July 1, 1951		$22,303.36
Cash receipts:		
Assessments	$60,788.00	
Sale of reports	93.75	
Sale of typewriter	75.00	60,956.75
		$83,260.11
Cash disbursements:		
Personal services	$28,787.69	
Travel	8,353.09	
Current expenses	2,835.60	
Capital outlay	744.50	
Information	284.25	
Office supplies	1,274.14	
Overpayment of income tax withheld from employees	11.45	
Expenses of fiscal year ended June 30, 1951 not paid until after July 1, 1951	2,447.14	44,737.86
Balance of cash and demand deposit at June 30, 1952		$38,522.25

INSURANCE COVERAGE

UPPER COLORADO RIVER COMMISSION

June 30, 1952

	TYPE OF COVERAGE	AMOUNT OF COVERAGE
Furniture and fixtures	Fire and comprehensive	$6,000.00
Automobile	Comprehensive	Actual cash value
	Bodily injury and property damage	$5/$100,000.00
Treasurer	Fidelity bond	$40,000.00
Assistant treasurer	Fidelity bond	$40,000.00
Employees	Workmen's compensation	Various

BALANCE SHEET — PROPERTY AND EQUIPMENT FUND

UPPER COLORADO RIVER COMMISSION

June 30, 1952

ASSETS

PROPERTY AND EQUIPMENT—at cost

Furniture and fixtures	$5,859.73
Automobile	2,780.07
Engineering equipment	1,305.00
	$9,944.80

FUND BALANCE

FUND BALANCE

Investment in property and equipment at July 1, 1951		$8,383.83	
Excess provision for purchase of furniture and fixtures for the fiscal year ended June 30, 1951		25.70	
		$8,358.13	
Transactions for the fiscal year ended June 30, 1952:			
Additions	$1,770.65		
Retirements	183.98	1,586.67	$9,944.80
			$9,944.80

APPENDIX C

BUDGET FOR THE FISCAL YEAR ENDING JUNE 30, 1954

PERSONAL SERVICES

Administrative			
Secretary and General Counsel	$13,750.00		
Administrative Assistant	3,772.95	$17,522.95	
Engineering			
Chief Engineer	$10,000.00		
Assistant Chief Engineer	9,350.00		
Summer Program	3,600.00		
Drafting and Miscellaneous	200.00	23,150.00	
Clerical			
Stenographer	$ 2,640.00		
Clerk-Typist	2,000.00		
Indexing and Extra	300.00	4,940.00	
Special Services			
To provide funds for the purpose of meeting urgent need that may arise for particular economic or engineering services not available to us except by the employment of specialists.	$ 3,500.00	3,500.00	
Social Security Taxes	$ 982.26	982.26	$50,095.21

TRAVEL		11,000.00
OFFICE SUPPLIES		2,000.00
INFORMATION		6,500.00
CURRENT EXPENSES		
Reporting	$ 2,500.00	
Telephone and Telegraph	1,200.00	
Insurance and Bonds	850.00	
Accounting	500.00	
Miscellaneous	250.00	
Printing (Office Forms)	350.00	
Printing (Annual Report)	2,000.00	7,650.00
CAPITAL OUTLAY		
Desks and Chairs (2 each)	$ 600.00	
Typewriter	175.00	
Miscellaneous	500.00	
File Cabinet	150.00	
Calculating Machine	527.00	
Automobile	1,500.00	3,452.00
		$80,697.21
Less: Unappropriated Fund Balance		17,435.25
		$63,261.96

The following is included as descriptive of the research carried on by the Engineering Department of the Commission. It is not, however, to be construed as binding on the Commission.

APPENDIX D

EFFECT OF OPERATION OF COLORADO-BIG THOMPSON TRANSMOUNTAIN DIVERSIONS ON FLOW OF THE UPPER COLORADO RIVER

In the Inflow-Outflow Manual prepared by the Engineering Advisory Committee and presented to the Upper Colorado River Compact Commission in August 1949, the Colorado River Basin above Cisco is covered by the data on Table No. 5 and Plate No. 8 (see Appendix L of the First Annual Report). The inflow index for this large drainage basin is made up of the discharges at eight rim stations plus the total annual trans-mountain diversions above these stations. The first of these stations is for the Colorado River at Hot Sulphur Springs which is a short distance below the reservoir, pumping and power plants of the West Slope facilities for the Colorado-Big Thompson diversion. Since the area and irrigation development above the Hot Sulphur Springs station is rather large and since the storage and diversion facilities for this project are located above Hot Sulphur Springs, principally between Granby and Grand Lake, it seemed desirable first to undertake an inflow-outflow study utilizing available stream discharge data on principal tributaries of the Colorado River above Hot Sulphur Springs. In this way the operation of the Granby and other reservoirs and the Adams Tunnel diversions could be isolated and treated separately. The result of this study is shown on Plate No. 1 from discharge data for 1936 to 1946, inclusive, for the correlations between the inflow index values and the outflow at Hot Sulphur Springs. Very satisfactory results were obtained for the period 1936 through 1946 before any large diversions, as shown by the fact that the adjusted square of the coefficient of correlation is 0.985 while the standard error of estimate is only 11,100 acre-feet, or an average of 2.85%.

The final selection of the five inflow index stations used was made only after intensive study of the geographical location and distribution of these stations using U. S. Geological Survey topographic maps and all the other data which could be collected. Some of this additional data includes the drainage area above each gage, the elevation of gaging stations, the maximum elevation of all sub-drainage basins, the location of the trans-mountain diversions, and the area and location of lands irrigated both above and below the stations. The following five index stations are all above Hot Sulphur

Springs and were finally selected as giving the most practical distribution and coverage of the drainage area involved. Also all earlier trans-mountain diversions above Hot Sulphur Springs are from these tributaries:

Colorado River near Grand Lake
Arapaho Creek at Monarch Lake
Ranch Creek near Fraser
Fraser Creek near Winter Park
Vasquez Creek near Winter Park

Since the correlation in this case is so nearly perfect it was not considered necessary to utilize any other independent variables than the inflow index. The resulting inflow-outflow relation is given by the following formula:

$$Y = 2.218X - 695$$

The annual discharge at each station was adjusted to virgin flow conditions. Trials of two other groupings, one of which included seven instead of five stations, were also made but the correlation coefficients were smaller and the standard errors were much larger. In this equation, X is the inflow index resulting from the addition of the adjusted annual discharges at the five stations used, in units of 100 acre feet, while Y is the computed outflow at Hot Sulphur Springs. Complete details as to the actual amount of water diverted and the return flow to the streams of the basin is not available and the consumptive use adjustments were based on an estimated one acre foot per acre irrigated, together with the best available information as to the acreage actually irrigated.

The West Slope features of the Colorado-Big Thompson Project began with the operation of the Alva B. Adams Tunnel in August 1947. Reservoirs and the dates of their operation are given below:

Shadow Mountain Reservoir — April 1947
Granby Reservoir and Pumping Plant — 1950
Willow Creek Reservoir and
Pumping Plant — Now under construction

On the above mentioned diagram, the points marked with the years 1947, 1948, 1949, 1950 and 1951 indicate the increase in the depletion of stream flow at Hot Sulphur Springs as compared with the theoretical average discharge. The very wide difference between theory and observation for the years 1950 and 1951 is due to the filling of Granby Reservoir. The estimated contents of the reservoir at the end of each year does not by any means account for the great increase in stream depletion. These differences are due in part to the large amount of "bank storage" which always occurs when any newly constructed reservoir is put into operation.

No estimate is here made of the probable losses by evaporation since no information is available at this time as to the average area of the water surface exposed, although some estimates of the probable average annual depth per acre could be made, and the total could be computed assuming a full reservoir. It is also well known that there was very large leakage from the reservoir under some of the newly constructed dikes and no attempt has been made to obtain any estimate of this quantity of loss since it is largely returned to the stream and should, therefore, appear in the outflow quantities. The depletions in the flow at Hot Sulphur Springs for the years 1947 through 1951 are indicated by a light solid line extending to the left from the point on the trend line of the graph except that for the year 1948 there is a small increase in the outflow. However, in no case does change in storage fully account for the observed outflow. In each case the outflow quantity is considerably greater than the change in storage and shows that if the loss due to evaporation were also added to the effect of change in storage the discrepancies would be even greater than indicated. For each of these years the amount of the unaccountable change which is shown graphically is 3 or more times as great as the standard error of the theoretically computed outflow and the discrepancy is therefore correctly stated as unaccountable change. It has been suggested that this quantity, or a part of it, may be considered as salvage.

The gaging station at Glenwood Springs is of very long standing with probably the longest continuous record available on the Upper Colorado River. Inflow-outflow studies were made at this intermediate point in order to follow the effect of the Colorado-Big Thompson diversions in greater detail. For this study some additional inflow index stations were used with the five stations mentioned above to replace the records at Hot Sulphur Springs. The complete list of inflow stations with the drainage area above each, together with a list of trans-mountain diversions, is as follows:

Colorado River near Grand Lake	103
Arapaho Creek at Monarch Lake	47
Ranch Creek near Fraser	20
Fraser River near Winter Park	28
Vasquez Creek near Winter Park	28
Williams River near Leal	90
Blue River at Dillon	129
Tenmile Creek at Dillon	113
Gore Creek at Minturn	100
Eagle River at Redcliff	72
Homestake Creek at Redcliff	59
Troublesome at Troublesome	178

Trans-Mountain Diversions

Grand River Ditch
Moffat Tunnel
Berthoud Pass Ditch
Jones Pass Tunnel
Columbine, Ewing, Wurtz Ditches
Data not available on Fremont and
Boreas Ditches

