RECLAMATION HANDBOOK

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RECLAMATION HANDBOOK

A compendium of information on the reasons for and the development, operations, and results of conserving water and reclaiming land in the western United States

1942

Prepared by the Information Division

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Chapter 1

The Multiple-Purpose Project

Rude ditches to water a few acres of bottom land for pasture and rough wooden flumes to carry a little water to a miner's diggings were the small beginnings of the gigantic task of conserving and using the most important resource in western United States—water. Today great projects are designated and built to conserve water in the West. They combine in unending variety and proportion the many uses of rivers and their waters to be found in a desert land.

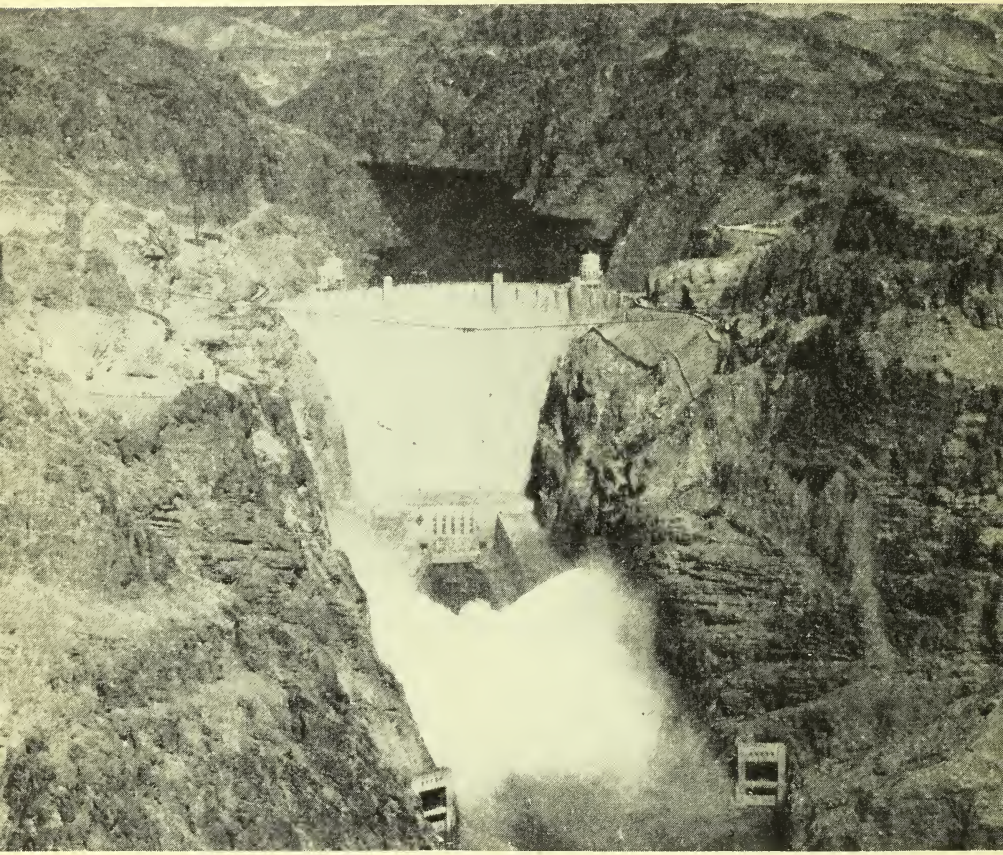
The multiple-purpose project which serves many uses is a relatively new conception—an expression in engineering terms and concrete and steel of an awakened social consciousness. There was a time when a dam was designed for the purpose of irrigation only; when a structure for the improvement of navigation was designed with that single thought; when a power dam was a power dam and nothing more so far as the designer and the operator were concerned. Fortunately, that day has passed. Today dams exercise several functions simultaneously. Careful attention is given to obtaining the highest efficiency through combining in the design provisions for the many uses of the present day public work.

Federal Reclamation is a Government enterprise designed to utilize the water resources of the West in the work of developing that arid and semiarid region. The development is obtained through the irrigation of desert lands and the creation of new opportunities to make homes and to build communities; it is fostered through providing low-cost power for farms, for homes, and for cities, and for mining and processing minerals and for manufacturing the essential tools of modern industrialized civilization; and it is promoted through other services wrung from unwilling rivers.

The rivers of the West, most of them, are unwilling rivers. The streams are comparatively few and their flow fluctuates more widely than the flow of rivers in humid regions. Mountainous areas receive

most of the precipitation, much of which comes as snow in winter. When the snows melt in spring, floods occur. When the floods pass, the streams dwindle and some of them actually go dry.

Frederick S. Delenbaugh who went with Maj. John Wesley Powell down the Colorado River on one of his memorable expeditions nearly 75 years ago, described the Colorado as a wild bull. He compared the more gentle rivers of humid regions with cows, saying they were easily domesticated and put to use by man, but the Colorado was the untamable bull of the herd. A ring was successfully put in the nose of the Colorado River with the construction of Boulder Dam in 1935. The river now has been broken to yoke to serve in many and varied ways.



Boulder Dam—key structure of a great multiple-purpose project, Arizona-Nevada-California

The multiple-purpose project through increased efficiency makes 50 cents do the work of a dollar in some instances in the provision of storage for irrigation, and leaves the other 50 cents to lower the cost of providing protection from floods, for example, or of generating electric energy.

The multiple-purpose project may consist of a dam; a dam and other

works; a series of dams; or a series of dams and other works designed and operated so as to perform efficiently more than one function in the field of water utilization and control. The project may serve irrigation and, in addition, power; or flood control and also navigation. River regulation for pollution abatement and for improvement of domestic or industrial water supplies may at the same time make useful recreational facilities which are enjoyed by millions. The multiple-purpose project may join any and all of these with still other useful functions.

The great Central Valley Reclamation project now under construction in California illustrates the point clearly. It will serve the following purposes: (1) The irrigation of about 1,000,000 acres of equally rich lands now inadequately supplied with water; (2) the improvement of navigation of two important rivers; (3) the reduction of flood damages to highly developed lands along these rivers; (4) the production of low-cost power for a rapidly growing market, of major importance in the war effort; (5) the provision of a safe fresh water supply for cities and industries as well as for farms; (6) the regulation of the fluctuating flow of the rivers for the protection of domestic water supply, industrial water supply, and of 400,000 acres of fertile delta lands now threatened with ruin by the infiltration of salt water from the sea; and (7) the creation of recreational and wildlife areas.

In the West where the Bureau of Reclamation operates are more than 740,000,000 acres of arid and semiarid lands. Irrigation is necessary for general farming, and close settlement of rural areas cannot be achieved without it. Since the maintenance of most of the population is dependent on irrigation, the use of the available water for irrigation generally is considered the primary use, excepting only its use for domestic purposes.

The regulation of most streams in the arid and semiarid regions therefore has irrigation as its first purpose. Where water is scarce, particularly, and where it must be conserved for irrigation to support the population, it would be wasteful to fail to make more than one use, when possible, of this limited and vital resource, however. That is the reason for the rise in modern times of the project for efficient, multiple use of the western waters to a place of high prominence. Power as a by-product of Reclamation has become increasingly important and has assumed a major role in the development and expansion of the West.

Chapter 2

The Why of Irrigation

Why is it necessary to irrigate farms in western United States?

To one familiar with the West this may seem to be an unnecessary question, but it is asked so often by those who are sincerely puzzled that it deserves an answer.

Geography books at one time in general use in our schools labelled all the West as "The Great American Desert." In truth most of this territory would be included in the best definition[1] of the term—a desert is

> "a barren tract incapable of supporting any considerable population without an artificial water supply, and almost destitute of moisture and vegetation."

West of the one-hundredth meridian lie more than 740,000,000 acres—a third of the land area of the continental United States—which receive on the average less than 20 inches of rain a year. More than 150,000,000 acres of this area receive an average of less than 10 inches of moisture a year.

With regard to precipitation as related to agriculture, the Department of Agriculture says:

> "the United States may be divided into an eastern and a western part. The dividing line roughly coincides with the one-hundredth meridian in the vicinity of which the average annual rainfall is about 20 inches. In general, east of this line precipitation is usually sufficient for crop production by ordinary farming methods, but in the West large areas have deficient rainfall, necessitating for crop growth special methods for artificially supplying moisture for conserving it in the soil. The minimum amount of rainfall needed for ordinary farming, *under favorable seasonal distribution*,[2] is usually considered to be about 15 inches in a relatively cool climate where the mean summer temperature is about 65°, and 20 to 25 inches in areas where the mean summer temperature is 75° to 80°. This difference in requirements is due largely, of course, to evaporation from the soil, transpiration from plants, etc., more pronounced in warmer climates."

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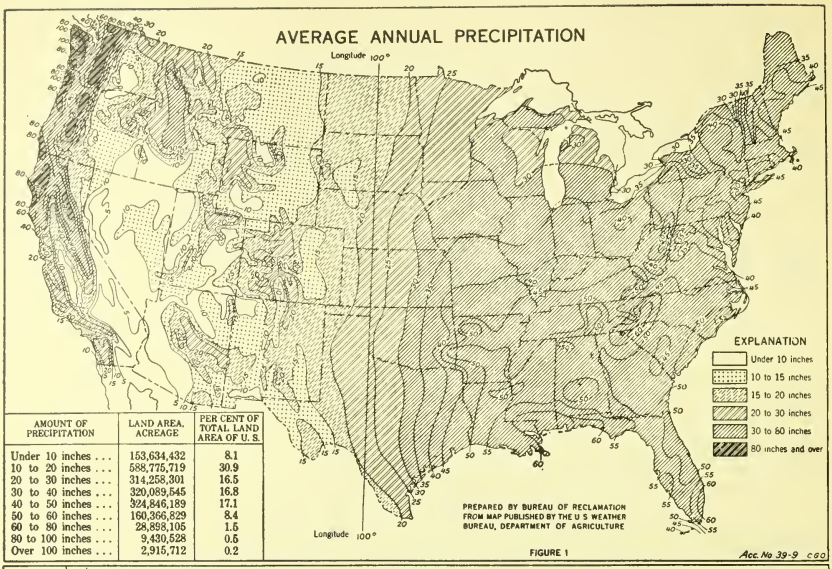
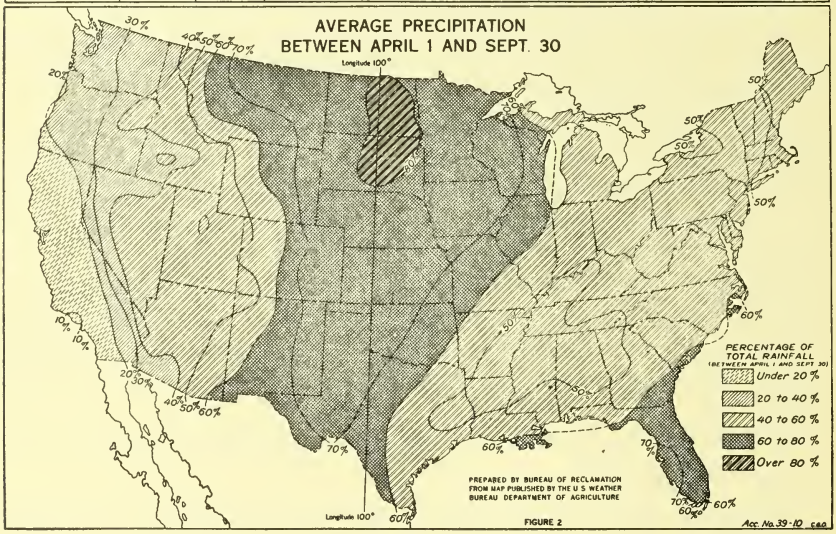
[1] Webster's New International Dictionary.
[2] Italics supplied.



AMOUNT OF PRECIPITATION	LAND AREA, ACREAGE	PER CENT OF TOTAL LAND AREA OF U. S.
Under 10 inches . . .	153,634,432	8.1
10 to 20 inches . . .	588,775,719	30.9
20 to 30 inches . . .	314,258,301	16.5
30 to 40 inches . . .	320,089,545	16.8
40 to 50 inches . . .	324,846,189	17.1
50 to 60 inches . . .	160,366,829	8.4
60 to 80 inches . . .	28,898,105	1.5
80 to 100 inches . . .	9,430,528	0.5
Over 100 inches . . .	2,915,712	0.2



Both the total rainfall and the distribution of the rainfall among the seasons are important to successful farming without irrigation.

These two Weather Bureau maps illustrate the average annual precipitation characteristics of various sections of the United States and the percentage of the total precipitation which is received on the average in various areas during the period from April 1 to September 30 of each year, the ordinary growing season for crops.

The two maps show that from the Continental Divide westward, virtually nowhere but in high mountains which cannot be farmed anyway, can more than 8 or 10 inches of rain be expected from April 1 to September 30, the period when moisture is most needed for crop growth. Between

the Continental Divide and the one-hundredth meridian only a few tillable areas can anticipate as much as 15 inches during the growing season.

In other words, not only does the area west of the one-hundredth meridian, for the most part, receive less than 20 inches of rainfall in the normal year, but also the moisture which does fall there is unfavorably distributed through the seasons so far as agriculture is concerned. That is why irrigation is essential to farming in virtually all the West.

Western Farming Dependent on Water Storage

In humid sections farming is a term denoting all types of agricultural pursuits. In the West this word is supplemented by such terms as "irrigation," "dry-farming," and "ranching."

In the arid and semiarid sections, irrigation farming alone is comparable to the general farming common to the humid sections.

Dry-farming—farming without irrigation—is a precarious operation. Except for wheat, few crops have been successfully grown by dry-farming in the West. Small, isolated areas are exceptions. Even wheat production by dry-farming methods is uncertain, since favorable spacing of winter and spring storms is necessary to mature the crop. In many localities where dry-farming is practiced extensively the farmers consider themselves fortunate if one crop in three matures, and in some sections the average is one crop in five.

Ranching, although the term is used loosely even in the West, usually denotes a type of agriculture unknown in humid sections. Livestock is the principal product. Little or no soil is tilled. The stock is grazed on the ranch and on public lands in the vicinity, feeding on the natural grasses produced by the scant rains. A cattle or sheep ranch may have an irrigated hay meadow, from which winter feed is cut. These meadows usually lie along streams, and the hay produced is ordinarily cut from natural grasses, although some meadows are well enough watered by the streams or by irrigation to produce alfalfa. In ranch country often the carrying capacity of the range is no more than 8 head of cattle for each section of land.[3]

Both dry-farming and ranching, of course, are types of agricultural pursuits. Irrigation is necessary, however, in the arid and semiarid sections for general, cultivated agriculture.

Few areas in the arid and semiarid West are dry-farmed, except in the Great Plains. The recent extended drought in the Great Plains, with its consequent uprooting of tens of thousands of farm families, has served to demonstrate the precariousness of this type of agriculture.

Ranching, if the term be used, as here, as synonymous with cattle and sheep raising in the ill-watered areas, is a more stable type of agriculture,

[3] The Division of Grazing of the Department of the Interior gives as the amount of grazing land needed for pasturing each head of cattle in the West a minimum of 12 acres (in North Dakota) and a maximum of 320 acres (in Arizona).

and also one practiced much more widely in the arid and semiarid section. In excess of 300,000,000 acres are given over to grazing. The livestock industry, founded on ranching, is one of the most important, if not the most important, in the West. Because of the great disparity between the areas devoted to grazing and those irrigated, it is important to note that approximately half of the feed units needed by the livestock industry comes from the irrigated lands. There is, therefore, a direct, complementary relationship between ranching and irrigation farming in the arid and semiarid section.

Dry farms encompassing one or two thousand acres are not uncommon. Ranches may consist of a single section or 100,000 acres, as do some in Texas, but regardless of their size, those in States where public grazing lands exist are but headquarters for livestock operations on the public pastures.

Irrigation is essential to general farming in the arid and semiarid section, and is the only means of providing for close settlement of rural areas in more than one-third of the land area of continental United States. Irrigation has made possible the subdivision of holdings and the establishment of farms on tracts of 10 to 160 acres in extent, each capable of supporting a family.

Irrigation in Ancient Lands

Irrigation dates back to Biblical days:

> "*And he said, Thus saith the Lord, Make the Valley full of ditches.*
> "*For thus saith the Lord, Ye shall not see wind, neither shall ye see rain; yet that valley shall be filled with water, that ye may drink, both ye and your cattle, and your beasts.*"—II Kings, 3:16–17.

Irrigation had been established when the writing of history began. The British Society of Anthropology accepts as a fundamental doctrine that historically civilization followed the invention of irrigation.

Queen Semiramis, an ancient Assyrian ruler who was supposed to have lived more than 2,000 years B. C., is credited with directing her government to divert the waters of the Nile to irrigate the desert lands of Egypt. An inscription on her tomb proclaims:

> "*I constrained the mighty river to flow according to my will and led its waters to fertilize lands that had before been barren and without inhabitants.*"

Ever since, irrigation dams and main canals in Egypt have been constructed and maintained by the national government. Irrigation canals, supposed to have been built under Queen Semirimas, are still delivering water.

There are records of continuous irrigation for thousands of years in the valleys of the Nile and comparatively long periods in Syria, Persia, India, Java, and some parts of Italy.[4] The practice in Holland involved irrigation by flooding low lands.

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[4] Senate Doc. No. 84, 44th Cong., 1st sess.

In both Egypt and India, irrigation has been found to be the "very condition of existence both of the government and the people," the Congress was advised in 1874.[5]

In the United States modern irrigation dates from July 24, 1847, when followers of Brigham Young broke some desert land in the Salt Lake Valley of Utah and the very next day diverted the waters of what is now City Creek, irrigated the plowed land and planted potatoes.

Pueblo Indian dipping precious water from a primitive reservoir in the Southwest

Previously the prehistoric Indians of the Southwest practiced irrigation and within the boundaries of the Casa Grande National Monument in New Mexico can be seen the traces of the ditches they dug to transport water to their fields. The early Spanish missionaries who came over the Mexican deserts into what is now Western United States brought from their Mediterranean homes knowledge of irrigation. They watered from nearby streams gardens and fields around their missions in California, Arizona, New Mexico, and Texas.

In the 15 years following the Utah settlement, the pioneers who began carving a civilization out of the western deserts, the national census of 1860 shows, had established 752 irrigation enterprises that were supplying water to 402,237 acres of land.[6] These irrigated areas were veritable oases in the wide expanse of arid land and they were the major sources

[5] House Doc. No. 290, 43d Cong., 1st sess.

[6] Irrigation of Agricultural Lands, Bureau of the Census, 1930.

of a food supply for the half-million persons who by that year were living in what are now the 11 States of the Mountain and Pacific group.

In those early days it was a comparatively easy matter for a farmer with a team of horses and ordinary tools to construct ditches leading from the creeks flowing out of the mountains and thus provide channels by which a farm could be irrigated. Later comers, however, found the streams were fringed with farms and that the irrigation of land farther removed from sources of water was more difficult and expensive.[7] This led to cooperation among neighboring farmers. Many of the 3,300 organizations now delivering water under cooperative organizations had their inception more than three quarters of a century ago.

Later private capital became interested in financing more expensive works, but generally these were not successful, and less than 400 irrigation enterprises have survived as strictly commercial ventures.[8] Most of the States in the arid regions enacted laws authorizing the creation of irrigation districts, with taxing powers, for the construction and maintenance of works, but in general the farmers were left to work out their own salvation in regard to the utilization of the West's greatest natural resource—water.

They did an excellent job—those pioneers—and by the turn of the century approximately 9,500,000 acres of land were being irrigated by works that represented an investment of a quarter of a billion dollars.[8] There were some 20,000 different enterprises operating by 1900.

Reclamation in the United States

Irrigated land in the United States—less than 6 percent of the country's active agricultural area—is today the principal support for 11 percent of the nation's population.

From 1900 to 1940, the 11 Mountain and Pacific States in which is centered 90 percent of the irrigation in the country, more than trebled in population. In the United States as a whole the population gain was less than 70 percent—one-fourth as great—in the same period.

While the early transformation through irrigation of limited areas into veritable oases in the desert drew newcomers in increasing numbers, the heaviest movement of population came after the turn of the present century. It was simultaneous with the institution of the Federal Reclamation policy in 1902. The period from 1900 to 1920 saw the irrigated area doubled to a point where it exceeded 19,000,000 acres. There are now 13,810,000 persons [9] in the 11 states of whom more than one-half live on irrigated farms or in cities and towns supported by these farms.

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[7] First Annual Report, Reclamation Service, 1902.

[8] Irrigation of Agricultural Lands, Bureau of the Census, 1920.

[9] There is also limited irrigation in the Great Plains States, principally west of the 100th meridian, and in Louisiana, Florida, and Arkansas. See Preliminary Report, Census of Irrigation, 1940.

In the past 20 years, the principal increases in irrigated areas have been through activities of the Federal Government. Without these publicly financed developments, including stabilization of water supplies for established areas, based on the Reclamation Law of 1902 and related statutes, there would have been a substantial recession in some of the irrigated areas of the West, owing to failures of other systems.

As it is, the Federal developments have offset to a large extent decreases in areas irrigated by other systems and have provided the means, so far as construction funds permitted, for the West to meet the demands of its increasing population.

Drought which centered in the Great Plains areas in the 1930–40 decade swept westward and had a disastrous effect on irrigation water supplies in some states, according to reports from the Bureau of the Census. There has been some recovery from the low point in irrigation water touched in 1934. In 1939, the last year for which complete Census reports on irrigation are available, there were 20,568,953 acres actually under irrigation. Not included in this total are the irrigated areas in Arkansas, Florida and Louisiana. (See Addenda, Chart AA, p. 92, irrigated land in the western United States.)

The two Federal agencies which construct and operate irrigation projects are the Bureau of Reclamation and the Office of Indian Affairs, both under the Department of the Interior. The Bureau of Reclamation increased the acreage it irrigated by 338,976 acres, while Indian Office projects showed a gain of 174,806 acres. In addition, the Bureau of Reclamation provided supplemental water for 270,240 acres more than it had served in this manner in 1929.[10]

The area receiving a full supply of water in 1940 from projects constructed by the Bureau of Reclamation was 1,831,653 acres, and the irrigated area receiving a supplemental supply was 1,542,525 acres, a total of 3,374,178 acres. (See Appendix, table 2, facing p. 83.)

The Government projects, including Indian, in 1939 were capable of serving a total of 5,064,228 acres or an increase of 28 percent in 10 years.

Preliminary Agricultural Census returns show a decrease in the irrigated cropped and pasture land in Colorado of 1,046,000 acres and in Utah of 412,000 acres from the total areas reported irrigated in 1929. In only one State of the West, reporting up to May 1941, is a substantial increase in cropped and pasture land recorded. That is in Nevada. Here a gain of 350,000 acres, principally in pasture land, is reported. There were decreases in irrigated acreage in Colorado, Utah and South Dakota.

Current (1941) Reclamation Construction

New land to be brought into cultivation through projects in the current Reclamation construction program totals 2,674,994 acres in 13 States, including 54,200 acres to be served by projects under the Water Conservation and Utilization program.

[10] Irrigation Census, 1940.

Projects under construction or authorized in 1941 are designed to provide supplemental water or otherwise serve a total of 5,232,409 acres in 6 States, including 64,735 acres to be served by projects under the Water Conservation and Utilization program.

When completed the Bureau of Reclamation program, as planned in 1941, will have brought into cultivation 5,115,224 acres and provided supplemental water for 7,116,074 acres inadequately served by other systems. The program of the Office of Indian Affairs calls for the irrigation of 1,283,867 acres, of which 791,533 acres were under constructed canals in 1940.

Thus when the current programs of the two Federal agencies are completed they will have facilities for serving 13,515,165 acres of land. The area is equivalent to about 65 percent of the total area actually irrigated in 1939.

The Bureau of Reclamation's activities, under existing law, are confined to areas in 17 States bisected by or west of the one hundredth meridian. Both public and privately owned lands are affected by new irrigation developments. Indian irrigation projects are confined to areas within Indian reservations.

In visualizing the future of irrigation in the United States, primary consideration must be given to water supplies that can be conserved and to the economic feasibility of projects for the development and maintenance of agricultural communities in the West. Since irrigated areas provide support in nearby cities and towns for two to three times the farm population, existing urban developments have an important place in the future of irrigation.

Chapter 3

The Place of Power

Electric power is a partner of irrigation in the conservation and economic utilization of the limited water resources of the western United States.

The energy from Reclamation power plants is transmitted to homes and farms. It illuminates cities and towns. It supplies normal commercial and industrial operations in peacetime and meets the needs of such critical industries as aluminum processing, shipbuilding, and airplane manufacturing in wartime.

More than 58 percent of the cost of all projects under construction on January 1, 1942 will be repaid from power revenues. Of the remaining costs water users on irrigated land will repay 37 percent, and 5 percent will be repaid by municipalities for domestic water supplies or will be charged to flood control or other nonreimbursable activities.

The Bureau of Reclamation pioneered in the development of public power in the West and in 1941 was the largest operator of Federal generating systems.

Power has reached this vital part it today occupies in the work of Reclamation through a natural sequence. The sole reason for building the first power plant on a Reclamation development—the Roosevelt plant on the Salt River Valley project, Arizona, in 1906—was to provide the power needed in the construction of irrigation works. The second—the Spanish Fork power plant on the Strawberry Valley project in Utah—was built in 1908 for the same reason. As time went on still other projects similarly required power for their construction and hydroelectric plants were built to provide it.

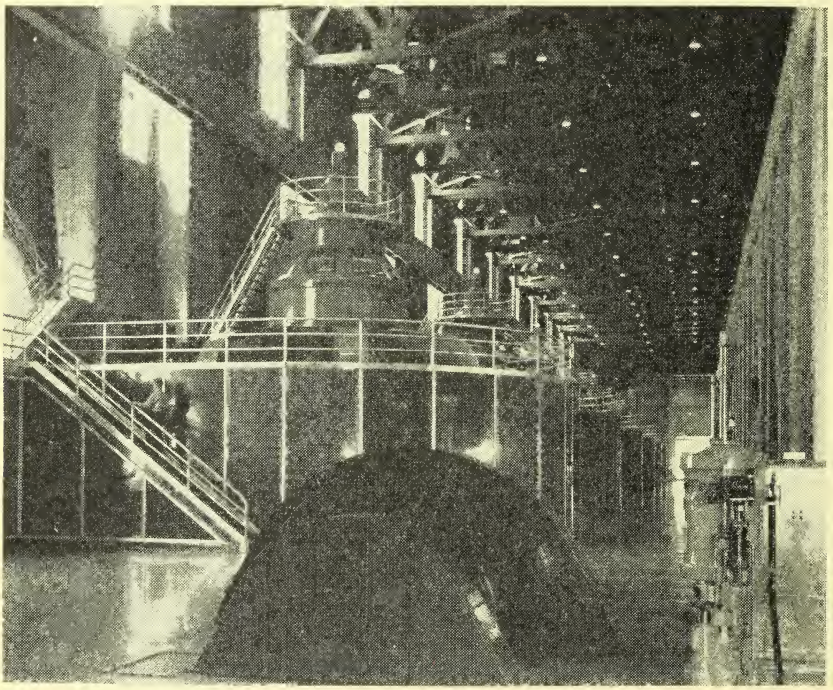
The electricity was needed and welcomed in other channels. The plants supplied the current for operating the permanent structures of the projects, for lighting the homes and farm buildings of the irrigation farmers on the projects and for operating their farm machinery.

As the demand for water conservation grew, however, and Reclamation projects became progressively larger and more complex, new needs developed. Power was required for pumping and drainage.

To meet these needs, essential to the success of the irrigation projects, other plants were built. An example is the Black Canyon power plant completed in 1925, used for pumping water on the Owyhee project in Idaho and Oregon.

Plants of this type were designed as part of the irrigation works. In addition to their pumping and drainage work, however, they supplied electric energy to project structures and project homes, stores and farms. And like those earlier power plants that were built to provide power for construction they helped to meet the demand for low-cost energy from industries growing up around the projects.

Production of power needed for pumping and drainage, the second phase of hydroelectric plant construction by the Bureau of Reclamation, was followed by further development.



Interior view of Boulder Dam power plant

The Boulder Canyon Project

The beginning of this development might be placed in the year 1928, when the Boulder Canyon Project Act was approved by the Congress. Power made construction of this great multiple-purpose project possible.

Boulder Dam regulates the supply of water for the irrigation of highly developed and richly productive lands in the Imperial Valley of California and elsewhere. It reduces destructive Colorado River floods to relatively harmless high waters. It makes possible the supply of a billion gallons of domestic water a day to Los Angeles and a dozen other California coastal cities, and the hydroelectric power it generates will repay 90 percent of the cost of the project with interest.