The following equation and graph on Plate No. 2 shows the inflow-outflow relationship based on the years 1932 through 1946 together with the points for the data for the years 1947, 1948, 1949, 1950 and 1951:

$$Y = 2.982X - 393$$

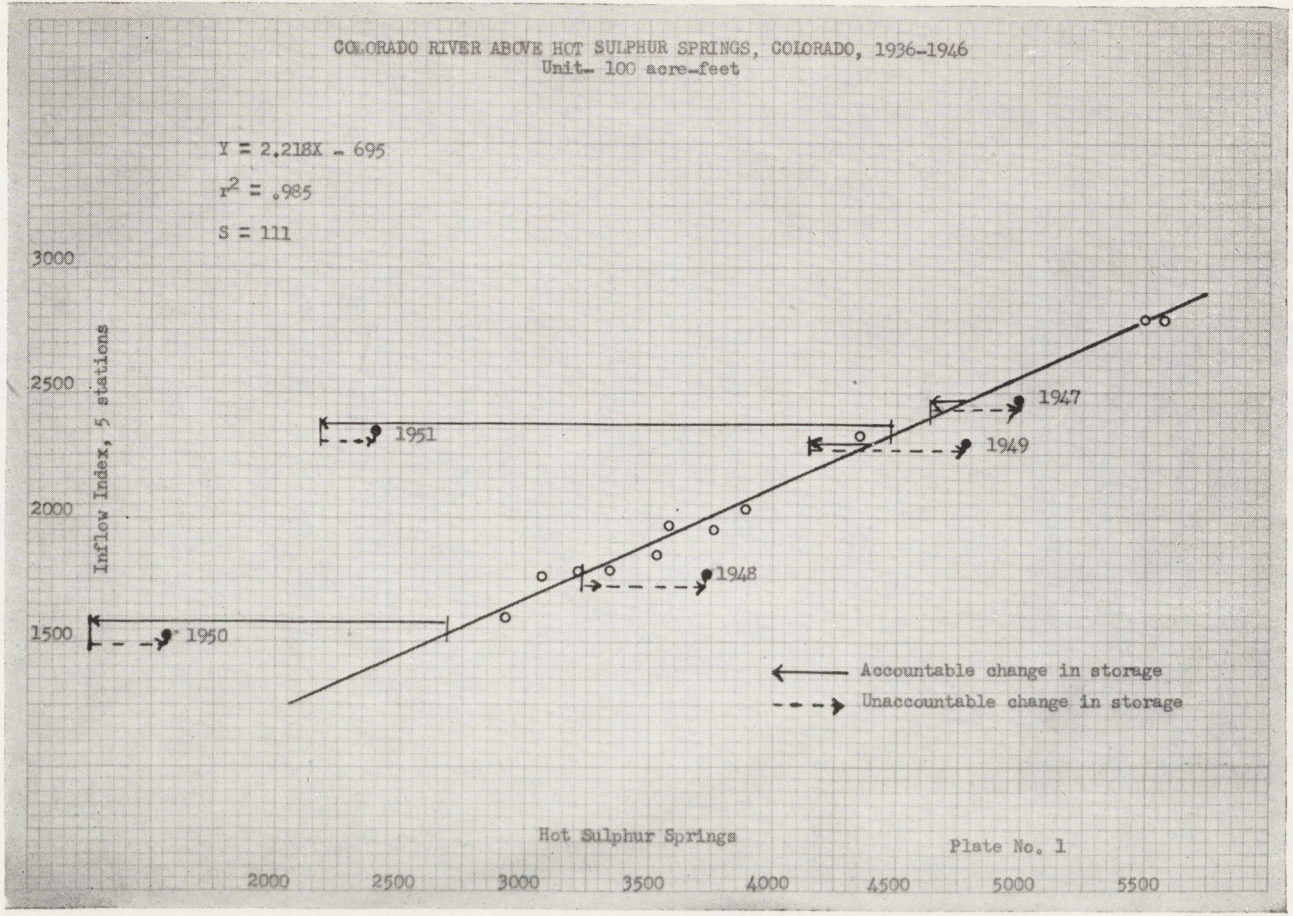
As before, X is the inflow index, Y is the computed outflow, and the variables are in units of 1,000 acre feet. The adjusted square of the coefficient of correlation is 0.9156 and the standard error of estimate is 104,000 acre feet. In this study it was necessary to estimate by correlation the discharge at a number of the inflow index stations for the earlier years. The same preliminary study as to the location and topography of the additional index stations was made as was done for those above Hot Sulphur Springs and much additional detailed information has been collected. The only tributary north of the Colorado River between Hot Sulphur Springs and Glenwood Springs for which there is adequate stream flow data is Troublesome Creek. A better and more representative geographical distribution of index stations was obtainable for tributaries to the south of the main stream.

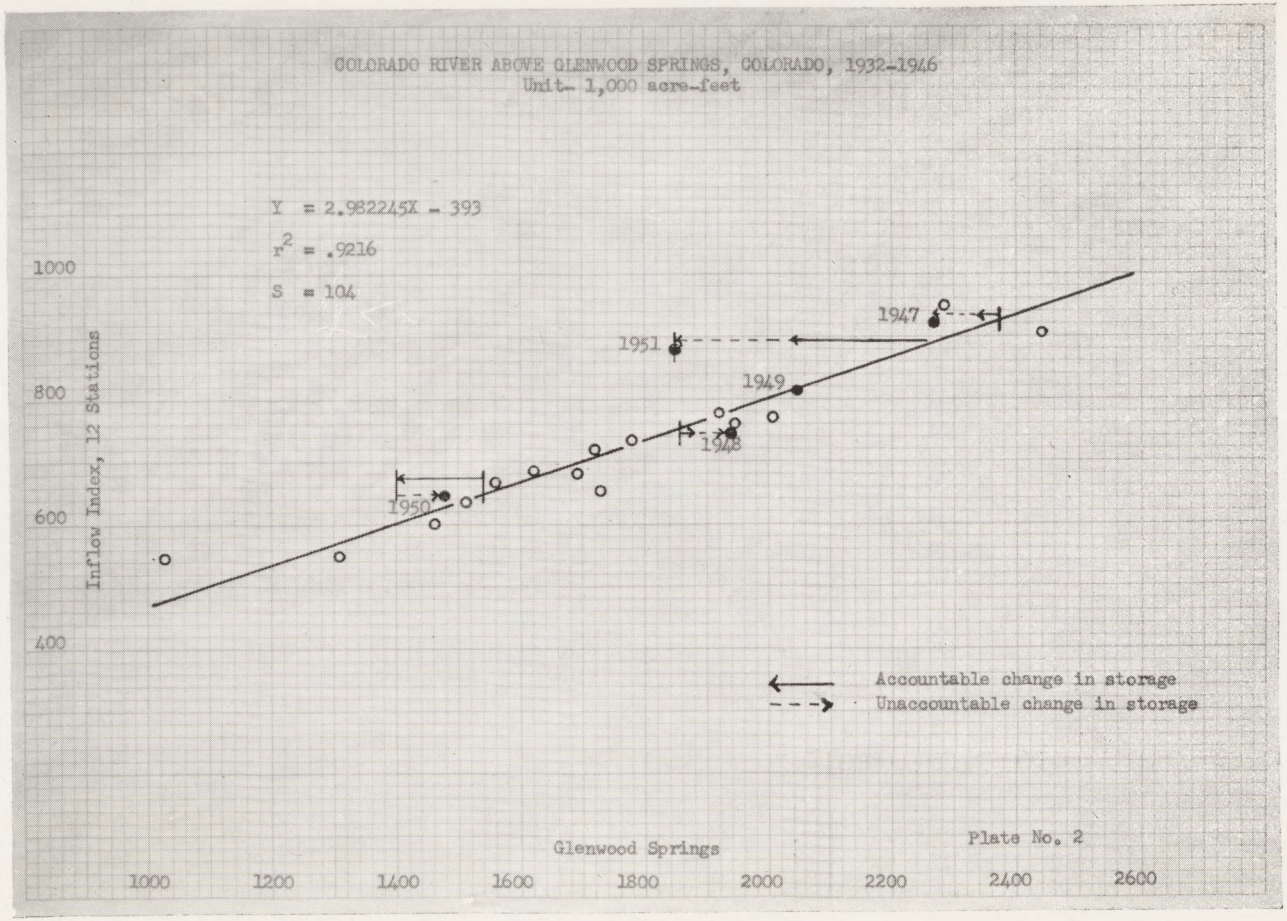
On this plate for the river above Glenwood Springs, similar unaccountable changes are found for the years 1948 and 1950. While for 1947 and 1951 the change in storage was much less than the total decrease in outflow from the probable discharge if storage reservoirs were not involved. However, it should be noted that only for the year 1951 is the unaccountable change greater than the standard error of estimate for the inflow-outflow formula.

Comparing the two plates for the year 1950 it will be noted that the inflow index for that year is smaller in amount than for the year 1940 which is the lowest one on the plate. (There is not sufficient information available for satisfactory estimate of the index for 1934 which point is therefore not shown.) On Plate 2 showing the conditions at Glenwood Springs there were four years having inflow indexes less than that for 1950 which however is among the low years. The annual discharge for tributaries other than those above Hot Sulphur Springs was relatively much greater than for

the Colorado at that point showing marked reduction in the influence of the discharge from streams above Hot Sulphur Springs on the total flow of the river as additional inflow takes place down stream. Time has not permitted completion of the study for the effect at the stations near Cameo and Cisco. Similar results are certainly to be expected.

This study will be continued and carried progressively downstream at least to the Cisco station in Utah and will include the newly established Ruby Canyon station near the Colorado-Utah state line. The investigation of other details in this whole problem will be taken up as time permits and information becomes available.


COLORADO RIVER ABOVE HOT SULPHUR SPRINGS, COLORADO, 1936-1946
Unit- 100 acre-feet
Y = 2.218X - 695
r^2 = .985
S = 111
3000
2500
2000
1500
Inflow Index, 5 stations
1951
1947
1949
1948
1950
Accountable change in storage
Unaccountable change in storage
Hot Sulphur Springs
Plate No. 1
2000
2500
3000
3500
4000
4500
5000
5500


COLORADO RIVER ABOVE GLENWOOD SPRINGS, COLORADO, 1932-1946
Unit- 1,000 acre-feet
Y = 2.982245X - 393
r² = .9216
S = 104
1000
800
600
400
Inflow Index, 12 Stations
1947
1951
1949
1948
1950
Accountable change in storage
Unaccountable change in storage
Glenwood Springs
Plate No. 2
1000
1200
1400
1600
1800
2000
2200
2400
2600

The following is included as descriptive of the research carried on by the Engineering Department of the Commission. It is not, however, to be construed as binding on the Commission.

APPENDIX E

RESERVOIR EVAPORATION STUDY

One of the engineering investigations undertaken during the past summer was the review and extension of the study of reservoir evaporation losses which was included in Report No. 15 by the Chief Engineer.

The first step in the summer study was to review the evaporation records which had formerly been used, check them with the source material, and bring them up to date. Records for a few additional stations were also collected and these extended records were compared with those of similar stations taken from the Climatological Reports on file in the office.

The second step was a study of the Dalton Meyer formula to be used in estimating evaporation at Grand Junction and Montrose, Colorado. This formula requires data on relative humidity, temperature and wind velocity in order to compute probable monthly rates of evaporation.