Other projects where power will pay more than 50 percent of the total cost, including that for irrigation, are the Columbia Basin project in Washington where 1,200,000 acres of land, largely desert, will be transformed into homes and farms; the Central Valley project in California where 2,000,000 acres of productive land will be benefited; and the Colorado-Big Thompson project in Colorado which will provide a sorely needed supplementary supply of water for more than 600,000 acres of intensively cultivated farms in northern Colorado.

Other projects under construction or authorized where all construction costs will be borne by power are Davis Dam at the Bullshead site on the Colorado River between Boulder and Parker dams; the Parker Dam power project which utilizes the head created by Parker Dam built to supply water to the Metropolitan Water District of southern California; and the Fort Peck power transmission system which will make possible the utilization of power produced at Fort Peck Dam, constructed by the Corps of Engineers of the War Department.

The transmission of power to markets is a fourth phase of the Bureau's power operations. Power generation by the Bureau has developed from a local necessity to an interstate public work. One of the Bureau's systems which now links power plants on the Shoshone, Riverton, Kendrick, and North Platte projects in Wyoming will be connected with the plants of the Colorado-Big Thompson project in Colorado to serve western Nebraska and northern Colorado.

The Fort Peck system will make power available in western Montana and eastern North Dakota.

More than 70 percent of the power produced in the far Western States comes from hydroelectric plants. Because of the erratic flow of such streams as the Sacramento River on which the Central Valley plants are located, which reduces the volume of firm power available, operators of power systems have found it advantageous in many instances to install steam plants to insure a greater output of continuous power.

In the case of the Central Valley project, it is estimated that a steam plant of 150,000-kilowatt capacity in 40 years will pay for itself and return a net income of from $75,000,000 to $83,000,000 which may be applied against the costs of the entire project, costs which would otherwise be borne by irrigationists or other beneficiaries.

The Bureau of Reclamation has recommended a steam plant and transmission system for the Central Valley project to balance its hydroelectric production and insure a wider market for the output.

Steam plants in California, Colorado, North Dakota, South Dakota, New Mexico, Texas, and Utah were recommended in 1942 by the Secretary of the Interior for construction and operation by the Bureau of Reclamation. Although designed to serve immediate war emergency purposes, they are linked with multiple-purpose projects for irrigation and other peace time benefits.

Power from Reclamation plants is sold wholesale with preference to municipalities and other public corporations or agencies, and to cooperatives and other nonprofit organizations.

In July 1941 there were in operation 28 hydroelectric plants on 17 projects in the states of Arizona, California, Colorado, Idaho, Nevada, New Mexico, Texas, Utah, Washington, and Wyoming.[1]

These plants with a capacity of 953,962 kilowatts supplied more than 3,500,000 people with more than half of their power and light needs. The ultimate capacity of these plants will be 3,567,962 kilowatts. This includes the plant at Grand Coulee Dam which first went into operation on March 22, 1941, with 20,000 kilowatts. Since July 1941 three great generators of 108,000-kilowatt capacity have been added, supplying power for the reduction of aluminum and for other electrometallurgical and electrochemical industries in the Pacific Northwest so vital to the Nation's war effort. When the irrigation system is completed, a large block of Grand Coulee power will be used for pumping.

Boulder Dam with ten generators installed in 1941 produced 3,200,000,000 kilowatt-hours of energy. When all of its 17 generators are installed Boulder will have a capacity of 1,322,300 kilowatts and will be able to generate more than 5 billion kilowatt-hours annually. Boulder Dam in 1941 provided 86 percent of the power generated for the system of the city of Los Angeles and in 1940 furnished more than half of the power requirements for southern California, Arizona, and Nevada within transmission distance of the dam.

The completion in 1942 of a magnesium plant near Boulder City, Nev., which needs more than 200,000 kilowatts of power, required installation of additional generating capacity at Boulder Dam.

In response to growing demands, by February 1942 the capacity on Bureau of Reclamation projects was increased to 1,252,462 kilowatts. Other scheduled installations are expected to raise this total to 1,620,462 kilowatts by the close of 1942, 1,855,062 kilowatts in 1943, 2,686,562 kilowatts in 1944, and 3,212,662 kilowatts in 1945.[2]

Projected Power Installations

The scheduled installations will greatly expand the capacities at Grand Coulee and Boulder Dams. Parker Dam on the Colorado River in the Pacific Southwest will add three 30,000-kilowatt units in 1942 and a

[1] See Appendix, table 6, p. 85.
[2] See Appendix, table 7, p. 86.

fourth in 1943. The Minidoka power plant in Idaho will increase its capacity to 13,400 kilowatts.

Installations by the Corps of Engineers at Fort Peck Dam in 1943 will make 50,000 kilowatts available for distribution over the Bureau's transmission system. Green Mountain Dam power plant on the Colorado-Big Thompson project will start operating in 1943.

A battery of five 75,000-kilowatt generators at Shasta Dam and three 25,000-kilowatt generators at Keswick Dam go into operation in 1944. In 1945, Davis Dam will begin power operations with the installation of 180,000 kilowatts and an ultimate capacity of 225,000 kilowatts. Anderson Ranch Dam on the Boise project in Idaho will make 27,000 kilowatts available in the summer of 1945. ~~Two~~ Three of five additional plants on the Colorado-Big Thompson project in 1945 will bring in 1,~~043,100~~ 103,100 kilowatts.

All the new installations scheduled by 1945 are located in areas where the demand for additional power is accentuating the importance of Bureau of Reclamation multiple-purpose projects, in war as well as in peace.

Each dollar expended in the war effort is estimated to require 2¾ kilowatt-hours of electric energy.

Power plants on Bureau of Reclamation projects at the end of 1942 will be capable of producing 10,785 million kilowatt-hours of electric energy annually. By 1945 the annual production will increase to 21,712 million kilowatt-hours—three times the total production of energy in 1920 of all power plants in the 11 States of the Mountain and Pacific groups.

The ultimate capacity of all hydroelectric power plants in operation, under construction or authorized in 1942 on Bureau of Reclamation projects totaled 4,734,762 kilowatts. This includes installations planned at Pine Flat Dam on the Kings River project in California, on the Palisades project in Idaho, on the Valley Gravity and Storage project in Texas, and on the Provo River project in Utah.

The capacity of the steam plants which have been recommended to supplement hydroelectric production or for independent operation to meet critical needs for war purposes is 450,000 kilowatts.

Chapter 4

Development of Reclamation

From the earliest days, as the frontier moved westward and State or territorial governments were established, there were persistent demands that the Federal Government should relinquish control of the vast areas of public land which it had acquired through treaties or right of discovery. There were originally 972,777,000 acres of public land in the 16 States of the arid region. (Texas, the seventeenth State, had no area in this classification.) By the close of the nineteenth century, there had been reserved or appropriated approximately 450,000,000 acres, and more than half a billion acres were vacant. This vast area was designated as "unreserved and[1] unappropriated."

With this vast area of public land in the West the Nation was potentially wealthy. The soil was rich, but without an assurance of water for irrigation homebuilding was precarious. How to dispose of this public land to insure successful development for an increasing population was a problem which challenged the Nation for almost a century.

Until 1841 public land had been sold to anyone with the cash to pay for it. In that year, however, the Government's attention was directed to acquiring a farming population whose industry would benefit the Nation permanently. The Preemption Act of 1841 gave only actual settlers the right to buy a maximum of 160 acres of land.

Homestead Act

Making settlement a condition for obtaining title to land logically led to the passage of the Homestead Act of May 20, 1862. This considerably modified and nearly supplanted the sales system. It awarded 160 acres free, except for a small filing fee, to any able-bodied citizen of good character who would agree to live on the property and develop it.

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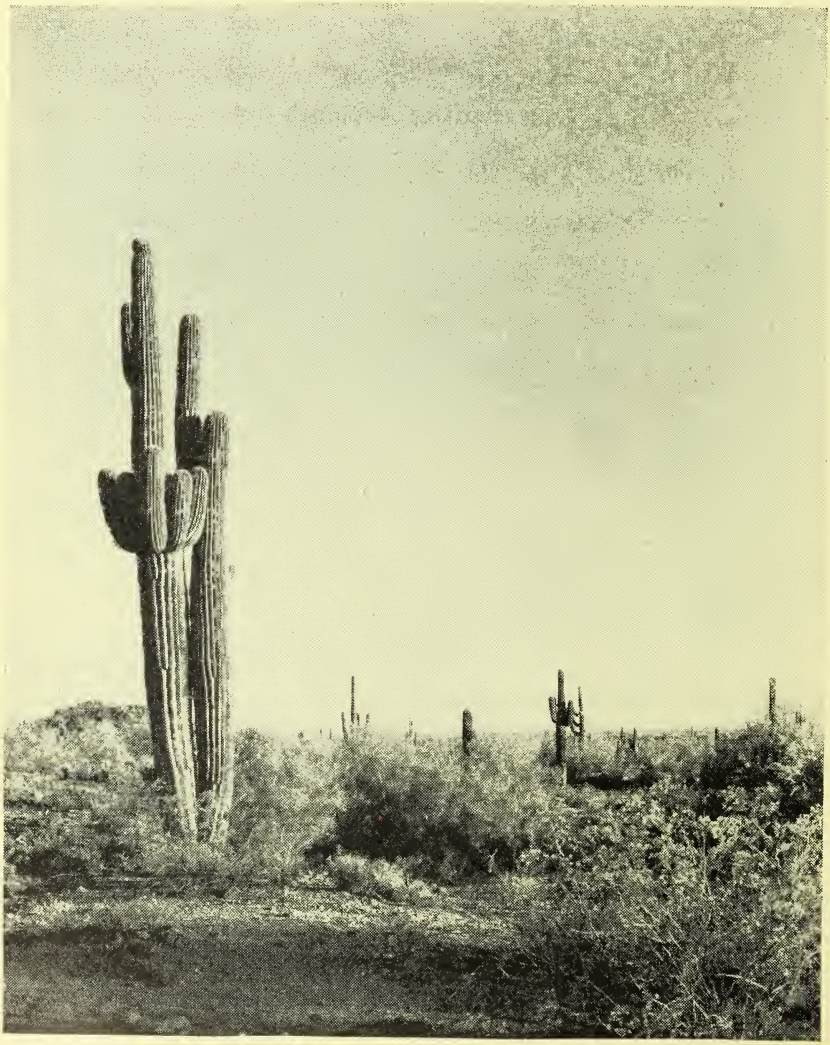
[1] Compiled from Report of Commissioner of the General Land Office.

This law operated successfully in the Mississippi Valley where rainfall was sufficient for agriculture and 160 acres were enough to support a family. But in the semiarid and arid West, where rainfall was not sufficient, 160 acres were found inadequate. The homestead entries were enlarged to 320 acres.

Later, with nearly all agricultural lands gone and remaining lands fit for little except to raise hardy stock—one to a half-dozen animals to the acre—the limit was again lifted to 640 acres in an effort to adapt its application to the growing West.

It became evident, however, that the homestead laws which did not specify irrigation development as a requisite for obtaining title to land



Saguara cacti, largest desert plant

applied very awkwardly to the arid West and did not adequately provide for the settlement of the desert lands.

Congress made a specific move to encourage irrigation of public lands by providing in February 1875[2] for the sale of desert lands in Lassen County, Calif. The object of the act was to reclaim desert lands by providing that one person might reclaim within 2 years not more than one section of land; having made satisfactory proof of such reclamation, he would acquire title to the land on payment of the minimum price of $1.25 per acre.

Desert Land Act

This law could not serve the demands of other desert States but served as an impetus to further legislative action which resulted in the passage of the Desert Land Act of March 3, 1877, which applied originally to 11 States—California, Oregon, Nevada, Washington, Idaho, Montana, Utah, Wyoming, Arizona, New Mexico—and the Dakota Territories.[3] This act described as "desert" all land which without irrigation would not produce some agricultural crop. It provided for the sale of 640 acres of land, at the price of $1.25 per acre to any person who would irrigate it within 3 years.

This act, as all previous land measures had been up to this time, was an expression of the laissez-faire policy—that irrigation, though necessary, should be left to its own devices.

It was then found that a 640-acre tract was too large for individual irrigation development and too small for grazing purposes, and that extensive speculation was resulting from operations of the Desert Land Act. In 1890 the act was modified, its application being extended to Colorado, and the acreage being reduced to 320 acres as the amount to which each settler was entitled.

As the population of the West increased with an almost constant stream of settlers from the East and particularly the Midwest moving into the area, demands for action in behalf of conservation of water for irrigation purposes became more insistent. By 1890, the population of the 11 States or territories in the Mountain and Pacific group had increased to 3,000,000 and the entire area under irrigation was about 6,000,000 acres.

Carey Act

The ensuing decade saw an even greater migration westward. Methods of making larger areas of public domain available for the permanent settlement of the newcomers were widely discussed.

The House Committee on Irrigation in 1892 reported that the only solution of the question "will be found in ceding these lands to the States and Territories." Two years later what is known as the Carey Act became a law.[4]

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[2] 18 Stat. 497.
[3] 19 Stat. 377.
[4] 28 Stat. 422.

The Carey Act provided that "to aid the public land states in the reclamation of the desert lands therein, and the settlement, cultivation, and sale thereof in small tracts to actual settlers," the United States would donate a million acres of desert land to each State having desert land within its boundaries. The legislation limited tracts to 160 acres to one person and prescribed that the land was to be used only for reclamation and settlement.

The operations of the Carey Act were fraught with many difficulties. Surveys of available water supplies were inadequate and data on the type, character, and productivity of the soil were not sufficient to guide the States. Settlers on many of the projects were in financial difficulties from the start in connection with heavy mortgages executed for financing construction of irrigation works.

By 1902 only 11,321 acres had been patented under the Carey Act out of a maximum of 7,000,000 acres that could have been filed on. Applications had been received for the segregation of less than 1,200,000 acres.[5]

In 1930, the Bureau of the Census reported that only 17 irrigation enterprises were being operated under the Carey Act. These covered 174,246 acres.[6]

Federal Reclamation Becomes Law

Although legislation during the middle and latter part of the nineteenth century was directed almost wholly toward encouraging individual and private efforts in the direction of irrigation, the Government also recognized the possible need for Federal sponsorship.

On October 2, 1888, Congress made an appropriation of $100,000 for investigating the extent to which the arid West could be developed by irrigation.