The third step was the study of the correlation between mean annual temperatures and annual rates of evaporation, the parallel records being available for several weather stations in the Upper Basin.

With the completion of these three steps records of evaporation from 14 Weather Bureau stations in or very near the Colorado River Basin together with 14 additional stations for which estimates of evaporation were obtained by use of the Dalton Meyer formula or by correlation with annual temperatures. As a matter of record the Dalton Meyer formula is as follows:

$$E = 11(e_s - e_a)\left(1 + \frac{\overline{v}_w}{10}\right)$$

E = Deep reservoir evaporation (inches per month)
e_s = Saturation vapor pressure (inches of mercury)
e_a = Average monthly vapor pressure (inches of mercury)
$\overline{v}_w$ = Mean monthly wind spread (miles per hour)

The harmonizing of data on relative humidity required very careful investigation to make it useable in this evaporation formula.

Readings of this quantity had been determined from humidity readings for three different time periods. The early records were taken twice daily at 8:00 a.m. and 8:00 p.m. Later, records were taken three times daily at 5:30 a.m., 12:00 noon and 5:30 p.m. They are now taken four times at 5:30 a.m. and 11:30 a.m. and 5:30 p.m. and 11:30 p.m. The daily means obtained by these three different methods are inconsistent and none of the three represents a true daily mean. A curve was finally devised from which the following correction factors were determined to reduce the data to a more probable base. These correction factors are 0.99 for the four readings per day, 1.05 for the three readings per day and 0.92 for the two readings per day. Thus, mean monthly humidity readings were obtained for use in the formula. (See Plates 3 and 4.)

The adjustment of velocity to the common standard of velocity of 30 feet above the surface of the earth required in the formula also required much detailed study. This is due to the fact that at Grand Junction the anemometers used for determining wind velocity have been at five different elevations during the period of observation from 1899 to 1952. These different elevations were 51 feet, 96 feet, 68 feet, 42 feet and now 101 feet above the surface of the earth. None of these elevations was the standard for use in the Dalton Meyer formula and correction factors had to be determined by the use of formulas obtained from aerodynamics and fluid mechanics. In this way, a curve for wind velocity at any height up to 101 feet above the earth surface with the corresponding correction factors has been obtained and the wind data were adjusted accordingly. The formula devised by the study is:

$$V = 13.0 \log \frac{Y}{11.8}$$

In this formula V is the wind velocity in MPH, Y is the elevation of the anemometer above the ground, in feet.

It is recognized, of course, that air density decreases with increase in elevation but since in this case the difference in elevation does not exceed 100 feet the variation in air density is negligible.

Curves for the determination of saturation vapor pressure from air temperature, the determination of average daily relative humidity and the variation of wind velocity with elevation all at Grand Junction are included herewith. (See Plates 3, 4, and 5.)

The next step was to determine the best possible correlation between mean annual temperature and mean annual reservoir evaporation. The accompanying diagram, together with a curve and

equation, was the result of this study and is believed to give the best means of correlating these variables for the Colorado River Basin. This curve is based on corresponding temperature and evaporation records for the 14 stations already referred to. It should be noted that this relationship is best indicated by a curve rather than by a straight line.

The following equation was devised for the curve shown on Plate No. 6, in which E is the average annual evaporation from a reservoir in inches and T is the mean annual temperature in degrees fahrenheit.

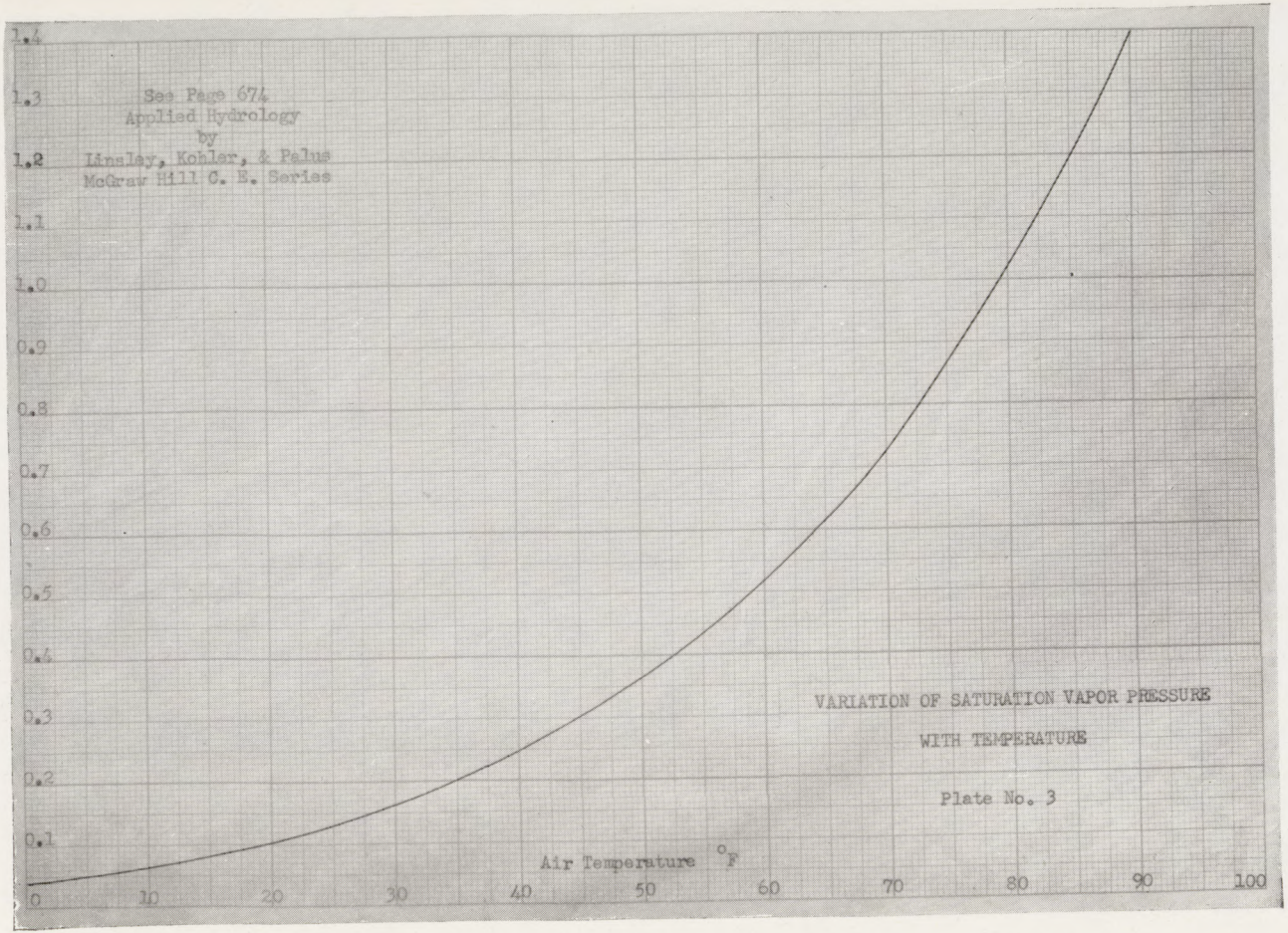
$$E = 11.05 + 0.003T^{2.37}$$

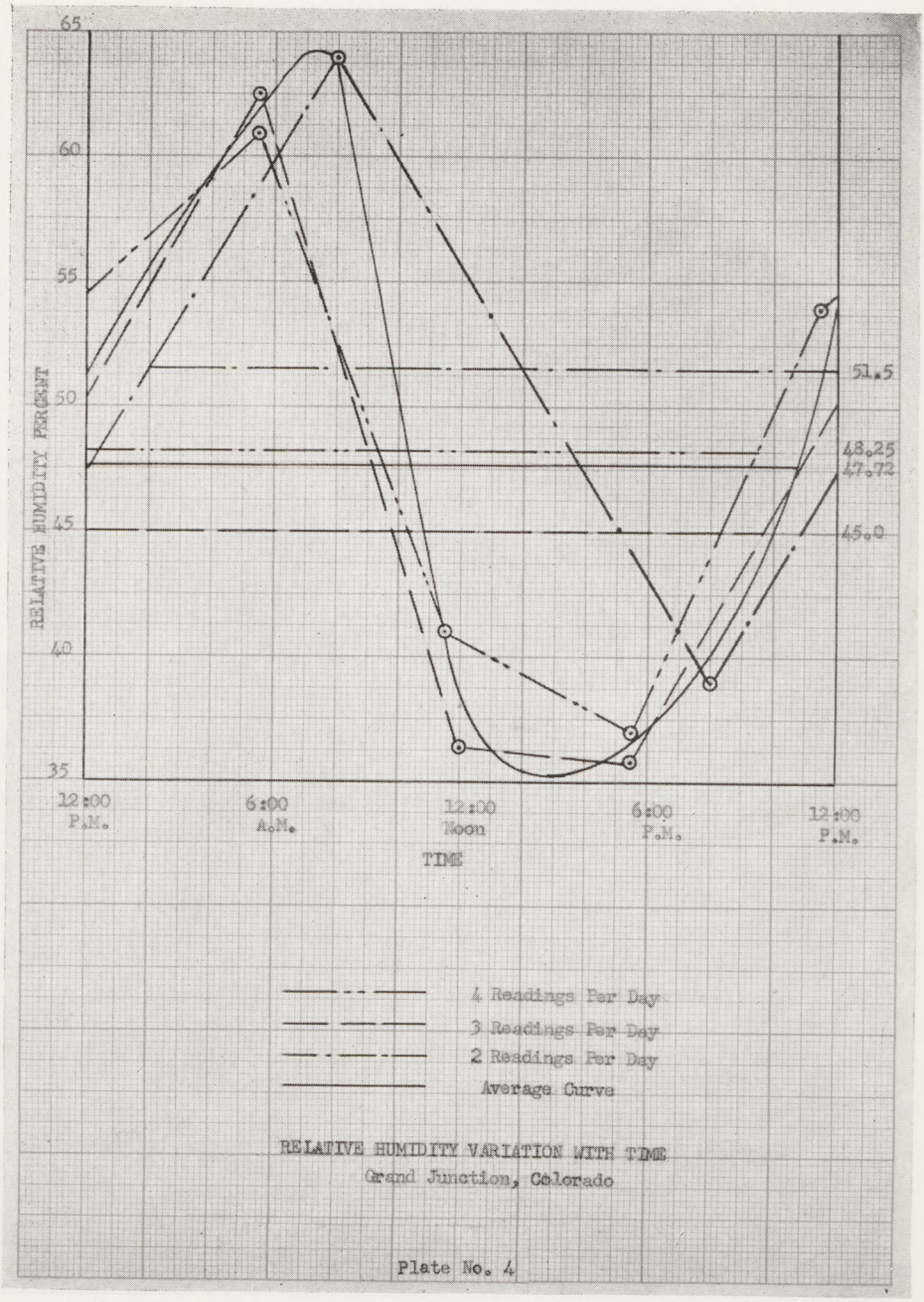
The value of the adjusted square of the coefficient of correlation, R^2 is 0.976.