In 1901 President Theodore Roosevelt precipitated Congressional action. He brought the issue to a head in his first message to the Congress:

"It is as right for the National Government [he said] to make the streams and rivers of the arid region useful by engineering works for the storage of water as to make useful the rivers and harbors of the humid regions by engineering works of another character." [7]

President Roosevelt then endorsed the major principles of a bill introduced by Representative Francis G. Newlands of Nevada. After much debate the bill was passed on June 3, 1902, receiving a vote of 146 to 55 in the House of Representatives and little opposition in the Senate. It was approved by Theodore Roosevelt on June 17, 1902.

The Reclamation Act of 1902

The Reclamation Act of June 17, 1902 [8] provided for the examination, survey, and construction of irrigation works to reclaim the public lands,

[5] Report of the Commissioner of the General Land Office for the year 1902, p. 248.
[6] Irrigation of Agricultural Lands, Bureau of the Census, 1930.
[7] Richardson, Messages and Papers of the Presidents, XIV, p. 658.
[8] 32 Stat. 388.

appropriating for this purpose receipts from the sale and disposal of the public lands in the 16 States and Territories of the arid region, this money constituting the "Reclamation fund."

The act provided for the entry of the reclaimed lands in accordance with the provisions of the homestead law, which was modified in certain important particulars, among them the following: That the settler must repay to the Reclamation fund the cost of constructing the works necessary to reclaim the land he had taken; that the entry could not be commuted; and that the area of the entry must be limited to an amount not less than 40 nor more than 160 acres.

The law applied to 16 Western States—Arizona, California, Colorado, Idaho, Kansas, Montana, Nebraska, Nevada, New Mexico, North Dakota, Oklahoma, Oregon, South Dakota, Utah, Washington, and Wyoming.

Within a few weeks after the passage of the Reclamation Act, the Secretary of the Interior ordered the creation of an organization to be called the Reclamation Service, later the Bureau of Reclamation, as the responsible agency for the administration of the act.

On March 14, 1903, 6 major projects were approved, and a few months later on August 28, 1903, construction was begun on the first Reclamation project—the Truckee-Carson project in Nevada. The following year, 1904, 5 more projects were authorized. In 1905, 9 more were authorized; in 1906, 4; and in 1907, 1; making a total of 25 projects for which construction was approved during the first 5 years.

The Power Act

In building irrigation works in the arid West, it was soon realized that large amounts of power were needed to operate construction machinery. Readily available was a source of power: The water to be conserved. Consequently on April 16, 1906,[9] Congress provided that whenever a power development was necessary for the irrigation of lands under a Reclamation project, or an opportunity was afforded for a power development under a project, the Secretary could lease for a period of not more than ten years [10] any surplus power or power privilege, giving preference to municipal purposes, provided that the lease would not impair the efficiency of the irrigation project.

On June 12, 1906,[11] Congress also extended the Reclamation Act of 1902 to the State of Texas.

Three years later, on June 25, 1910,[12] Congress required an order of the President to start construction of a new project. No new project

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[9] 34 Stat. 116.

[10] Extended to not more than 50 years on the Rio Grande project in New Mexico-Texas by the Act of February 24, 1911 (36 Stat. 930), and on the Salt River Project, Arizona, by the Act of September 18, 1922 (42 Stat. 847). Also, see Reclamation Project Act of 1939, p. 27.

[11] 34 Stat. 259.

[12] 36 Stat. 836.

was to be begun until it had been recommended by the Secretary of the Interior and approved by the direct order of the President.

Warren Act

Very early in the application of the Reclamation Act it had become evident that a more comprehensive policy must be adopted in connection with the inclusion of privately owned lands.

The Salt River Valley in Arizona, for instance, had great tracts of reclaimable vacant public lands, but there Reclamation might have forced a large part of the population off land already brought under irrigation by pioneers. The solution was to permit the stored water to be shared by the privately owned lands instead of trying to use it wholly for irrigating adjacent tracts of public lands.

On February 21, 1911, the Reclamation Act was amended accordingly by the Warren Act [13] which authorized the sale of surplus water from a project for use on lands outside the project.

The Extension Act

An important change in the fiscal policy relative to Reclamation works was effected by the Extension Act of August 13, 1914.[14] To meet the repayment difficulties experienced by many project settlers, the act lengthened from 10 to 20 years, the period of time for payment of construction charges. The act provided also that after July 1, 1915, no expenditure should be made out of the Reclamation fund except by Congressional appropriation.

Owing to restricted funds, only one new project had been undertaken by the Reclamation Service between 1907 and 1920. The lack of funds resulted from a decline in receipts from the sale of public lands combined with the comparatively small return from construction repayments resulting from the longer 20-year period repayment and from the necessity of setting aside $1,000,000 each year to repay a Treasury advance authorized in 1910.

The Mineral Oil Leasing Act on February 25, 1920,[15] provided that 52½ percent of the amount received from oil royalties derived from public land oil leases, except those from Alaska, be paid into the Reclamation fund. This was done to increase accretions to the Reclamation fund.

On May 15, 1922,[16] Congress authorized contracts with irrigation districts for the repayment of construction charges, thereby shifting from the earlier requirements of contracts with individual water users and permitting releases of liens on individual lands. This act enabled landowners on Reclamation projects to obtain Federal land bank loans.

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[13] 36 Stat. 925.
[14] 38 Stat. 686.
[15] 41 Stat. 441.
[16] 42 Stat. 541.

Fact Finders' Act

Depressed farm prices and repayment difficulties of the early 1920's resulted in a review of national Reclamation. As a result, Congress on December 5, 1924, passed the Fact Finders' Act.[17]

The act provided that no new project or new division of a project should be constructed or estimate submitted therefor by the Secretary until the Secretary had made a finding of feasibility regarding engineering features, cost of construction, land prices and probable cost of development.

It also provided that whenever the water users of a project or division of a project take over operation and maintenance, the net profits from power-plant operation, grazing or farm-land leases and the sale or rental of townsite land should be credited to construction charges against the project, first, and thereafter applied to operation and maintenance charges, after which the profits were to be used as the water users directed.

On May 25, 1926, the Omnibus Adjustment Act[18] lengthened the repayment period from 20 to 40 years. Other provisions of the act were that repayment contracts on new projects should be made only with water users' organizations and that a repayment contract covering the cost of construction must be entered into before water could be delivered.

In the same act, at the request of the Bureau, which had encountered speculative abuses on project land, Congress also provided that irrigable project land in single ownership over 160 irrigable acres should not receive water. (In May, 1937 specific legislation[19] extended antispeculation provisions to the Columbia Basin project in terms making 40 and 80 acres the basic sizes of farm units. Later legislation[20] modified and strengthened these provisions.)

Boulder Canyon Project Act

Reclamation policy was broadened and advanced when Congress approved the Boulder Canyon Project Act on December 21, 1928.[21] The approval of this project, which called for the construction of the largest power plant in the world, signified a marked advance in the concept of Reclamation. Reclamation construction for the conservation of the Nation's water resources now embraced the idea of the multiple-purpose project. The sale of Boulder power at competitive rates was to pay for this first great multiple-purpose project. (An amendment[22] later—July 19, 1940—substituted an amortization basis for the competitive rate basis of power sale in repayment of the project construction cost.)

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[17] 43 Stat. 672.
[18] 44 Stat. 636.
[19] 50 Stat. 208.
[20] H. R. 6522, 77th Cong., 2d sess.
[21] 45 Stat. 1057.
[22] 54 Stat. 774.

The National Industrial Recovery Act of June 16, 1933,[23] which authorized an expenditure of $3,300,000,000 for public works, resulted in great expansion of the construction program of the Bureau. Allocation of funds were made to irrigation projects.

The vastly expanded program emphasized the necessity for increasing the number of sources from which flowed the funds for Reclamation, which were dwindling.

Owing to effective application of an oil conservation policy, the one important supplementary revenue to the Reclamation fund—the royalties received from the exploitation of oil on the public domain—was also diminishing.

Accordingly, Congress passed legislation providing new revenues for the fund. The Hayden-O'Mahoney amendment[24] to the departmental appropriation bill for 1939 covered into the Reclamation fund 52½ percent of the total of all receipts, including penalties, received by the Treasury from lands within Naval oil reserves except those in Alaska between February 25, 1920, and June 30, 1938. It also provided that repayments of emergency and regular funds appropriated for Reclamation construction from the general Treasury fund, except those for the Boulder Canyon project, be placed in the Reclamation fund until the cost of these projects is repaid.

Great Plains Legislation

Reclamation operations were further broadened by the Interior Department Appropriation Act of 1940,[25] approved May 10, 1939, which made $5,000,000 available for allocation by the President to such Federal departments, establishments and agencies as he might designate for the purpose of constructing water conservation and utilization projects in the Great Plains and other arid and semiarid areas as a measure of drought and work relief. By the President's designation the Bureau of Reclamation was made the construction agency for such projects.

The 1940 Appropriation Act required that the water users on such projects repay in not more than 40 annual instalments the cost of construction met from appropriations under the act, in accordance with Reclamation policy. It also provided that the cost of labor or material supplied for such construction by the Work Projects Administration, Civilian Conservation Corps, or any other Federal agency should be repaid in such amounts and on such terms as the President might fix for each project. The Act of August 11, 1939, called the Water Conservation and Utilization Act, authorized the Secretary to undertake the construction of similar projects on a similar repayment basis. Provision was made in the act for cooperation by the Department of Agriculture, which was

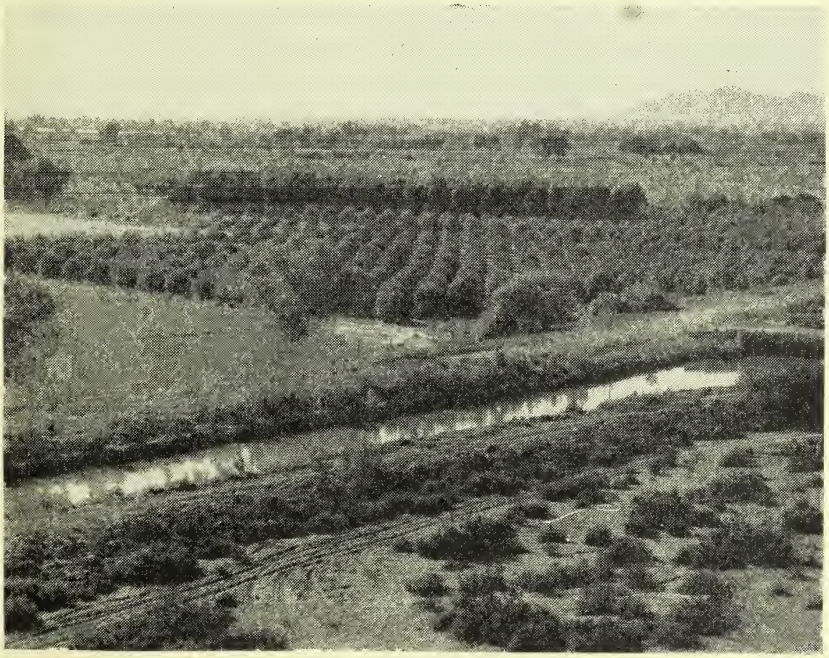
[23] 48 Stat. 195.
[24] 52 Stat. 291.
[25] 53 Stat. 685.

authorized to assist in project planning and assume land use and resettlement responsibilities.

Reclamation Project Act of 1939

During the same year Congress passed the Reclamation Project Act of August 4, 1939.[26] This law made it possible to adjust many difficulties of the water users, to draft new contracts gearing payments to the ability, year by year, of the farmers to make payments, to reclassify lands from time to time, and to accomplish other needed reforms.

The Act recognized the importance of power in determining the feasibility of a project. It provided that any sale of electric power or lease of power privileges should be for a period not longer than 40 years and at such rates as would cover an appropriate share of the annual operation and maintenance cost as well as the construction investment. In accordance with previous acts preference in such sale and leases was to be given



In the immediate foreground is desert wasteland which water fed by gravity from the canal in the center of the picture has transformed to productive fields and orchards in background

to municipalities and other public corporations or agencies, and no contract was to be made that would impair the efficiency of the project for irrigation. The provisions of the act respecting the terms of sales of electric power and leases of power privileges were in addition and alternative to any authority in existing laws relating to particular projects.

[26] 53 Stat. 1187.

The Reclamation Project Act established a broad foundation for the conservation and economic development of the water resources of the West. The cost of constructing multiple-purpose Reclamation projects was to be shared according to their various benefits. To irrigation was allotted only that share of the construction cost which could probably be repaid by the irrigation farmers within 40 years and, in concession to national considerations, without interest. A proportionate share was to be borne by power, to be repaid also but with interest, at not less than 3 percent. The shares allotted to municipal water supply "and other miscellaneous purposes" were also reimbursable. Shares were allotted to flood control and navigation but under long established national policy were nonreimbursable.

Social Implication of Reclamation

In the Interior Department Appropriation Act of 1941 the Congress said, significantly, that it was "the policy of the Congress that, in the opening to entry of newly irrigated public lands, preference shall be given to families who have no other means of earning a livelihood, or who have been compelled to abandon, through no fault of their own, other farms in the United States * * *"

This legislative comment was significant because it gave definite expression to the social implications of Reclamation development in the West and confirmed the purpose of the original Reclamation Act of 1902 to provide the maximum number of settlement and employment opportunities by the construction of irrigation systems in arid regions of the United States.

Chapter 5

Organization and Administration of the Bureau

The Bureau of Reclamation as it is constituted today represents an evolution of the original conception of the agency contemplated when the Reclamation Act was approved on June 17, 1902. It now operates as a full-fledged bureau, with a Commissioner in Washington reporting directly to the Secretary of the Interior.

The Chief Engineer located at Denver, Colo., heads the field organization in charge of all investigational and construction activities. At Denver also is the headquarters of the Bureau's general supervisor of operation and maintenance, including soil and moisture conservation operations.

Including the Denver office and 5 field legal offices, there are 57 field offices located in 16 States for construction or operation and maintenance.

The work of the Bureau, somewhat complex in its character and extent, is confined under the Reclamation law to the arid and semiarid regions west of the one hundredth meridian, but by special legislation may be extended to other areas.