With the use of this equation the probable annual evaporation from reservoir surfaces at 14 stations for which adequate temperature records were available has been computed. Since average values for evaporation at points in the Colorado River Basin have been obtained from records of greater length at several Weather Stations than was formerly available later studies with the data as finally adopted for the 28 stations now listed in the accompanying table the formula previously reported is being restudied and revised.

EVAPORATION DATA USED FOR FINAL EQUATION

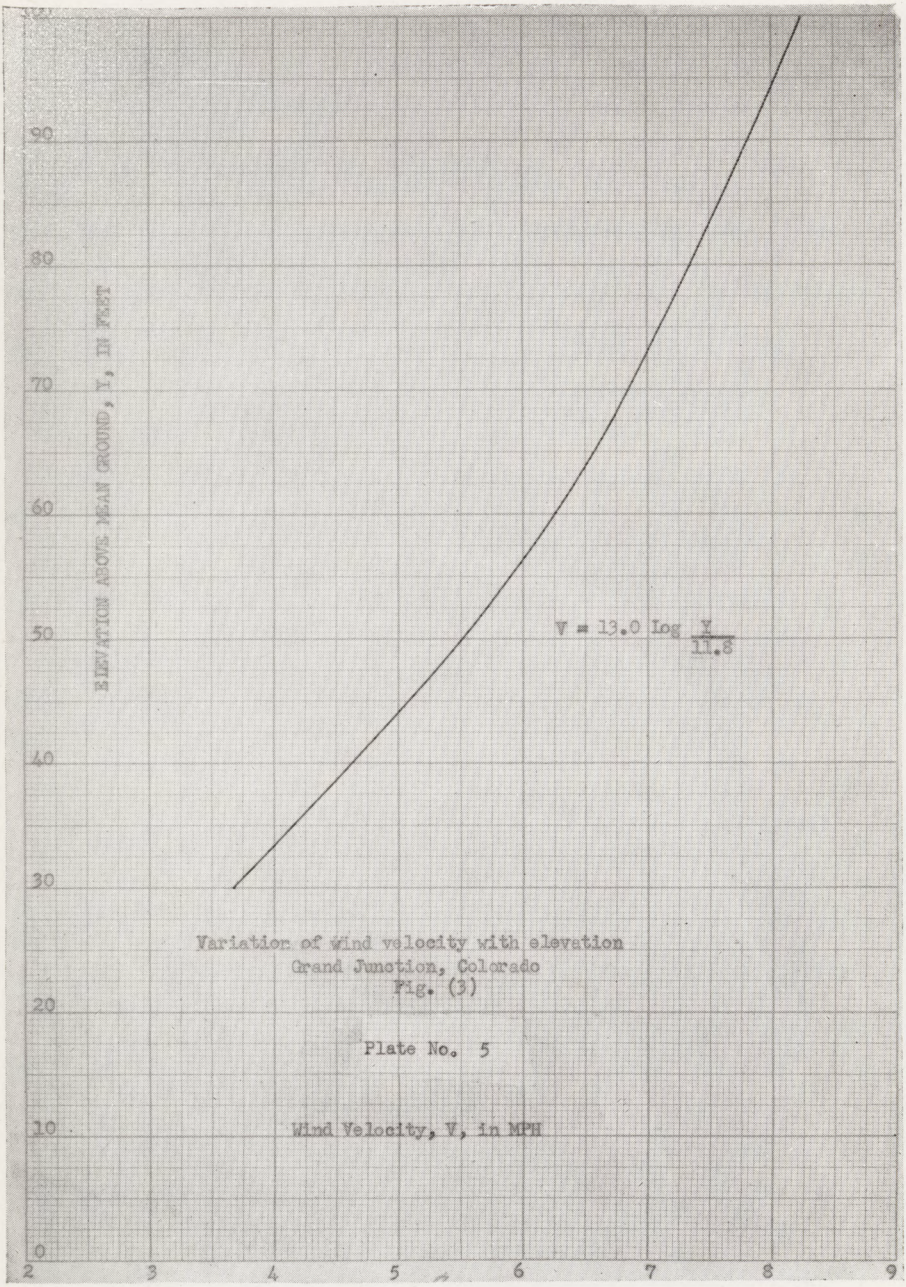
No.	Station	Reservoir Evaporation (In.)	Altitude (Ft.)	Latitude (Degrees)
1	Salton Sea, California	90.0	−230	33° 00′
2	Bartlet Dam, Arizona	84.8	1650	33° 49′
3	Lake Mead, Arizona	84.1	1200	36° 07′
4	Davis Dam, Arizona	80.0	530	35° 11′
5	Boulder City, Nevada	79.2	2530	35° 59′
6	Inner Canyon, Arizona	80.0	2490	36° 06′
7	Overton, Nevada	77.5	1280	36° 33′
8	Lees Ferry, Arizona	62.8	3140	36° 50′
9	Hite, Utah	61.0	3300	37° 50′
10	Bluff, Utah	53.0	4320	37° 17′
11	Grand Junction, Colorado	50.3	4730	39° 05′
12	Moab, Utah	51.0	4000	38° 35′
13	Green River, Utah	50.0	4090	39° 00′
14	Fruita, Colorado	48.0	4530	39° 09′
15	Farmington, New Mexico	44.5	5370	36° 44′
16	Grand Valley, Colorado	41.0	5090	39° 25′
17	Myton, Utah	40.9	5030	40° 12′
18	Ouray, Utah	40.5	4660	40° 07′
19	Montrose, Colorado	40.0	5810	38° 29′
20	Glenwood Springs, Colorado	38.0	5820	39° 34′
21	Jensen, Utah	36.3	4740	40° 23′
22	Ft. Duchesne, Utah	35.6	4940	40° 18′
23	Green River, Wyoming	34.0	6110	41° 32′
24	Linwood, Utah	33.0	6000	40° 59′
25	East Portal (Strawberry Resev.), Utah	32.0	7600	40° 10′
26	Lower Wagon Wheel Gap, Colorado	29.2	8500	37° 48′
27	Sugar Loaf Reservoir, Colorado	21.8	10000	39° 16′
28	Upper Wagon Wheel Gap, Colorado	21.5	9610	37° 43′


See Page 674
Applied Hydrology
by
Linsley, Kohler, & Paulus
McGraw Hill C. E. Series
1.4
1.3
1.2
1.1
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
10
20
30
40
50
60
70
80
90
100
Air Temperature °F
VARIATION OF SATURATION VAPOR PRESSURE
WITH TEMPERATURE
Plate No. 3



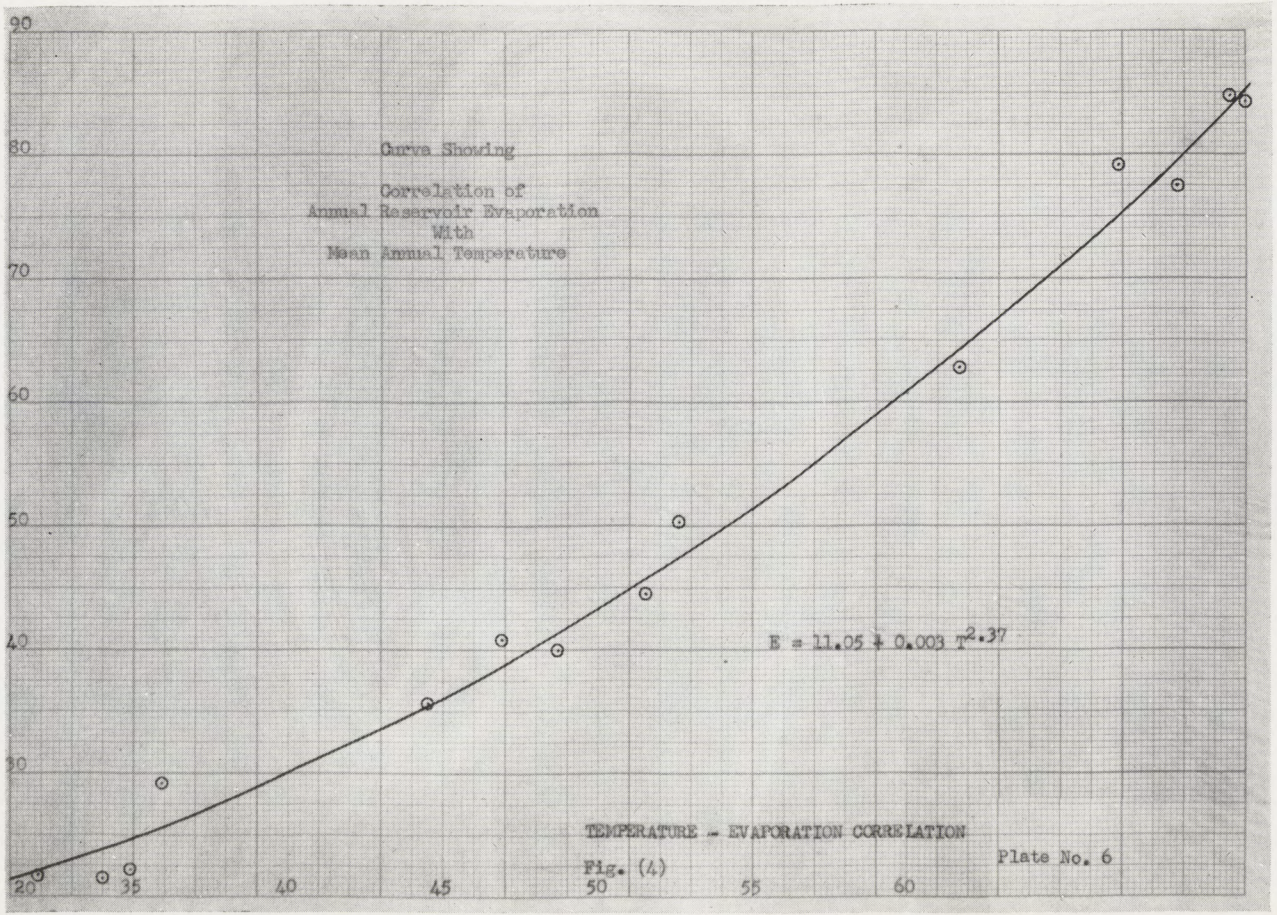
RELATIVE HUMIDITY VARIATION WITH TIME
Grand Junction, Colorado

Plate No. 4



Variation of wind velocity with elevation
Grand Junction, Colorado
Fig. (3)

Plate No. 5


Curve Showing
Correlation of
Annual Reservoir Evaporation
With
Mean Annual Temperature
E = 11.05 + 0.003 T^2.37
TEMPERATURE - EVAPORATION CORRELATION
Fig. (4)
Plate No. 6
Annual Reservoir Evaporation (Inches)
Mean Annual Temperature °F
90
80
70
60
50
40
30
20
35
40
45
50
55
60

The following is included as descriptive of the research carried on by the Engineering Department of the Commission. It is not, however, to be construed as binding on the Commission.

APPENDIX F

INFLOW-OUTFLOW METHOD

Inflow-Outflow Method for Green River in Wyoming.

At the September 1951 meeting of the Commission a report was given by the Chief Engineer which included a statement of the progress which had been made on the study of the inflow-outflow method applied to the Green River Basin in Wyoming. It seemed at that time that substantial progress was being made but that considerable further investigation would be necessary in order to bring the formulas into a more useable form.

A complete review of this work has been made during this past year and formulas have been derived which we believe will generally be more satisfactory. At the present time the procedure adopted has been set up in several steps as follows:

(1) The inflow index, as computed on an annual basis, is first related to the outflow, giving an equation for this simple linear relation. This form was used in the original "Manual" and now serves as a reference and check.

(2) It was found that a division of the annual flow into five months of winter flow and seven months of summer flow usually gave some improvement in the square of the coefficient of correlation. Six months division between winter and summer flows did not give as high a coefficient of correlation, and it was felt that the lower coefficient might be due to the influence of the increase in surface run-off from melting snow which usually occurs during the latter part of March; while the winter flow is almost entirely due to ground water and has much less fluctuation from month to month.

(3) In the belief that precipitation on the plains below the index stations might have a material effect, numerous trials were made using some of this information. There are five Weather Bureau stations located at Kendall, Pinedale, Sage, Eden and Green River, Wyoming for which it was possible to determine monthly records of precipitation

with relatively few estimates to supply missing data. It was learned from papers given at the Western Snow conference and at the annual meeting of the American Geophysical Union that fall precipitation was being used successfully to indicate what has been called "soil priming." It was hoped that this factor might show some material influence on changes from year to year in the winter runoff, and the introduction of precipitation data for the months of September and October at the beginning of each water year gave a precipitation index which did improve the correlation.

(4) Since it is well known that summer precipitation during the irrigation season acts to reduce the consumptive use of water applied in irrigation, the next step was to introduce this summer index of precipitation into our equation. After many trials it was found that the use of summer precipitation for the four months of May through August, the usual irrigation season, as combined from the three stations in the lower area of the Green River Valley, that is, Sage, Eden and Green River, could be utilized with good effect. The sum of the precipitation quantities less than one inch during each month of the season at each of these stations, precipitation equal to and less than one inch, equal to and less than one and one half inches, equal to and less than two inches, and, finally, the total precipitation for each of these four months at each of these three stations, were all found to give an index which could be combined with an average irrigation depletion factor to adjust the observed historic outflow to virgin flow conditions. Actual depletion of stream flow will vary from year to year with variations in summer precipitation. In Appendix B, "Consumptive Use of Water Rates in the Upper Colorado River Basin" of the Final Report of the Engineering Advisory Committee to the Upper Colorado River Compact Commission summer precipitation was used only as an average quantity. In our investigations it has been treated as an independent variable.

While it was believed earlier that variations in water supply, as used in the Debler formula adopted by the U. S. Bureau of Reclamation in its studies of water supply of the Colorado River Storage Project would improve our coefficient, consistent results could not be obtained in this way, and for the present this factor has been omitted from our set of independent variables.

(5) It has been observed from the beginning of the study of the inflow-outflow method that in certain drainage areas a curvilinear relation would be required in order to secure a satisfactory degree of correleation between inflow-index variables and observed outflow. The first method used to obtain this curvature was by trial and error with fractional exponents. This procedure required many approximate solutions and repeated trials with from three to six simultaneous equations.

By using a parabolic equation with the independent variable taken to the first and second powers, it is possible to avoid the use of fractional exponents and obtain an equation to which the standard solution by the method of least squares is more readily applied with the determination of the square of the coefficient of correlation and standard error being easily computed. The mathematical investigation up to this time has covered the very wide range of no less than 26 different variables having been included at various times. It was found as was to be expected that when more than 6 variables were involved in any one solution very little significant improvement in results could be obtained. Not less than 100 of the many possible combinations of these different variables have been used with the result that half of them could be immediately discarded. The other half have received much more intensive study, and at the present time about a dozen equations are under consideration for submission to the Engineering Committee for the possible selection of one or more for the purposes of the application of the inflow-outflow method under the provisions of the Upper Colorado River Compact. It may well be understood that a study of this kind in which such a large number of factors are involved, as is the case with the natural influences causing variations in stream flow, final selection of a formula must depend upon the combined judgment of the engineering services at the disposal of the Commission as to the selection of the most important and significant of these variables, and the dependability of determining their numerical values in the future as well as in the past. Among the principal factors which have been used and which may prove to be significant, in addition to the inflow index which is well understood by the Commission, is the employment in calculation of separate variables which distinguish between the character of flow during fall and winter months and spring and summer months. It is also possible that in certain cases the character of stream discharge from drainage areas of different topographical and geological conditions may make it desirable to separate inflow index stations into groups depending on those features. This is one line of investigation which has been also considered. The significance

of multiple correlation is believed to be so great that in all probability some formula permitting easy transition from a strictly straight line to a curvilinear correlation will be adopted. This is the case with the formula which has been most recently studied and which is most likely to be presented for consideration of the Engineering Committee.

Other variables include outflow for previous years or for certain months of previous years including not only the first previous, but, also, the second earlier year, the latter being rather significant. Precipitation is still another variable which has proved to be significant, and this is true both as to precipitation during the irrigation season and during the months of late summer and early fall. It is also possible that precipitation in different areas may be significant, the one most commonly adopted having been that on the plains areas during the summer months. It is also recognized that temperature, especially during the summer months of the year, may be a significant factor in connection with the study of channel losses as well as man-made depletions. The significance of this factor is most evident in studies of evaporation. One factor which has not been included in any of these studies is that of wind. It, of course, causes large variation in evaporation but, is believed to be of relatively minor importance in direct connection with studies of stream flow.

Efforts have been made to avoid a large number of variables in any single equation since "as a matter of practical procedure, it is seldom that a problem is so complicated or that enough observations are available so that significant results for each variable will be obtained using ten or more variables; and, **ordinarily analysis involving not more than five variables are all that will yield stable results."*** (emphasis supplied)

The consistent endeavor of the engineers who have been employed on these studies to improve the methods of application of the inflow-outflow method for the Commission's uses has been to secure a formula or formulas which would make possible the estimation of stream discharge with a reasonably high degree of accuracy as indicated by the "coefficient of determination" as used by the author of the book just quoted, which is the square of the coefficient of correlation. When adjusted to take account of the number of variables and the length of the period covered by the series of observations it has been possible to secure a number of equations with the coefficient ranging from 92 to nearly 94%.

*Page 205, Methods of Correlation Analysis by Mordecai Ezekiel, second edition.

For many purposes this should be adequate, but the real significance of any correlation equation depends also upon the range of variation for individual estimates of discharge. If this includes occasional years with wide discrepancies it becomes difficult to account for such differences, and it may be necessary, as has sometimes been suggested, that an arbitrary adjustment should be made depending on someone's experience and judgment. It is to avoid, if possible, such a necessity that a great deal of study has been devoted to this investigation.

It is the aim of this investigation to derive a dependable equation for virgin flow affected by the most important influences in nature. The equation will, of course, include factors of virgin inflow and other contributing factors when required, for adequate determination of outflow. As stated in previous reports, it is felt that substantial progress toward this end is being made. However, it is felt that further study is desirable, and as time permits factors which have not yet been reduced to measurable terms will be included in the investigations.

APPENDIX G

UPPER COLORADO RIVER COMMISSION

Key Gaging Stations

Derived from reports of U. S. Geological Survey and others. Not to be construed as findings.

Ref. (1)	Stream (2)	Drainage Area Sq. Miles (3)
1.	Animas River near Cedar Hill, N. M.	1,092
2.	Animas River at Durango, Colorado	692
3.	Animas River at Farmington, N. M.	1,360
4.	Ashley Creek near Jensen, Utah	386
5.	Ashley Creek at Sign of the Maine, near Vernal, Utah	241
6.	Ashley Creek near Vernal, Utah	101
7.	Big Sandy Creek at Leckie Ranch, Wyo.	94
8.	Blacks Fork near Millburne, Wyo.	156
9.	Blacks Fork near Green River, Wyo.	3,670
10.	Blue River at Dillon, Colorado	129
11.	Boulder Creek below Boulder Lake, Wyo.	130
12.	Bloomfield Canal (see Citizens Ditch)	
13.	Brush Creek near Jensen, Utah	255
14.	Brush Creek near Vernal, Utah	82
15.	Burnt Fork near Burnt Fork, Wyo.	53
16.	Carter Creek near Manila, Utah	
17.	Carter Creek at mouth near Manila, Utah	110
18.	Citizens Ditch (Bloomfield Canal) near Turley, N. M. Diverting water around Blanco gage	
19.	*Colorado River near Cameo, Colorado	8,055
20.	Colorado River near Cisco, Utah	24,100
21.	Colorado River near Colorado-Utah state line	20,680
22.	*Colorado River at Glenwood Springs, Colorado	4,560
23.	Colorado River at Hite, Utah	76,600
24.	Colorado River at Hot Sulphur Springs, Colorado	782
25.	(A) Colorado River at Lee Ferry, Arizona	@109,889
26.	Colorado River at Lees Ferry, Arizona	@108,335
27.	Cottonwood Creek near Orangeville, Utah	200

Unit of flow—1000 acre-feet.