Under the President's reorganization Order No. 4 in 1940, soil-conservation work by the Department of Agriculture on public and other lands under the control of the Secretary of the Interior was transferred to the Department of the Interior. The Division of Soil and Moisture Conservation was established in the Bureau of Reclamation under a field supervisor with headquarters at Denver to handle this important phase of work on Reclamation project lands. The economical use of irrigation water, savings in storage, prevention of waterlogging, preservation of soil fertility, and the need for increased crop yields influenced the establishment of this division.

In 1941 the Commissioner's office in Washington employed 140 persons. At Denver under the Chief Engineer were approximately 1,000 employees and in the field were about 7,000 including construction forces. Twenty-six construction engineers in charge of projects under construction, a

director of power in charge of Boulder Dam and power plant and 3 supervising engineers reported to the Chief Engineer. Sixteen superintendents in charge of projects reported to the General Supervisor of Operation and Maintenance in Denver who had supervision over 53 projects or divisions of projects operated by irrigation districts or water-user organizations.

Fundamental Objectives

Fundamentally the objectives of the Bureau revolve around the conservation of the land and water resources of this area for the transformation through irrigation of desert lands into productive farms. The maintenance of production on lands threatened with retrogression to the desert as a result of shortage of water supplies from other systems has become of equal importance. Incidental to these major purposes are the facilities for the generation of hydroelectric power, drainage, flood control, improvement of navigation, silt control, stream regulation, municipal water supplies and the creation of recreation facilities and wildlife refuges. Preceding the construction of projects involving one or more of these objectives in addition to irrigation, are extensive investigations into water resources, soil characteristics and economic factors. Construction work is by force account or contract for this type of project.

Under special legislation in 1939–40 the activities of the Bureau have been extended to the rehabilitation of established agricultural areas in the Great Plains and other areas to the westward affected by drought or other conditions. Through a Water Conservation and Utilization program the Bureau constructs small projects with labor provided by the Work Projects Administration and the Civilian Conservation Corps. Construction of farm ditches and land preparation, with settlement activities, on these projects and, in some instances, operation and maintenance, is under the Farm Security Administration, Department of Agriculture.

In all other instances the responsibility for operation and maintenance, through its own forces or under contract with irrigation districts or water users associations, rests with the Bureau of Reclamation.

Origin of Bureau

The nucleus of the Reclamation organization in 1902 came from the division of hydrography of the Geological Survey. This division had long been engaged in the work of gaging streams and of investigations of the water supply in the arid regions of the United States. The chief of the division became Chief Engineer of the Reclamation Service under the Director of the Geological Survey who in turn reported directly to the Secretary of the Interior.

On March 9, 1907, the Reclamation Service was separated from the Geological Survey and the Chief Engineer became the Director, reporting directly to the Secretary. This step was taken in order to establish "a somewhat more direct personal contact between the Reclamation Service

and the Secretary of the Interior." The Assistant Chief Engineer became the Chief Engineer.

By 1912, after 10 years of irrigation construction, the Service had resolved itself into a far-flung organization with 6,468 employees, of whom 4,739 were construction laborers. The remainder were engaged in administrative, engineering, clerical, and legal activities connected with project construction, operation, or maintenance.

In 1915, following 2 years of inquiry into methods of conducting the activities of the Reclamation Service, a central field office was established in Denver. This move was designed to concentrate at that point all work that could be economically and efficiently performed there. There, also, purchases and disbursements were consolidated. A Chief of Construction was placed in charge at Denver who reported to the Director and Chief Engineer in Washington. Project managers and engineers in charge of construction reported to the Chief of Construction at Denver.

With the resignation of the Director in 1915 the duties of the Chief Engineer were merged with that position and a single executive officer headed the organization in Washington. Five years later, the duties of the Director and Chief Engineer were divided and the Director with headquarters in Washington continued in administrative charge of the Service, reporting directly to the Secretary of the Interior. The designation of Chief of Construction was changed to that of Chief Engineer and that official, reporting from his headquarters in Denver to the Director in Washington, administered the field offices of the Service.

In 1921 a Chief Hydraulic Engineer with offices in Denver was named to take charge of all secondary investigations in cooperation with States or localities that participated in financial arrangements.

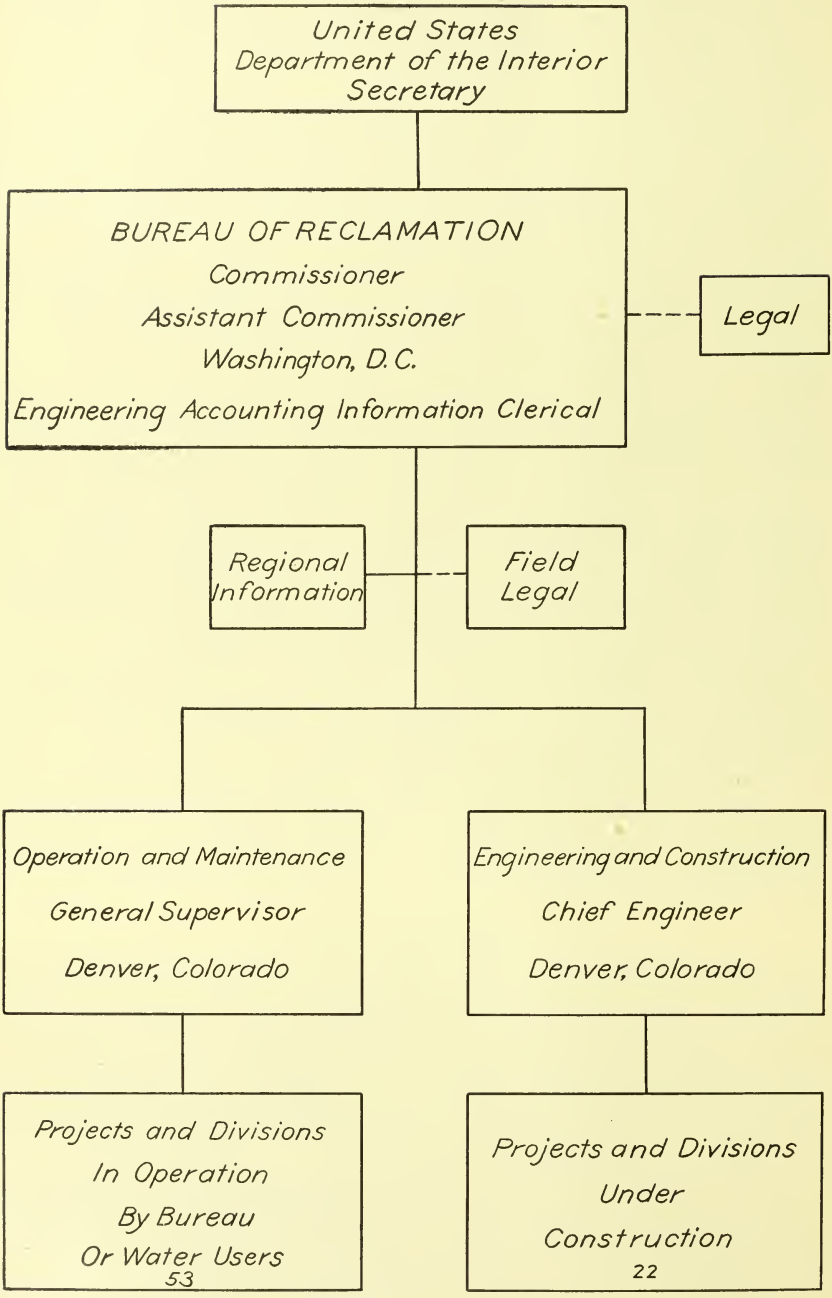
By 1920 the net expenditure on the construction of Reclamation projects had reached $125,000,000. The value of land in cities, towns, and villages within project areas meanwhile had increased more than $100,000,000 as a consequence.

Full Bureau Status

On June 20, 1923, full bureau status was conferred on the Reclamation Service, with a Commissioner appointed by the Secretary of the Interior as the chief executive officer at Washington. Project managers and construction engineers of the newly created Bureau continued to report to the Chief Engineer at Denver. Under the act of May 26, 1926, the Commissioner is appointed by the President, but serves under the supervision and direction of the Secretary.

With the allotment of more than $100,000,000 under the National Industrial Recovery Act in 1933 for the continuation of construction of projects under way and for starting work on new projects, Reclamation activities took on new emphasis. They had already entered an enlarged field through the planning and design of Boulder Dam on the Colorado

ORGANIZATION CHART



Organization of the Bureau of Reclamation

River under the Boulder Canyon Project Act of 1928. Construction of this first large multiple-purpose structure by the Bureau began in 1930.

The staff of the Denver office was increased from 250 to 700 to handle the extensive program and make necessary studies and investigations, and prepare plans and specifications for bids. In addition, the Denver office assumed the design and specification work for Wheeler and Norris Dams of the Tennessee Valley Authority, and for Caballo Dam on the Rio Grande, which the Bureau constructed with funds appropriated for the International Boundary Commission.

In 1935, through its several types of projects, the Bureau was providing water for slightly less than 3,000,000 acres.

In this same year the greatly expanded construction activities led to separation of operation and maintenance work so as to give the Washington office closer contact with water users. The position of general supervisor of operation and maintenance was created. All engineering and electrical staffs were centralized in Denver. In 1941 the operation and maintenance division was also centralized in Denver, and in 1942, owing to Government decentralization, additional Bureau personnel (all) accountants except the Chief Accountant and an assistant) was transferred to Denver.

Fifty-three Projects in Operation

Under this expansion such multiple-purpose projects as Grand Coulee in Washington, Central Valley in California, and Colorado-Big Thompson in Colorado were initiated in charge of supervising engineers reporting directly to the Chief Engineer at Denver. Completion of other projects was advanced, and in 1941, 53 projects or divisions of projects [1] were in operation.

[1] See Appendix, table 1, p. 81.

Chapter 6

Functions of the Bureau

Project-planning and project-investigation activities of the Bureau of Reclamation are carried on under the basic authority of the Reclamation Act [1] of June 17, 1902. With respect to the Reclamation fund it created, this act reads in part as follows:

"to be used in the examination and surveys and the construction and maintenance of irrigation works for the storage, diversion, and development of water for the arid and semiarid lands."

The Reclamation Project Act of 1939[2] provides that:

"No expenditures for the construction of any new project, new division of a project, or new supplemental works on a project shall be made, nor shall estimates be submitted therefor, by the Secretary until after he has made an investigation thereof and has submitted to the President and to the Congress his report and findings on—

"(1) the engineering feasibility of the proposed construction;

"(2) the estimated cost of the proposed construction;

"(3) the part of the estimated cost which can properly be allocated to irrigation and probably be repaid by the water users;

"(4) the part of the estimated cost which can properly be allocated to power and probably be returned to the United States in new power revenues;

"(5) the part of the estimated cost which can properly be allocated to municipal water supply or other miscellaneous purposes and probably be returned to the United States."

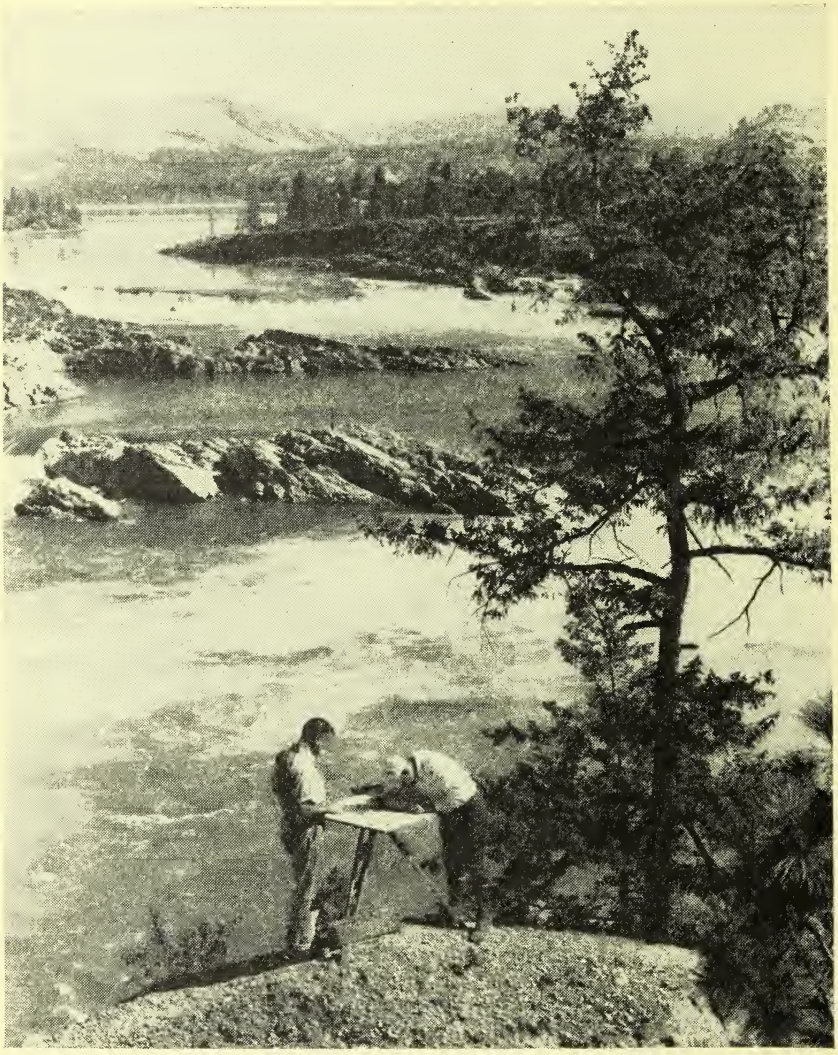
Determination of Feasibility

Thus the engineering and economic feasibility of a project must be determined and reported upon prior to the submission to the Bureau of the Budget of estimates for appropriation of funds for construction. By the provisions of the Act of 1939, a project is authorized upon a finding by the Secretary of the Interior that the probable return to the United States within the repayment period of 40 years equals the

[1] 32 Stat. 388.

[2] 53 Stat. 1187.

construction cost, less any proper allocation for flood control or navigation. Repayment with interest at not less than 3 percent of the costs allocated to power is required; the cost, with interest not exceeding 3⅛ percent if the Secretary so determines, of water supplies for municipal or miscellaneous



Surveying the reservoir site for Grand Coulee Dam on the Columbia River, Washington

purposes must also be repaid. If the Secretary of the Interior finds that the probable return from a proposed project, minus allocation for flood control or navigation, does not equal its total estimated cost of construction, the project must be approved for construction by the President and the Congress, and funds for construction must be appropriated by the Congress, to construct it.