Average Annual Historic Flow (4)	Period Covered by Average (5)	Flows in Water Years (Provisional) 1951 (6)	1952 (7)
793.9	1914-48	372.9	985.4
650.5	1914-48	324.4	
741.2	1914-48	294.6	935.2
59.7	1947-48	31.5	
97.6	1940-48	75.8	
77.2	1914-48	59.6	27.3
(E) 56.2	1932-48	76.6	73.6
113.2	1914-48	111.6	
311.3	1948-50	307.8	460.1
86.2	1910-48	102.0	88.3
126.9	1932-48	194.9	162.8
34.3	1914-48	7.6	
39.35	f 1940-48	19.7	
24.8	1914-48	18.6	30.1
	1948	5.4	11.1
55.6	1947-48	32.1	68.2
	Mar-Sept 51	51.3	70.4
3,480.2	1914-48	2,910.7	4,130.4
6,131.0	1914-48	3,916.0	7,699.0
	May-Sept 51	2,837.4	6,847.0
2,066.5	1914-48	1,847.6	
11,055.0	1948-49	8,783.7	14,780.0
469.5	1914-48	239.6	345.6
13,633.8	1914-48	9,830.6	17,975.4
13,608.8	1914-48	9,816.7	17,956.6
74.6	1910-20, 12-27, 32-48	57.9	

Ref. (1)	Stream (2)	Drainage Area Sq. Miles (3)
28.	Crystal River near Redstone, Colorado	225
29.	†Dirty Devil River near Hite, Utah	
30.	Dolores River near Cisco, Utah	
31.	Dolores River at Dolores, Colorado	556
32.	Dolores River at Gateway, Colorado	4,350
33.	Duchesne River near Myton, Utah	2,705
34.	Duchesne River near Randlett, Utah	3,820
35.	Duchesne River near Tabiona, Utah	352
36.	Eagle River below Gypsum, Colorado	957
37.	East River at Almont, Colorado	295
38.	East Fork of Smith Fork near Robertson, Wyo.	53
39.	†East Fork of Beaver Creek near Lonetree, Wyo.	
40.	Elk River at Clark, Colorado	206
41.	Escalante River near Escalante, Utah	315
42.	Escalante River near mouth, Utah	
43.	Florida River near Durango, Colorado	96
44.	Fontenelle Creek near Fontenelle, Wyo.	224
45.	†Fontenelle Creek above Irrigation, Wyo.	
46.	Green River near Greendale, Utah	
47.	Green River at Green River, Utah	40,920
48.	Green River at Green River, Wyo.	7,670
49.	Green River near Jensen, Utah	**
50.	Green River near Linwood, Utah	14,300
51.	Green River near Ouray, Utah	**
52.	Green River at Warren Bridge, Wyo.	468
53.	Gunnison River and Redlands Power Canal near Grand Junction, Colorado	8,020
54.	Gunnison River near Gunnison, Colorado	1,010
55.	Gunnison River below Gunnison Tunnel, Colorado	3,980
56.	Hams Fork near Frontier, Wyo.	
57.	Henrys Fork at Linwood, Utah	530
58.	Henrys Fork near Lonetree, Wyo.	55
59.	LaPlata River at Colorado-New Mexico state line	331
60.	LaPlata River at Hesperus, Colorado	37
61.	Little Snake River near Dixon, Wyo.	1,028

Average Annual Historic Flow (4)	Period Covered by Average (5)	Flows in Water Years (Provisional) 1951 (6)	1952 (7)
270.8	1936-48	256.2	356.2
		153.8	1,067.0
351.8	1921-48		
767.9	1914-48	158.2	1,092.0
426.8	1914-48	349.2	797.2
632.1	1914-48	434.8	1,041.0
152.6	1914-48	184.5	252.5
494.6	1947-49	464.2	580.7
254.8	1910-13, 16-20, 34-48	234.8	353.8
32.4	1914-48	31.4	51.0
6.1	1948-49	4.5	5.8
257.5	1914-22, 31-48	233.1	276.4
10.47	1943-48	3.3	
		60.4	
86.9	1910-12, 17-24, 27-48	30.1	
42.6	1916-19, 31-48	88.3	62.9
		3,244.0	
4,633.0	1914-48	4,725.0	6,844.0
e 1,273.3	1914-48		
3,558.5	1947-48	3,673.0	
1,518.8	1914-48	2,256.8	2,016.0
4,032.0	1948	4,718.0	
355.1	1932-48	488.5	396.4
2,038.0	1914-48	1,127.0	2,625.0
624.0	1911-14, 16-28, 45-48	460.1	740.3
931.1	1943-48	569.1	1,457.0
		167.9	147.2
66.3	1914-48	45.9	109.2
31.9	1914-48	28.2	42.9
29.5	1914-48	8.0	
34.4	1917-48	17.9	
414.9	1914-48	291.2	611.8

Ref. (1)	Stream (2)	Drainage Area Sq. Miles (3)
62.	Little Snake River near Lily, Colorado	3,680
63.	Little Snake River near Slater, Colo.	285
64.	Los Pinos River near Bayfield, Colo.	284
65.	(C) Los Pinos River at LaBoca, Colorado	
66.	Los Pinos River at Ignacio, Colorado	448
67.	†Mancos River near Towoac, Colorado	550
68.	†McElmo Creek near Colorado-Utah state line	
69.	McElmo Creek near Cortez, Colorado	233
70.	†Middle Fork Beaver Creek near Lonetree, Wyo.	
71.	†Minnie Maud Creek near Myton, Utah	231
72.	Navajo River at Edith, Colorado	165
73.	North Fork Gunnison River near Somerset, Colo.	521
74.	†North Fork White River at Buford, Colorado	240
75.	North Piney Creek near Mason, Wyo.	58
76.	Paria River at Lees Ferry, Arizona	1,550
77.	†Pine Creek near Fremont Lake, Wyo.	
78.	Pine Creek at Pinedale, Wyo.	118
79.	Plateau Creek near Cameo, Colorado	604
80.	Price River near Heiner, Utah	430
81.	Price River at Woodside, Utah	1,500
82.	Rio Blanco River near Pagosa Springs, Colorado	58
83.	Rito Blanco River at Pagosa Springs, Colorado	23
84.	Roaring Fork at Aspen, Colorado	109
85.	Roaring Fork at Glenwood Springs, Colorado	1,460
86.	San Juan River near Blanco, N. M.	3,558
87.	San Juan River near Bluff, Utah	23,010
88.	San Juan River at Farmington, N. M.	7,245
89.	San Juan River at Pagosa Springs, Colorado	298
90.	San Juan River at Rosa, N. M.	1,990
91.	San Juan River at Shiprock, N. M.	12,876
92.	San Miguel River near Placerville, Colorado	308
93.	San Rafael River near Green River, Utah	1,690
94.	Savery Creek near Savery, Wyo.	330
95.	Sheep Creek near Manila, Utah	46

Average Annual Historic Flow (4)	Period Covered by Average (5)	Flows in Water Years (Provisional) 1951 (6)	1952 (7)
462.6	1914-48	294.6	728.5
166.3	1943-47	153.1	226.6
266.4	1927-48	145.5	
		32.0	282.3
246.9	1914-48	26.7	259.2
49.2	1914-48	2.0	60.7
		7.5	24.9
40.8	1914-48	13.8	28.4
16.9	1948-49	12.7	23.9
17.2	1948-49	1.7	
127.2	1914-48	52.2	156.6
339.6	1934-48	256.1	474.7
			274.8
36.3	1932-48	75.2	49.8
25.0	1914-48	13.9	18.8
95.8	1914-48	130.4	81.3
183.4	1914-48		
89.8	1914-48	72.6	225.3
37.3	1946-48	60.1	247.8
67.0	1936-48		
14.0	1936-48		
158.0	26 yrs.	59.2	81.3
1,026.8	1914-48	872.7	
1,218.7	1914-48	331.4	1,490.1
2,214.0	1914-48	668.3	2,542.0
2,051.0	1914-48	651.0	2,401.0
287.4	1936-48	130.7	415.1
926.4	1914-48	327.9	1,234.9
2,007.7		666.2	2,481.8
191.6	1943-48	95.7	217.3
1,686.9	1910-18, 46-48	67.8	314.8
76.0	1942-46 &		
	1948	55.8	147.9
14.2	1944-48	2.9	20.4

Ref. (1)	Stream (2)	Drainage Area Sq. Miles (3)
96.	Sheep Creek at mouth near Manila, Utah	111
97.	(B) Sheep Creek Upper Canal, near Manila, Utah	
98.	(B) Sheep Creek Lower Canal near Manila, Utah	
99.	Slater Fork near Slater, Colorado	161
100.	†Snake River near Montezuma, Colorado	59
101.	†South Fork White River at Buford, Colorado	
102.	(C) Spring Creek at LaBoca, Colorado near Colorado-Utah state line	
103.	Strawberry River at Duchesne, Utah	1,040
104.	Taylor River at Almont, Colorado	440
105.	Tenmile Creek at Dillon, Colorado	113
106.	Tomichi Creek at Gunnison, Colorado	1,020
107.	Uinta River near Neola, Utah	181
108.	Uncompahgre River at Colona, Colorado	437
109.	West Fork Beaver Creek near Lonetree, Wyo.	
110.	West Fork Smith Fork near Robertson, Wyo.	37
111.	White River near Meeker, Colorado	762
112.	White River near Watson, Utah	4,020
113.	Whiterocks River near Whiterocks, Utah	115
114.	Willow Creek near Ouray, Utah	967
115.	Yampa River near Maybell, Colorado	3,410
116.	Yampa River at Steamboat Springs, Colorado	604

* This is a U. S. G. S. station but is not required at the present time for administration by the Upper Colorado River Commission.

** Drainage area not shown in latest U. S. G. S. water supply paper available.

† This station is to be installed or reestablished and operated by the U. S. G. S. for administration uurposes by the Upper Colorado River Commission.

(A) Lee Ferry one mile down stream from the mouth of the Paria River is the 1922 "Compact Point" and the discharge at this point is taken as the sum of Nos. 25 and 76.

(B) Discharge measurements reported in U. S. G. S. Water Supply Paper 1059 (1946) p. 384.

Average Annual Historic Flow (4)	Period Covered by Average (5)	Flows in Water Years (Provisional) 1951 (6)	1952 (7)
24.7	1947-48	10.8	30.7
		3.4	4.2
		12.0	11.3
51.3	1932-48	39.1	79.6
44.9	1943-45		
			259.2
	Jan-Sept 51	11.0	22.1
113.7	1914-48	101.5	292.8
252.0	1911-48	204.0	304.4
88.3	1911-19, 30-48	114.1	104.8
131.0	1939-48	89.5	197.1
123.8	1925-26, 30-48	114.6	
213.8	1918-48	93.6	219.5
		10.7	17.4
16.2	1914-48	16.6	19.2
461.5	1914-48	440.2	606.0
574.7	1914-48	467.8	694.4
92.8	1914-48	73.0	
16.3	1948	12.8	
1,183.2	1914-48	1,016.0	1,447.0
344.1	1914-48	346.0	447.1

(C) Add Spring Creek to Los Pinos River at LaBoca to give flow at Colorado-Utah state line.