Appropriation of funds by the Congress must precede construction of any Reclamation project, in whole or in part.

Project planning by the Bureau of Reclamation revolves around irrigation. Its object is to plan for the utilization of available water resources in irrigation and for related purposes. The most desirable lands for irrigation must be selected and consideration given to domestic and industrial water supply requirements, flood-control regulation, power production, and other interests in water, as well as to interbasin, interstate, State, and local interests where competitive uses of these limited water resources are involved.

Exploration and Investigation

The approaching exhaustion of usable water supplies in the arid and semiarid West makes basin-wide preliminary examinations necessary to insure proper selection of project areas for detailed consideration.

Available funds preclude extensive exploration programs for dam sites or detailed location surveys for canals prior to appropriation for construction. However, repayment contracts are generally required in advance of construction. This necessitates a high degree of accuracy in the preliminary plans and cost estimates.

Cooperation and consultation with Federal, State, and local groups is the prevailing practice. Formal agreements are in force with a number of States, counties, and other interests. Project planning of the Bureau has entered a new and beneficial phase in the interdepartmental agreement of July 1939, with the War and Agriculture Departments providing for cooperation and consultation in project reports. Other agencies frequently consulted are the Fish and Wildlife Service, the National Park Service, the Geological Survey, the Weather Bureau, and Forest Service, which provide data for use in the investigations.

Investigations of more than 150 potential projects were in progress during the fiscal year 1942 by the Bureau of Reclamation. The investigations are generally limited to (*a*) examinations of individual projects, including land classification, reservoir and canal surveys, economic and water-supply studies, (*b*) reconnaissance surveys of stream basins to determine irrigation potentialities within those basins, and (*c*) basin-wide surveys, including reconnaissance and examination of individual projects within the basin. The principal basin-wide survey which the Bureau has undertaken is that of the Colorado River area in seven intermountain and Pacific States, which was authorized by section 15 of the Boulder Canyon Project Act of 1928,[3] which directs that investigations and public reports be made of the feasibility of projects for irrigation, generation of electrical power, and other purposes in the States of Arizona, Nevada, Colorado, New Mexico, Utah, Wyoming, and the basin area in California.

[3] 45 Stat. 1057.

Designs and Specifications

Almost all phases of technical engineering are embraced in the preparation of the Bureau of Reclamation engineering designs. When funds are appropriated for a proposed project, preliminary design studies are initiated and carried on concurrently with the project investigations. Beginning with the analyses of hydrologic studies made to determine the adequacy of the water supply, the designs include consideration of dams for diversion or storage, outlet works for withdrawal from the reservoir, canals for distribution to the land, pumping plants, incidental power development and transmission, flood control and other related features such as the relocation of highways and railroads.

Drafting room, Denver field headquarters

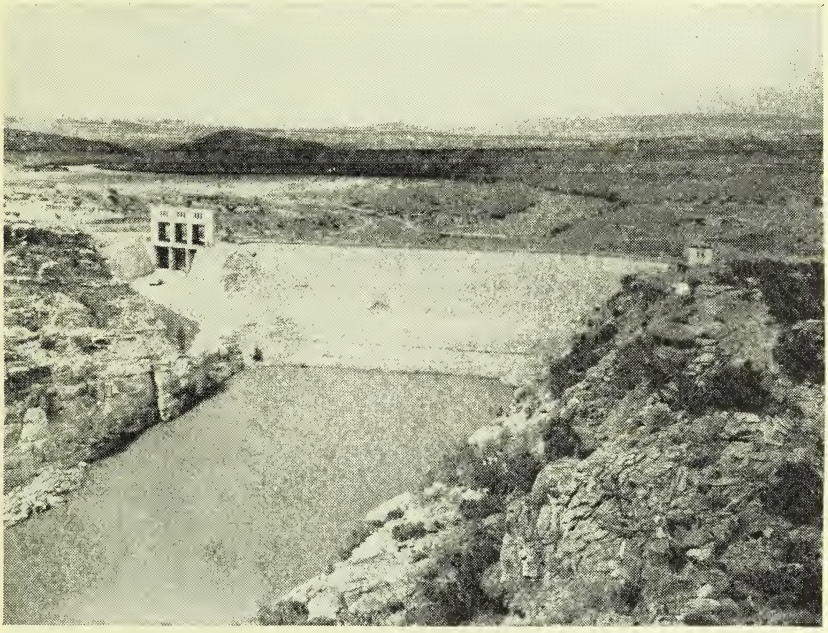
The design problem as a whole requires the skill of the hydraulic, civil, electrical, and mechanical engineer, the architect, geologist, and frequently of specialists in related branches of science. All detailed designs, working drawings and specifications for construction and for the purchase of materials are prepared in the Denver office. The Denver laboratories of the Bureau of Reclamation are an important part of the designing organization. Many problems of design and construction are studied under various conditions, with the result that much progress has been made in the establishment of basic design criteria and in methods of processing and utilizing construction materials.

Construction

In conformance with the policy adopted by the Department of the Interior in 1925, practically all new construction of the Bureau of Recla-

mation on regular projects is performed under contracts awarded on the basis of competitive bids. These bids, which normally provide for the furnishing of all labor and the construction plant, are invited upon completion of project designs and issuance of specifications covering the requirements of the work.

The necessary materials and equipment are bought by the Bureau and are furnished to the general contractor as needed. These purchases are likewise made after competitive bidding on specifications prepared by the Bureau. Bureau of Reclamation forces sometimes build the camp for housing technical and administrative personnel, build access roads,



Alcova Dam, Kendrick project, Wyoming

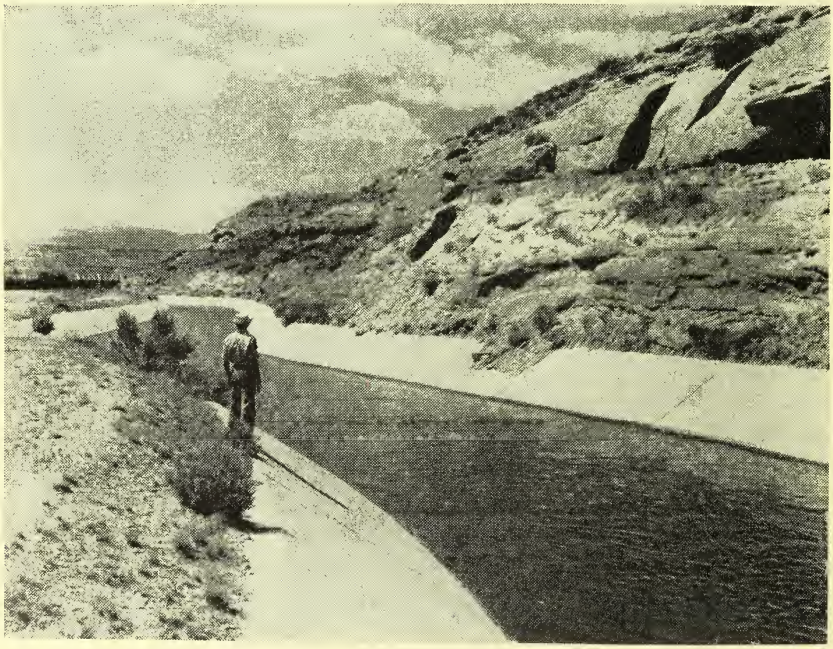
electric power lines, railroad spurs, and other facilities necessary for construction activities.

The project field organization consists of a staff of engineers, inspectors, laboratory technicians, and clerical and other administrative personnel as required. It is normally headed by a construction engineer. The organization of the construction engineer is responsible for laying out the work, inspecting performance and materials, testing materials and for obtaining compliance with the specification requirements. In the case of large projects including two or more distinct but definitely related features that in themselves constitute major undertakings, the field work may be under the general direction of a district or a supervising engineer with a construction engineer assigned to each major subdivision.

Dams designed and constructed by the Bureau of Reclamation range in size from simple diversion structures of a few feet in height to dams of unprecedented proportions with the multiple purposes of irrigation storage, flood control, municipal and industrial water supply, power development, and other benefits.

Through the years since the Federal Government began the construction of self-liquidating irrigation projects in the arid and semiarid western States, the regional growth in population with corresponding agricultural and industrial development has demanded an increasing utilization of available water supplies. Early irrigation consisted very largely of simple diversion dams and dependence on unregulated stream flows; today these unregulated flows are insufficient for existing needs and storage works are required for impounding surplus run-offs and flood flows. Storage dams have become larger and more expensive, and as the better dam and reservoir sites have been utilized less favorable locations have imposed added construction difficulties and costs.

The relation between the increasing costs and economic feasibility is a current problem of irrigation development. When the scope of the project is comprehensive, a solution is found in the construction of multiple-purpose dams. The cost of irrigation water to the farmers is kept within economic limits, proper assessments are made for flood-control or other nonreimbursable benefits, and the balance of the project



Wyoming Canal, feeder for the Riverton project, Wyoming

cost is returned with revenues derived from the sale of industrial and domestic water and power.

Many of the early practices of the Bureau in dam design and construction have been outmoded or greatly altered. Such structures as Boulder, Grand Coulee, and Shasta Dams have introduced new and unprecedented problems of design and construction.

Canals

Reclamation of arid lands is achieved, of course, only after water actually is delivered to the land for the production of crops. Application of the water to the land and the production of crops is the function of the farmer but the delivery of water to the land is a function of the reclamation agency.

Delivery to the land involves three principal operations: Diversion, conveyance, and distribution, each requiring the construction of distinct types of work, although those for conveyance and distribution often merge into each other.

Diversion works range from simple headworks set in the bank of a stream without any dam or training works to elaborate structures including diversion dams with movable crests, highway crossings and headworks with power-operated gates and power-operated fish screens.

Conveyance works include canals, tunnels, pipe lines, flumes, and incidental structures. Canals may be channels excavated in earth or rock with earth or concrete-lined embankments following a grade contour along a hillside or located on a valley floor. The 80-mile All-American Canal in southern California is by far the largest irrigation canal constructed in the United States. The Coachella Canal, diverting from the All-American 36 miles from its head, is under construction and when completed will have a total length of 130 miles.

Distribution works consist of laterals diverting from a principal conveyance conduit and of sublaterals diverting from a main lateral. Deliveries are usually made to each farm unit or to each legal subdivision the size of which is established for each project, and at an elevation which will permit the covering of the entire irrigable area of the land-holding served.

Power Plants

The development of hydroelectric power on projects engineered by the Bureau of Reclamation is incidental to the release of water from storage reservoirs and to the utilization of drops in canals of the water distribution systems.

The power thus generated is used in part to pump irrigation water to areas that cannot be served by gravity canals, and for operation of project structures. The power surplus to these needs is sold on a wholesale basis, a purchase preference being given to utilities publicly owned or operated by cooperative or nonprofit organizations.

In 1942 there were 29 hydroelectric power plants in operation on 18 Reclamation projects in the West, in Arizona, California, Colorado, Idaho, Nevada, New Mexico, Texas, Utah, Washington, and Wyoming. Their installed capacity exceeded a million kilowatts. Transmission lines from these plants supplied areas of nearly 4,000,000 population with more than half their power and light.

The largest single installed capacity at any plant on a Reclamation project was at the Boulder Dam power plant in the Southwest, in Arizona-Nevada. Installed capacity in 1942 was 952,300 kilowatts. The ultimate capacity is 1,322,300 kilowatts.

Larger potentially than even the Boulder plant was the Grand Coulee Dam power plant in Washington with an ultimate capacity of 1,974,000 kilowatts. In 1942 the installed capacity was only 344,000 kilowatts but being increased with all possible speed to meet war needs in the Pacific Northwest.

These two great hydroelectric plants, one in the northwestern United States supplying power for shipbuilding, electrometallurgical and other war industry, the other in the southwestern part of the country supplying power for magnesium, planes and mining, proved themselves incalculably important in the Nation's war effort.

Pumping Plants

Gravity will not always carry irrigation water to the lands to be served, and pumping has been resorted to for both large and small irrigation systems. Pumps are also used in disposal of collected drainage water in many instances.

Pumping plants constructed by the Bureau for irrigation and drainage purposes may be divided into three classes:

1. Pumping plants which are located at a source of water to lift the water to receiving reservoirs or for discharge directly into distribution systems.

2. Pumping plants which function as a part of a distribution system, serving to relift water along the main canals or to relift water from the main canals into secondary canals and laterals.

3. Pumping plants which are constructed for the purpose of pumping collected drainage water into adequate disposal channels.

The Bureau of Reclamation has constructed pumping plants, both small and large, of the three classes named. There were 77 pumping plants having a total pumping capacity of 6,100 second-feet and operating at static lifts ranging from 1.5 to 200 feet on Reclamation projects in 1940. These installations comprised pumping units of both the vertical and horizontal types, driven by electric motors, hydraulic turbines, and oil and gas engines.

Auxiliary Activities

The construction work of the Bureau of Reclamation ordinarily centers around the problems of the storage, distribution, and drainage of water

and the production of power and its transmission. There are other incidental problems. These may require construction of new and relocation of existing railroads and highways, construction of bridges, tunnels, and towns; protection of migratory fish; removal of excessive silt from the water to prevent filling the canals; temporary diversion of the stream to permit construction of a dam; and innumerable other auxiliary features. These auxiliary features may assume major importance on some projects.

The construction of Shasta Dam, Central Valley project, with its attendant reservoir necessitated the relocation of a portion of the main line of the Southern Pacific Railroad and of U. S. Highway No. 99, both of which, in search of "water grade," had followed the Sacramento River Canyon through the reservoir area. Construction of approximately 30 miles of railroad with 12 tunnels and 8 bridges, one the highest of its type in the world; adequate station and operational facilities including buildings, water tanks, water-supply and sewage disposal-systems; suitable signal systems and the relocation of telegraph, telephone, and power lines; and the construction of about 2½ miles of new highway were included in the job of building the dam.

Fish Propagation

A little more unusual is the problem of preserving the migratory fish industry on the streams being utilized for reclamation purposes. Salmon and steelhead trout spawned in fresh water migrate to the sea and return to their native streams at maturity to spawn in their turn. A high dam will block the run of these fish attempting to reach their spawning grounds, and they will not naturally seek other areas accessible to them. In order to avoid the loss of blocked runs some means must be provided to allow the fish unrestricted passage over, through, or around any dam built on streams subject to these migrations, or, if that is impossible, as at Grand Coulee and Shasta Dams, the runs must be salvaged through transplanting.