(D) U. S. G. S. Water Supply Paper 1149.

(E) Flow estimated for some years included in the period.

(F) Flow estimated by correlation.

e Flow for the years 1940 to date are estimated by correlation with flow at Green River, Utah.

f This station is not now operating but is to be reinstalled. These flows are estimated.

@ Area from Final Report of Engineering Advisory Committee to Upper Colorado River Compact Commission, November 1948.

TRANSMOUNTAIN DIVERSIONS IN COLORADO

From Colorado River Basin

Water Year - 1952

Ditch or Tunnel	Stream	Acre-Feet
Grand River Ditch	Headwaters Colorado River	21,380
Eureka Ditch	Tonahutu Creek	103
Alva B. Adams Tunnel	Shadow Mt. & Granby Reservoirs	56,020
Berthoud Pass Ditch	Headwaters Fraser River	730
Moffat Tunnel E. Portal	Fraser River & Tribs.	31,230
Williams Fk. Tunnel (Jones Pass)	Headwaters Williams River	6,810
Boreas Pass Ditch	" Blue River	13
Hoosier Pass Tunnel E. Portal	" " "	2,380
Fremont Pass Ditch	Tenmile Cr. Tributaries	0
Columbine Ditch	" "	1,020
Ewing Ditch	Eagle River	1,820
Wurtz Ditch	" "	2,950
Busk-Ivanhoe Tunnel	Frying Pan River	6,340
Twin Lakes Tunnel	Roaring Fork Tribs.	51,360
Larkspur Ditch	Tomichi Creek	422
Tabor Ditch	Gunnison River	308
Sub Total		182,886
Fuchs Ditch	No. Fk. Los Pinos	536
Raber-Lohr Ditch	Trib. of Los Pinos	1,726
Squaw Pass	Trib. of San Juan	240
Piedra Pass Ditch	Trib. of San Juan	0
Treasure Pass	Trib. of San Juan	198
Sub Total		2,700
Grand Total		185,586

APPENDIX H

ATTENDANCE AT MEETINGS OF THE COMMISSION

March 17, 1952

Jean S. Breitenstein, Attorney, Colorado Water Conservation Board, Denver, Colorado

Chas. R. Neill, Colorado River Water Conservation District, Hotchkiss, Colorado

John H. Bliss, State Engineer, Santa Fe, New Mexico

Fred E. Wilson, Legal Adviser for New Mexico Commissioner, 806-8 First National Bank Building, Albuquerque, New Mexico

I. J. Coury, New Mexico Interstate Stream Commission, Farmington, New Mexico

C. O. Roskelley, Assistant State Engineer, State Capitol, Salt Lake City, Utah

Wm. R. Wallace, President, Utah Water Users Ass'n., Salt Lake City, Utah

Thomas W. Jensen, Utah Water Users Ass'n., Salt Lake City, Utah

B. Frank Ward, Secretary-Manager, Chamber of Commerce, Vernal, Utah

Harry S. Harnsberger, Attorney General, Cheyenne, Wyoming

H. T. Person, Dean of the School of Engineering, University of Wyoming, Laramie, Wyoming

Joe L. Budd, Big Piney, Wyoming

Norman W. Barlow, Cora, Wyoming

J. R. Riter, Chief Hydrologist, Hydrology Division, Bureau of Reclamation, Denver, Colorado

J. Stuart McMaster, Counsel, Region 4, Bureau of Reclamation, Salt Lake City, Utah

Francis M. Bell, District Engineer, U. S. Geological Survey, Denver, Colorado

May 9, 1952

Jean S. Breitenstein, Attorney, Colorado Water Conservation Board, Denver, Colorado

John H. Bliss, State Engineer, Santa Fe, New Mexico

I. J. Coury, New Mexico Interstate Stream Commission, Farmington, New Mexico

Clinton D. Vernon, Attorney General, State Capitol, Salt Lake City, Utah

B. H. Stringham, Chairman, 21 Counties Committee, Vernal, Utah

B. Frank Ward, Secretary-Manager, Chamber of Commerce, Vernal, Utah

May 9, 1952 (continued)

I. Dale Despain, Director of Planning in Utah County, Provo, Utah

R. E. Huber, Secretary-Treasurer, Strawberry Water Users Ass'n., Payson, Utah

Henry B. Millecam, Mayor of Vernal, Vernal, Utah

J. A. Miller, Manager, Springville Chamber of Commerce, Springville, Utah

Sterling E. Price, Manager, Greater Utah Valley, Inc., Springville, Utah

Platt Wilson, Special Assistant State Engineer, Cheyenne, Wyoming

J. R. Riter, Chief Hydrologist, Hydrology Division, Bureau of Reclamation, Denver, Colorado

J. Stuart McMaster, Counsel, Region 4, Bureau of Reclamation, Salt Lake City, Utah

July 19, 1952

I. J. Coury, New Mexico Interstate Stream Commission, Farmington, New Mexico

Clinton D. Vernon, Attorney General, State Capitol, Salt Lake City, Utah

G. E. Untermann, Director, Utah Field House of Natural History, Vernal, Utah

B. H. Stringham, Chairman, 21 Counties Committee, Vernal, Utah

Jack C. Turner, First Vice President, Chamber of Commerce, Vernal, Utah

H. T. Person, Dean of the School of Engineering, University of Wyoming, Laramie, Wyoming

Norman W. Barlow, Assistant to Commissioner, Cora, Wyoming

Joe L. Budd, Assistant to Commissioner, Big Piney, Wyoming

Ernest B. Hitchcock, State Natural Resources Board, Rock Springs, Wyoming

L. F. Thornton, State Natural Resources Board, Thermopolis, Wyoming

H. P. Dugan, Head of the River Regulation Section, Bureau of Reclamation, Hydrology Branch, Denver, Colorado

Palmer B. DeLong, Area Engineer, Bureau of Reclamation, Rock Springs, Wyoming

Francis M. Bell, District Engineer, U. S. Geological Survey, Denver, Colorado

Jack M. Terry, Ass't. District Engineer, U. S. Geological Survey, Denver, Colorado

Marshall R. Smith, Soil Conservation Service, Eden Valley Project, Rock Springs, Wyoming

September 15 and 16, 1952

John H. Bliss, State Engineer, Capitol Building, Santa Fe, New Mexico

I. J. Coury, New Mexico Interstate Stream Commission, Farmington, New Mexico

Clinton D. Vernon, Attorney General, State Capitol, Salt Lake City, Utah

Sterling E. Price, Manager, Greater Utah Valley, Inc., Springville, Utah

Norman W. Barlow, Assistant to Commissioner, Cora, Wyoming

J. R. D'Amico, Assistant Director, Wyoming Natural Resource Board, Cheyenne, Wyoming

H. P. Dugan, Head of the River Regulation Section, Bureau of Reclamation, Hydrology Branch, Denver, Colorado

J. Stuart McMaster, Bureau of Reclamation, Counsel, Region 4, Salt Lake City, Utah

C. B. Jacobson, Regional Hydrologist, Bureau of Reclamation, Region 4, Salt Lake City, Utah

Francis M. Bell, District Engineer, U. S. Geological Survey, Denver, Colorado

Berkley Johnson, District Engineer, U. S. Geological Survey; also Chairman of Rio Grande Compact Commission and Pecos Compact Commission, Santa Fe, New Mexico

G. B. Keesee, Area Irrigation Engineer, Indian Service, Gallup, New Mexico

Wayne M. Akin, Chairman, Arizona Interstate Stream Commission, 309 Security Building, Phoenix, Arizona

J. H. Moeur, General Counsel, Arizona Interstate Stream Commission, Phoenix, Arizona

Hans Kramer, Chairman, Arkansas Compact Administration, San Francisco, Calif.

November 14, 1952

Jean S. Breitenstein, Attorney, Colorado Water Conservation Board, Denver, Colorado

Ray E. Peterson, Administrative Assistant, Colorado Water Conservation Board, Denver, Colorado

A. P. Gumlick, Chairman, Denver Water Board, Denver, Colorado

Glenn G. Saunders, Attorney, Denver Water Board, Denver, Colorado

J. M. Dille, Northern Colorado Water Conservation District, Greeley, Colorado

A. W. McHendrie, Attorney, Arkansas Valley Ditch Ass'n., Pueblo, Colorado

November 14, 1952 (continued)

H. H. Christy, Colorado Fuel and Iron Co., Pueblo, Colorado
Gail Ireland, Attorney, Denver, Colorado
John P. Thompson, Attorney, Denver, Colorado
Fred E. Wilson, Attorney, New Mexico Interstate Stream Commission, Albuquerque, New Mexico
John H. Bliss, State Engineer, Santa Fe, New Mexico
I. J. Coury, New Mexico Interstate Stream Commission, Farmington, New Mexico
B. Frank Ward, Secretary-Manager, Chamber of Commerce, Vernal, Utah
H. T. Person, Dean of School of Engineering, University of Wyoming, Laramie, Wyoming
J. R. Riter, Chief Hydrologist, Bureau of Reclamation, Hydrology Division, Denver, Colorado
G. B. Keesee, Area Irrigation Engineer, Indian Service, Gallup, New Mexico
Murray L. Crosse, Area Counsel, Indian Service, Window Rock, Arizona

January 30, 1953

R. J. Tipton, Consulting Engineer, Colorado Water Conservation Board, Denver, Colorado
R. M. Gildersleeve, Acting Director, Colorado Water Conservation Board, Denver, Colorado
H. Lawrence Hinkley, Deputy Attorney General, Denver, Colorado
Frank C. Merriell, Colorado River Water Conservation District, Grand Junction, Colorado
John L. Heuschkel, Colorado River Water Conservation District, Carbondale, Colorado
William Nelson, Chamber of Commerce, Grand Junction, Colorado
George Cory, Montrose, Colorado
Garner L. McKnight, President, Chamber of Commerce, Delta, Colorado
Doyle L. Davidson, Secretary-Manager, Chamber of Commerce, Delta, Colorado
Charles J. Beise, Southeastern Colorado Water Users Association, Denver, Colorado
William R. Kelly, Attorney, Northern Colorado Water Conservancy District, Greeley, Colorado
Glenn G. Saunders, Attorney, Denver Water Department, P. O. Box 600, Denver, Colorado
T. P. Campbell, Manager, Improvements and Parks, Denver, Colorado

January 30, 1953 (continued)

C. Paul Harrington, Member, City Council, Denver, Colorado
James Fresquez, Member, City Council, Denver, Colorado
T. A. Dines, Vice President, Chamber of Commerce, Denver, Colorado
A. P. Gumlick, Member, Denver Board of Water Commissioners, Denver, Colorado
E. L. Mosley, Manager, Denver Water Department, Denver, Colorado
H. L. Potts, Water Engineer, Denver Water Department, Denver, Colorado
Nicholas R. Petry, President, Denver Board of Water Commissioners, Denver, Colorado
John H. Bliss, State Engineer, Santa Fe, New Mexico
Fred E. Wilson, Legal Adviser to Commissioner, Albuquerque, New Mexico
I. J. Coury, New Mexico Interstate Stream Commission, Farmington, New Mexico
Ed. H. Foster, President, San Juan Reclamation Association, Farmington, New Mexico
Orval Ricketts, San Juan Reclamation Ass'n., Farmington, New Mexico
Walter O. Berger, Governor Mechem Water Policy Committee, Albuquerque, New Mexico
E. R. Callister, Attorney General, State Capitol, Salt Lake City, Utah
William R. Wallace, Utah Water and Power Board, Salt Lake City, Utah
J. A. Howell, Utah Water and Power Board, Salt Lake City, Utah
Thomas W. Jensen, Utah Water Users Association, Salt Lake City, Utah
B. Frank Ward, Secretary-Manager, Chamber of Commerce, Vernal, Utah
Dale Jenson, Vice Chairman, Colorado Development Committee, Vernal, Utah
Harry S. Harnsberger, Attorney General, Cheyenne, Wyoming
Norman W. Barlow, Assistant to Commissioner, Cora, Wyoming
Joe L. Budd, Assistant to Commissioner, Big Piney, Wyoming
Earl Lloyd, Deputy State Engineer, Cheyenne, Wyoming
Sam Ahkeah, Chairman, Navajo Tribal Council, Window Rock, Arizona
Howard Gorman, Chairman, Resources Committee, Navajo Tribal Council, Window Rock, Arizona

January 30, 1953 (continued)

Charles M. Tansey, Jr., Attorney, Navajo Tribal Council, Farmington, New Mexico

H. T. Person, Consulting Engineer, Navajo Tribal Council, Laramie, Wyoming

J. R. Riter, Chief Hydrologist, Bureau of Reclamation, Hydrology Division, Denver, Colorado

C. B. Jacobson, Regional Hydrologist, Bureau of Reclamation, Region 4, Salt Lake City, Utah

Francis M. Bell, District Engineer, U. S. Geological Survey, Denver, Colorado

Geraint Humphreys, Indian Irrigation Legal Counsel, Los Angeles, California

Murray L. Crosse, Area Counsel, Bureau of Indian Affairs, Window Rock, Arizona

W. L. Miller, Chief of Branch of Irrigation, Bureau of Indian Affairs, Washington, D. C.

G. B. Keesee, Area Irrigation Engineer, Bureau of Indian Affairs, Gallup, New Mexico

G. M. Goudie, Jr., Assistant Area Irrigation Engineer, Bureau of Indian Affairs, Gallup, New Mexico

C. V. Marmaduke, Jr., Special Assistant to the Attorney General, Department of Justice, Denver, Colorado

February 26, 1953

Ivan C. Crawford, Director, Colorado Water Conservation Board, Denver, Colorado

R. M. Gildersleeve, Engineer, Colorado Water Conservation Board, Denver, Colorado

H. Lawrence Hinkley, Deputy Attorney General, Denver, Colorado

Frank C. Merriell, Colorado River Water Conservation District, Grand Junction, Colorado

George Cory, Montrose County Chamber of Commerce, Montrose, Colorado

J. M. Dille, Northern Colorado Water Conservation District, Greeley, Colorado

Glenn G. Saunders, Attorney, Denver Water Department, P. O. Box 600, Denver, Colorado

H. H. Christy, Southeastern Colorado Development Association, Pueblo, Colorado

William Nelson, Chamber of Commerce, Grand Junction, Colorado

Reed Hixson, Radio Station KFXJ, Grand Junction, Colorado

John H. Bliss, State Engineer, Santa Fe, New Mexico

February 26, 1953 (continued)

Fred E. Wilson, Legal Adviser to Commissioner, Albuquerque, New Mexico

E. R. Callister, Attorney General, State Capitol, Salt Lake City, Utah

Harry Ratliff, Engineer, Vernal, Utah

Glenn H. Cooper, President, Chamber of Commerce, Vernal, Utah

Jack C. Turner, Vice President, Chamber of Commerce, Vernal, Utah

Hugh W. Colton, Director, Utah Water Users Ass'n., Vernal, Utah

E. J. Bancroft, Vernal, Utah

Howard Black, Deputy Attorney General, Cheyenne, Wyoming

H. T. Person, Dean of the School of Engineering, University of Wyoming, Laramie, Wyoming

Breck Moran, Chief of Resources Development, Natural Resource Board, Cheyenne, Wyoming

W. K. Snyder, Reporter, Cheyenne Tribune, Cheyenne, Wyoming

J. R. Riter, Chief Hydrologist, Bureau of Reclamation, Hydrology Division, Denver, Colorado

J. Stuart McMaster, Regional Counsel, Region 4, Bureau of Reclamation, Salt Lake City, Utah

C. V. Marmaduke, Jr., Special Assistant to the Attorney General, Department of Justice, Denver, Colorado

John J. Cooney, Department of Justice, Denver, Colorado

March 7, 1953

Wayne M. Akin, Chairman, Arizona Interstate Stream Commission, Phoenix, Arizona

J. H. Moeur, General Counsel, Arizona Interstate Stream Commission, Phoenix, Arizona

John Henley Eversole, Chief Assistant Attorney General, Phoenix, Arizona

Edwin C. Johnson, United States Senator, Denver, Colorado

Eugene D. Millikin, United States Senator, Denver, Colorado

Byron G. Rogers, United States Representative, Denver, Colorado

J. Edgar Chenoweth, United States Representative, Trinidad, Colorado

Wayne N. Aspinall, United States Representative, Palisade, Colorado

Ivan C. Crawford, Director, Colorado Water Conservation Board, Denver, Colorado

March 7, 1953 (continued)

H. Lawrence Hinkley, Deputy Attorney General, Denver, Colorado

George Cory, Member, Colorado Conference Committee, Montrose, Colorado

Glenn G. Saunders, Attorney, Denver Water Department, Denver, Colorado

Dan B. Hunter, Colorado Water Board, Dove Creek, Colorado

Charles R. Neill, Colorado River Water Conservation District, Hotchkiss, Colorado

Barney Rogers, Denver Post, Denver, Colorado

Clinton P. Anderson, United States Senator, Albuquerque, New Mexico

Antonio M. Fernandez, United States Representative, Santa Fe, New Mexico

John J. Dempsey, United States Representative, Santa Fe, New Mexico

Frank Burnett, Administrative Assistant to U. S. Senator Dennis Chavez of Albuquerque, New Mexico

John H. Bliss, State Engineer, Santa Fe, New Mexico

Fred E. Wilson, Legal Adviser to Commissioner, Albuquerque, New Mexico

I. J. Coury, New Mexico Interstate Stream Commission, Farmington, New Mexico

Jack Cline, Fruitland, New Mexico

J. P. Murphy, N.R.G. Flood Control Ass'n., Albuquerque, New Mexico

W. Carlos Powell, Santa Fe, New Mexico

Arthur V. Watkins, United States Senator, Orem, Utah

Douglas Stringfellow, United States Representative, Ogden, Utah

William A. Dawson, United States Representative, Salt Lake City, Utah

Lyle M. Ward, Administrative Assistant to U. S. Senator Wallace F. Bennett of Salt Lake City, Utah

E. R. Callister, Attorney General, State Capitol, Salt Lake City, Utah

Thomas W. Jensen, Utah Water Users Association, Salt Lake City, Utah

Frank A. Barrett, United States Senator, Cheyenne, Wyoming

Norman W. Barlow, Assistant to Commissioner, Cora, Wyoming

Joe L. Budd, Assistant to Commissioner, Big Piney, Wyoming

Breck Moran, Chief of Resource Development, Natural Resource Board, Cheyenne, Wyoming

March 7, 1953 (continued)

Harvey F. McPhail, Ass't. Commissioner of Reclamation, Washington, D. C.

N. B. Bennett, Jr., Ass't. Director, Branch of Project Planning, Bureau of Reclamation, Washington, D. C.

Edward W. Fisher, Chief Counsel, Bureau of Reclamation, Washington, D. C.

T. Richard Witmer, Ass't. Chief Counsel, Bureau of Reclamation, Washington, D. C.

J. R. Riter, Chief Hyrologist, Hydrology Div., Bureau of Reclamation, Denver, Colorado

E. O. Larson, Regional Director, 4, Bureau of Reclamation, Salt Lake City, Utah

J. Stuart McMaster, Regional Counsel, 4, Bureau of Reclamation, Salt Lake City, Utah

C. B. Jacobson, Regional Hydrologist, Region 4, Bureau of Reclamation, Salt Lake City, Utah

John L. Mutz, Area Engineer, Bureau of Reclamation, Albuquerque, New Mexico

Harry A. Sellery, Jr., Chief Counsel, Bureau of Indian Affairs, Washington, D. C.

Samuel J. Flickinger, Assistant Chief Counsel, Bureau of Indian Affairs, Washington, D. C.

W. L. Miller, Chief of Branch of Irrigation, Bureau of Indian Affairs, Washington, D. C.

G. B. Keesee, Area Irrigation Engineer, Bureau of Indian Affairs, Gallup, New Mexico

Sam Ahkeah, Chairman, Navajo Tribal Council, Window Rock, Arizona

Howard Gorman, Chairman, Resources Committee, Navajo Tribal Council, Window Rock, Arizona

J. M. McCabe, Secretary-Treasurer, Navajo Tribal Council, Window Rock, Arizona

Norman M. Littell, Counsel, Navajo Tribal Council, Washington, D. C.

Charles M. Tansey, Jr., Assistant Counsel, Navajo Tribal Council, Farmington, New Mexico

William E. Welsh, Secretary-Manager, National Reclamation Association, Washington, D. C.

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