Small dams are provided with fish ladders. Elevators have been found more satisfactory at larger dams. In such mammoth structures as Grand Coulee and Shasta no satisfactory means could be found to get the fish over, however. It would have been useless anyway, since the fingerlings would have been killed by the sudden changes of waterpressures in their migration downstream over the dam. The alternative was to establish the fish runs in the tributaries which enter the rivers below the dams.

Desiltation

In building the Imperial Dam across the silt-laden Colorado River to divert water for the All-American and Gila Project (Arizona) canals it was necessary to make provision for the removal of the silt to avoid excessive canal maintenance costs. The All-American Canal is designed for an ultimate capacity of 15,155 second-feet but is being operated at a capacity of 12,000 second-feet. The estimated silt load at 12,000 second-feet is 60,000

tons dry weight per day with a maximum of 90,000 tons per day. The desilting equipment is designed to remove about 80 percent of the silt, allowing the remaining 20 percent to pass through into the canals.

Operation and Maintenance of Projects

The original Reclamation Act [4] provides that the Secretary of the Interior is to use the Reclamation fund for the operation and maintenance of the reservoirs and irrigation works constructed under the provisions of the act. The water used for irrigation requires careful and proper distribution to the farmers. The expense involved in distributing the water is the annual operation cost. The structures and canal systems built by the Bureau represent a large outlay of money. These structures and canals must be cared for in the best possible manner. The expenditures for such purposes are known as the annual maintenance cost. The operation and maintenance costs, or O & M cost, are usually grouped together because the services overlap and the same organization looks after both. The charges to repay the O & M cost are payable yearly by the farmers and vary from year to year on each project, depending upon the amount of work done and the problems encountered. The charges are due and payable in advance, at or before the beginning of the irrigation season, as announced by the Secretary of the Interior.

The operation and maintenance of completed projects is the responsibility of the Operation and Maintenance Division of the Bureau of Reclamation. However, it is the long-established policy of the Bureau to turn over the operation and maintenance of the projects to local organizations of water users when practicable. The farmers on the projects organize into water users' associations or irrigation districts, elect their governing boards, and assume all costs. It is with these organizations that the United States enters into contracts for the repayment of construction costs. Thirty-two projects or divisions of projects are now operated by water users.[5] With few exceptions, the Bureau has retained the care and operation of storage works.

The responsibility of the Bureau does not cease with the assumption of operation and maintenance operations by local organizations. Through cooperation with county agricultural agencies and through the recently established division of soil and moisture conservation operations, it seeks to aid project farmers in agricultural development and in improving irrigation practices.

Settlement and Development

To fully realize the ultimate objective of Reclamation work, the creation of homes and the provision of opportunities for successful living, the Bureau of Reclamation supervises the settlement and development of its project lands.

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[4] 32 Stat. 388.

[5] See Appendix, table 1, p. 81.

As irrigation systems are completed and water becomes available to irrigate lands on Reclamation projects, announcement of the opening of any public land is made by the Secretary of the Interior. The original act provided that the Secretary of the Interior "shall give public notice of the land irrigable under such project, and limit of area per entry, which limit shall represent the acreage which, in the opinion of the Secretary, may be reasonably required for the support of a family upon the lands in question." [6] It also provided that the "entryman upon lands to be irrigated by such works, shall, in addition to compliance with the homestead laws, reclaim at least one-half of the total irrigable areas of his entry for agricultural purposes, and before receiving patent for the lands covered by his entry shall pay to the Government the charges apportioned against such tract * * *." [7]

How to Acquire Reclamation Farms

A person who wishes to make homestead entry on a Reclamation project should first obtain definite information from the project superintendent in respect to units available and the conditions under which entry may be made. Application forms for homestead entry may be obtained from the local land office. The act of December 5, 1924[8] authorizes the Secretary of the Interior to require of each applicant, including preference right ex-service men,[9] for entry to public lands on a project, such qualifications as to industry, experience, character, and capital as, in his opinion, are necessary to give reasonable assurance of success by the prospective settler. An applicant for homestead entry on a Reclamation project must first appear before an examining board and submit a written statement giving his age, status of citizenship, whether married or single, number of children and their sex and ages, other dependents, ownership of farm lands elsewhere and the value thereof, farming experience, assets and liabilities, and give references as to character and industry. Applicants must possess good health and vigor and have had at least 2 years' actual experience in farm work or farm practice, and have at least $2,000 or its equivalent in livestock, farming equipment or other assets. Homestead entries cannot be filed until the applicant has been approved by the examining board.

To meet the financial requirement for settlement on Reclamation projects assistance was offered by the Farm Security Administration during 1940 by the passage of the act of August 7, 1939.[10] This act authorized the Secretary of the Interior "to consider the money or any part of the money made available to settlers or prospective settlers by the Farm

[6] 32 Stat. 388.

[7] 32 Stat. 388.

[8] 43 Stat. 672.

[9] The 90-day preference right of entry for ex-service men on public land expired at the close of February 14, 1940, with the exception of lands which may be obtained in the future under the Boulder Canyon Project Act.

[10] 53 Stat. 1238.

Security Administration, as all or a portion of the capital required for such settlers * * * an entryman of any such unit to enter into a mortgage contract with the Farm Security Administration to repay the value of such improvements thereon before an entry is allowed."

Subsequent legislation [11] extended this provision to June 30, 1942.

Privately owned land may be purchased in the various projects. Purchasers, however, must comply with the rules and regulations of the Bureau of Reclamation, particularly in regard to the payment of construction and operation and maintenance charges. Privately owned land located within the project boundaries is subject to the Reclamation law if covered by water-right application or by subscription for stock in a water users' association or is included in an irrigation district which has contracted with the United States.

The act of May 25, 1926,[12] provided that in connection with the settlement and development of projects the Secretary, in his discretion, is authorized to enter into agreement with the proper authorities of the State whereby such State shall cooperate with the United States in promoting the settlement of the project and securing and selecting settlers. Contracts with irrigation districts provide for the appraisal and sale of private land held in excess of 160 acres on the basis of the value without reference to the proposed construction of irrigation works. The intent of this provision was to eliminate speculation.

Columbia Basin Anti-Speculation Act

Further legislation to prevent speculation was enacted May 27, 1937.[13] This act, known as the "Columbia Basin Anti-Speculation Act," amended a provision of the original Reclamation Act providing that "no right to the use of water for land in private ownership shall be sold for a tract exceeding 160 acres to any one landowner," by reducing the acreage in connection with the settlement of land in the Columbia Basin project area in Washington to be irrigated by Grand Coulee Dam. Here a smaller acreage is considered sufficient for the support of a family. Further revision [14] of legislation which would limit holdings and affect the condition of sale of Columbia Basin land was under consideration in 1942.

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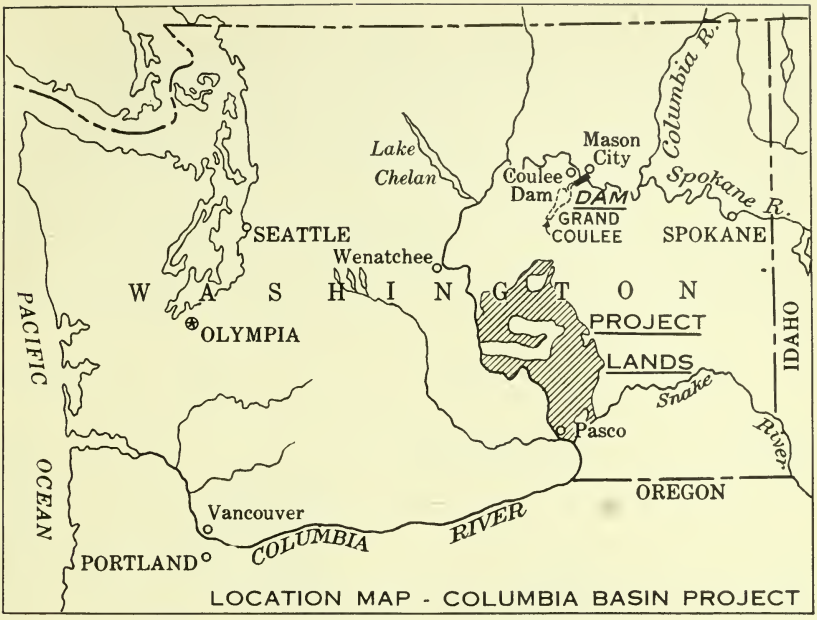
[11] 54 Stat. 402.

[12] Omnibus Adjustment Act (44 Stat. 636).

[13] 50 Stat. 208.

[14] H. R. 6522, 77th Cong., 2d sess., known as the Columbia Basin Project Bill, is designed to replace the Columbia Basin Anti-Speculation Act. Grown out of the Columbia Basin Joint Investigations, the bill authorizes the Government to buy privately owned land in the project area at values established through impartial Government appraisal; to dispose of this land to settlers in tracts platted with reference to soil quality and characteristics and of a size designed to support a farm family; to improve these farms by such means as drilling wells for domestic water and providing farm buildings and fences; to make loans to settlers and to aid in ways to provide opportunity for successful settlement and development of the Columbia Basin project.



Columbia Basin Investigations

In preparation for the day when water may be available for the irrigation of the first block of lands included in the 1,200,000 acres ultimately to be irrigated by Grand Coulee Dam in Washington, the Bureau of Reclamation in July 1939 launched an investigation of the Columbia Basin Reclamation project area. The object of the investigation called the "Joint Investigations," was to plan for the successful settlement and development of the project area which is expected to support a population of 350,000 to 400,000 persons on the farms and in cities and towns that will expand or be created by the irrigation activities. A plan for the joint investigations includes 28 separate problems in addition to the basic engineering surveys. Participating in the studies in some capacity and in varying degrees are more than 40 agencies of the Federal, State, and local governments, educational institutions, private industries, and local civic organizations. Subjects of study ranged from the number and proper location of new towns or cities within the area to suitable guides for ornamental and useful tree plantings on the individual farmsteads.

Nearly all of the land to be irrigated from the Grand Coulee Dam is owned by individuals, corporations, counties and the State of Washington. Prospective settlers on the project must buy their land from such owners, or from such agencies, if any, as may be provided to acquire lands for resale to settlers as development progresses. The small percentage of Government land on the project will be opened to homestead entry when water is available.

Projects under construction in 1941 were expected to provide homes for the support of an additional million persons by supplying water for 2,370,925 additional acres,[15] transforming them from sagebrush wastes into productive farms. Supplemental water or other service was expected to preserve or protect 5,164,600 acres already under irrigation systems.

These projects as planned in 1941 will provide water for the irrigation of public lands in six States. Announcement of openings on the projects indicated will be made from time to time by the Secretary of the Interior.

State	Project	Division	Public lands to be opened
Arizona	Gila (First unit)		101,010
California	All-American Canal		267,813
		East Mesa	177,938
		West Mesa	67,233
		Coachella Valley	9,724
		Pilot Knob Mesa	12,918
Idaho	Boise	Payette	4,674
Oregon	Klamath	Tule Lake	7,431
Washington	Yakima	Roza	4,200
Wyoming	Kendrick		1,503
	Riverton		50,037
	Shoshone	Heart Mountain	37,724

Civilian Conservation Corps

The Bureau of Reclamation has under its supervision CCC camps, engaged in activities on Reclamation projects. The first CCC camp on a Reclamation project was established in May 1934 on the North Platte project in the hills of eastern Wyoming. In 1941, 44 CCC camps were operating on 23 Reclamation projects in 14 States. The work program of these camps falls into three general types. The first engages in reconstruction and rehabilitation work on the canals and structures of the irrigation systems. The second involves the construction of small dams and the building of feeder canals to bring additional water to existing reservoirs. The third provides such facilities as can be used in recreational activities in the vicinity of the irrigation reservoirs. Enrollees have opportunities to learn pursuits which may provide them gainful employment later.

CCC enrollees have constructed Midview Dam on the Moon Lake project, Utah, Anita Dam on the Huntley project in southern Montana, and several masonry dams along the borders of the Rio Grande Valley to check hillside erosion and flash floods. They have built roads leading to reservoirs; they have landscaped parks and picnic grounds, built shelter houses and boat landings on reservoirs.

[15] See Appendix, table 3, p. 83.

Recent legislation authorizes the use of CCC camps and facilities on water conservation and utilization projects constructed under the provisions of the act. In November 1940, the Director of CCC approved an allotment of CCC camps, not to exceed 50 in number, for work on the water conservation and utilization projects in the Great Plains area and other regions. The enrollees were assigned to such work as the construction of earth dams, canals, water-control structures, improvement of natural waterways and related work.

Reclamation Handbook

Chapter 7

Financial Aspects, the Repayment Policy

Of the $250,000,000 expended to 1940 on the construction of Reclamation projects operating in the West, more than $65,000,000 had already been repaid—97½ percent of the amount due and payable despite the depression 1930's and their low prices for farm products. The expenditure for the construction and settlement of these projects is the equivalent of about $265 for each person who has been enabled to provide himself with a home and a decent livelihood.

Sources of Funds

The Reclamation Act of 1902 provided that the funds obtained from the sale of public lands in 16 arid Western States should be used by the Secretary of the Interior for the examination and survey for and construction and maintenance of Federal Reclamation projects. These receipts, together with payments made by settlers for the cost of the irrigation works, were to be deposited in the Treasury in a special fund known as the "Reclamation fund," to be reinvested in Reclamation projects in the West.

For the first 30 years of its existence Federal Reclamation was financed from the Reclamation fund with relatively small loans from the Federal Treasury. The act of June 25, 1910,[1] provided for a loan of $20,000,000 from the Treasury. An additional loan of $5,000,000 was granted in 1931.[2] Both loans have been repaid. Additional funds were made available by the Mineral Leasing Act of February 25, 1920.

In 1934 funds were allotted under the National Industrial Recovery Act of 1933 [3] which resulted in an expansion of the construction program of

[1] 35 Stat. 835.
[2] 46 Stat. 1507.
[3] 48 Stat. 195.

the Bureau of Reclamation. In subsequent years allocations for construction by the Bureau were made pursuant to various emergency appropriation acts providing for public works.

In 1938 the Hayden-O'Mahoney amendment to the Interior Department Appropriation Act of 1939 [4] covered into the Reclamation fund 52½ percent of royalties received by the Treasury from lands within naval oil reserves, between February 25, 1920, and June 20, 1938. Of the total sum involved, however, $15,000,000 was retained in the general Treasury to repay the unpaid balances of loans made to the Reclamation fund. Approximately $15,000,000 was paid into the fund. Over a period of 40 years it is expected that approximately $350,000,000 will be received into the Reclamation fund through the operation of the Hayden-O'Mahoney amendment.

In 1941 certain large projects such as Grand Coulee Dam and the Central Valley project which were initiated with emergency funds or under special acts were being completed with reimbursable funds advanced from the general Treasury. The Hayden-O'Mahoney amendment also provided that receipts from projects constructed with emergency allocations or general fund appropriations were to be paid into the Reclamation fund but the effect of these repayments has not been felt, nor was there expected to be received any substantial amount from this source for several years owing to the fact that the projects on which this money had been expended were not completed.

As a consequence, it was anticipated that by the close of the 1942 fiscal year the Reclamation fund would be so depleted that it would be unable to carry the construction of all the projects being financed from that fund. The Congress accordingly decided to finance from the general fund of the Treasury certain additional projects whose construction progress was being delayed by the limited amount of money in the Reclamation fund. Selected projects were shifted in the Interior Department Appropriation Act of 1942. This action will permit larger appropriations for projects financed from the Reclamation fund.

A special fund known as the Colorado River Dam fund was established under the Boulder Canyon Project Act of 1928 [5] for the construction of Boulder Dam and the All-American Canal. Appropriations up to $165,000,000 were to be made to this fund from the general Treasury. Construction costs of Boulder Dam were to be repaid at 4 percent interest, within 50 years, principally from power revenues, while the cost of constructing the All-American Canal is repayable under the Reclamation Act. The Boulder Canyon Project Adjustment Act of 1940 [6] provides for deferring repayment of a $25,000,000 flood control allocation in connection with Boulder Dam and places the interest rate at 3 percent during the repayment period of 50 years.

[4] 52 Stat. 291.
[5] 45 Stat. 883.
[6] 54 Stat. 774.

Construction Costs

On June 30, 1941, Bureau of Reclamation construction expenditures totaled $723,000,000. Included in this amount were the costs of the Boulder Canyon development (Boulder Dam and power plant and the All-American Canal system), Parker Dam, Marshall Ford Dam for flood control on the Colorado River project in Texas; and the Water Conservation and Utilization projects. Exclusive of these projects construction costs totaled $533,000,000. Construction financed by the Reclamation fund had cost $250,000,000; in addition, allotments from emergency funds totalling $121,000,000 had been made and $162,000,000 had been appropriated from the general Treasury. The allotments from the emergency funds for Reclamation projects are also reimbursable.

Repayment Periods

The original Reclamation Act of 1902 and its amendments provide that those who settle upon the reclaimed lands shall be required to repay in installments and without interest the money which has been expended in the construction of the works necessary to make water available to their lands. The waiving of interest, which has been continued in connection with strictly irrigation developments regardless of the source of funds, was a concession to national consideration—a recognition of national responsibility for aiding the development of the West in which the country at large holds such an extensive economic stake.

The original Reclamation Act of 1902 provided that the construction cost should be repaid in equal annual installments, not exceeding 10, beginning with the date specified in the public notice. The extension act of August 13, 1914,[7] lengthened the period of repayment to 20 years. The Fact Finders' Act of December 5, 1924,[8] provided for an indefinite period of repayment with the annual charge calculated on 5 percent of 10-year average crop returns. While this act was in force 10 contracts were executed providing for payment of construction charges on a crop-production basis. This provision was repealed by the Omnibus Adjustment Act of May 25, 1926,[9] substituting the 40-year repayment plan in force today.

The 40-Year Repayment Plan

Under the provisions of the act of May 25, 1926, the Secretary of the Interior was authorized to enter into a contract with irrigation districts providing for payment of the cost of constructing the project works within such term of years as he may find to be necessary, in any event not more than 40 years.

During the periods of economic stress, 1921–24 and 1931–36, Congress responded to appeals for relief by extending the time of repayment of

[7] 38 Stat. 686.
[8] 43 Stat. 672, 701.
[9] 44 Stat. 636.

construction charges or by authorizing such action when circumstances beyond the control of the settlers affected their ability to meet the annual charges. This relief was in the form of a postponement of repayments and not in the form of cancellations.

Charge-offs

Another phase of Reclamation finances relates to the abandonment of several small projects on which construction was begun in the early days and to charge-offs of construction costs, as authorized by the Congress. The Reclamation Act provided that funds accruing to the Reclamation fund from the sale of public lands should be expended in the States wherein these lands were sold. Owing largely to this provision several projects were constructed which later had to be written off. The provision was repealed because too great a restraint was placed on the selection of sound projects. In the early years of Federal Reclamation errors were also made in estimating water supplies that could be made available and the acreage that could be brought into production.

The Omnibus Adjustment Act of 1926 and other enactments provided for the charge-off of costs of abandoned projects and of construction outlays; also construction charges against land found to be temporarily unproductive were suspended. The total of $17,133,000 was thus written off the books. This represented about 10 percent of the construction cost of all Federal Reclamation projects at the time of the passage of the Adjustment Act of 1926.

The Reclamation Project Act of 1939 authorized the Secretary of the Interior, after consultation with the Secretary of War and the Chief of the Corps of Engineers, to allocate to navigation or flood control those parts of the cost of new projects as he may find proper. Such allocations are to be nonreimbursable.

Under the present system of determining the economic feasibility of proposed projects assurance that the settlers will be able to pay the cost of construction in 40 years must be determined prior to the construction of a project. Adequate funds for thorough investigations of proposed projects have been insisted upon by the Bureau of Reclamation as essential to initiating and developing Reclamation projects on a sound basis.

Chapter 8

Water Conservation and Utilization Program

Critical droughts in the Great Plains and irrigation water shortages in other established western agricultural areas with disruption of their economy and heavy Federal relief expenditures led to the Water Conservation and Utilization program.[1]

This program is designed to rehabilitate communities dependent on agriculture. It came into being largely as a result of the exodus of farm and other families from the Great Plains and their migration westward in search of irrigated land on which to make a fresh start in life. The effect of the droughts may be gauged by the 1940 census figures which show that 501 of 650 counties in the Great Plains had a net loss in population of 753,554 during 1930–39.[2] The migrations continued during 1940 and 1941, despite the slackened drought.

Impact of Migrations

That the impact of the migrations from the Great Plains was heavy in Western States was evidenced by the increased population in 277 out of 309 counties in the Mountain and Pacific States.[2] At least 150,000 families from the Great Plains were estimated to have moved into these areas in search of settlement or employment opportunities. They represented nearly a third of the increased population of 1,941,601 reported for the last decade by the Bureau of the Census in the Intermountain and Pacific Coast States.[2]

Although the Bureau of Reclamation construction program had been advanced as rapidly as funds would permit, irrigated land in the West fell far short of the demands of the migrants, many of whom were in destitute circumstances. The result was that they were compelled to

[1] Interior Department Appropriation Act, 1940 (53 Stat. 685).

[2] Preliminary reports, Bureau of the Census, 1940.

rely on seasonal agricultural employment or on relief, principally the latter.

The effects of the dislodgment of families from the Great Plains and their migration westward were reflected in Federal relief expenditures in the 17 arid and semiarid States. During the 8 years from 1933 to 1941, the Work Projects Administration and its predecessor agencies expended more than 2½ billion dollars of Federal funds. The amount was at least a quarter of a billion dollars in excess of the requirements of the normal population.

Problems incident to the drought were studied in 1936 by the Great Plains Committee appointed by President Roosevelt, and were followed by reports on specific conditions by the Northern Great Plains Committee to the President on October 14, 1938. From the recommendations of the latter committee there have come appropriations, legislative authorizations and executive instructions under which a water conservation program is being advanced. Initial steps have been taken toward remedying conditions that have threatened continued disruption of the economy of more than 100 agricultural communities with consequent drains on the Federal Treasury for relief.

Twelve Rehabilitation Projects

Twelve projects have been authorized.[3] They demonstrate what can be expected of this program. Through the use of limited reimbursable funds, appropriated direct from the Federal Treasury, supplemented by allotments of Work Projects Administration labor and Civilian Conservation Corps enrollees, projects of this type advance the conservation of human and physical resources. Highly desirable social and economic objectives are attained.

Following the inception of the program with an allocation of $5,000,000 in the Interior Department Appropriation Act of 1940,[4] legislative authorization was embodied in the Case-Wheeler Act of August 11, 1939,[5] amended by an act approved October 14, 1940.[6] A subsequent appropriation of $3,500,000 was made in the Interior Department Appropriation Act of 1941,[7] and of $5,000,000 in the Appropriation Act of 1942.[8]

Projects authorized under the program up to July 1941 are as follows: Colorado—Mancos, 10,000 acres (supplemental water); Idaho—Mann Creek, 4,300 acres; Montana—Buffalo Rapids No. 1, 3,000-acre extension of the Glendive Unit constructed with ERA funds, all of which is brought under the program for land preparation and resettlement; Buffalo Rapids No. 2, 11,600 acres; Saco Divide, 9,400 acres; Nebraska—Mirage

[3] See Appendix, table 5, p. 84.
[4] 53 Stat. 685.
[5] 53 Stat. 1418.
[6] 54 Stat. 1119.
[7] 54 Stat. 406.
[8] Public, 136, 77th Cong., 1st sess.

Flats, 12,000 acres; North Dakota—Buford-Trenton, 13,400 acres; Bismarck, 4,800 acres; South Dakota—Rapid Valley, 12,000 acres (supplemental water); Angostura, 16,210 acres; Utah—Newton, 2,225 acres (supplemental water); Wyoming—Eden, 20,000 acres (supplemental water).

The combined reimbursable cost of the 12 projects already authorized amounts to $9,181,000. The President under the authority of legislation has approved allotments of $11,455,000 of nonreimbursable amounts represented by WPA and CCC labor and small amounts for materials, supplies and equipment. These nonreimbursable expenditures are offset by the employment provided in the construction of the projects, of immense value in the reduction of relief costs and the social stabilization of the areas affected.

The over-all construction costs of the 12 projects total $20,636,000—an average over-all cost per acre of about $165, of which about $30 represents outlays by the Department of Agriculture.

Previous to the initiation of this program, the Glendive Unit of the Buffalo Rapids Project in Montana of 12,500 acres was constructed with funds allocated from the Emergency Relief Act of 1937. Extension of this project is provided for in the current program.

Land Preparation

For the first time since inauguration of the Federal Reclamation policy a Government irrigation program—this program—includes provision for rough levelling of land, construction of small farm ditches, and definite plans for land-use readjustments. This provision will enable settlers to become self-sustaining sooner than would be possible if they were compelled to settle on raw land without adequate facilities for preparation of the soil.

Construction of the irrigation facilities is the responsibility of the Bureau of Reclamation. Land preparation and settlement are the responsibility of the Department of Agriculture. Negotiations for the disposal of land in excess of economical-size units are also under the Department of Agriculture, which will also assume responsibility for the operation and for repayment contracts on most of the projects so far authorized. The Work Projects Administration and the Civilian Conservation Corps provide most of the labor. The National Resources Planning Board coordinates the program.

Projects with Special Authorization

In addition to projects under the water conservation and utilization program, construction was begun on certain other projects under special authorization. (See Appendix, table 4, p. 83.)

The Deschutes project in Oregon was authorized by the President November 1937 and construction was begun in 1938. The Civilian Conservation Corps is contributing approximately $2,000,000 worth of labor

and materials, which will be nonreimbursable. The remainder of the cost amounting to $6,500,000 will be repayable by the water users under the Reclamation law. This project will provide water for 50,000 acres of dry but inherently fertile lands immediately north of Madras on the east side of the Deschutes River in central Oregon.

The Tucumcari project in New Mexico was authorized for construction on April 9, 1938 [9] on the basis that only that part of the project cost which could be repaid feasibly by the water users should be charged to irrigation. The Congress also provided that construction was not to be undertaken until the balance of the cost had been made available from other sources such as Public Works Administration or Work Projects Administration.

The Altus project was authorized under the Rivers and Harbors Act of 1938.[10] The reimbursable cost has been placed at $3,080,000 with irrigation farmers and other agricultural water users repaying $2,000,000 in 40 years. With the city of Altus participating to the extent of $1,080,000 for its municipal supply, the remainder of the cost is to be divided between a flood-control allocation of $1,130,000 and a Work Projects Administration and Civilian Conservation Corps allotment amounting to $1,390,000.

[9] 52 Stat. 211.
[10] 52 Stat. 1215.

Reclamation Handbook

Chapter 9

Results of Federal Reclamation

When President Theodore Roosevelt signed the Reclamation Act on June 17, 1902, high hopes were held that important and lasting benefits would be derived from the conservation of the arid soils and the scant waters of the West. It was hoped that new opportunities to gain an American level of living could be made available to large numbers of people who might find homes on the reclaimed land; that the natural handicaps of these big western States could, in part, be overcome through the construction of soundly planned irrigation works with public funds on a self-sustaining basis; and that through building homes and communities the United States could be made a better and richer country.

A review of the achievements of the Federal Reclamation program in 1941 shows that the expectations of 1902 were fully justified. In fulfilling its mission the Bureau of Reclamation constructed irrigation projects in 17 arid and semiarid western States for the irrigation of more than 4,000,000 acres of land supporting nearly a million people. More than 150 dams and 80 reservoirs were built on the projects. (See Appendix, tables 8, 9, and, 10, pp. 87–90.)

Water for 4,000,000 Acres

The Bureau of Reclamation had placed irrigation works in operation serving 4,272,695 acres of land with a full or supplemental water supply. Of this total area 2,369,820 acres were previously unproductive desert and 1,902,875 acres formerly were served by inadequate non-Federal irrigation facilities. Actually irrigated were 3,374,178 acres, including 1,831,653 acres in regular projects, and 1,542,525 in projects being furnished a supplemental supply. Roads, canals, urban developments, and farm home tracts occupy much of the unirrigated but irrigable lands within the projects.

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First year farm home, Riverton project, Wyoming

On the projects wholly dependent on Federal works were 57,441 irrigated farms with a population of 214,781, while in the 279 cities and towns largely dependent on Federal Reclamation operations there was an additional population of 688,134, making the combined population of these towns and irrigated farms 902,915.

Within the area thus developed as the result of the construction of the Federal irrigation systems there had been established 963 schools and 1,208 churches. There were 111 banks serving the settlers of the project farms and towns.

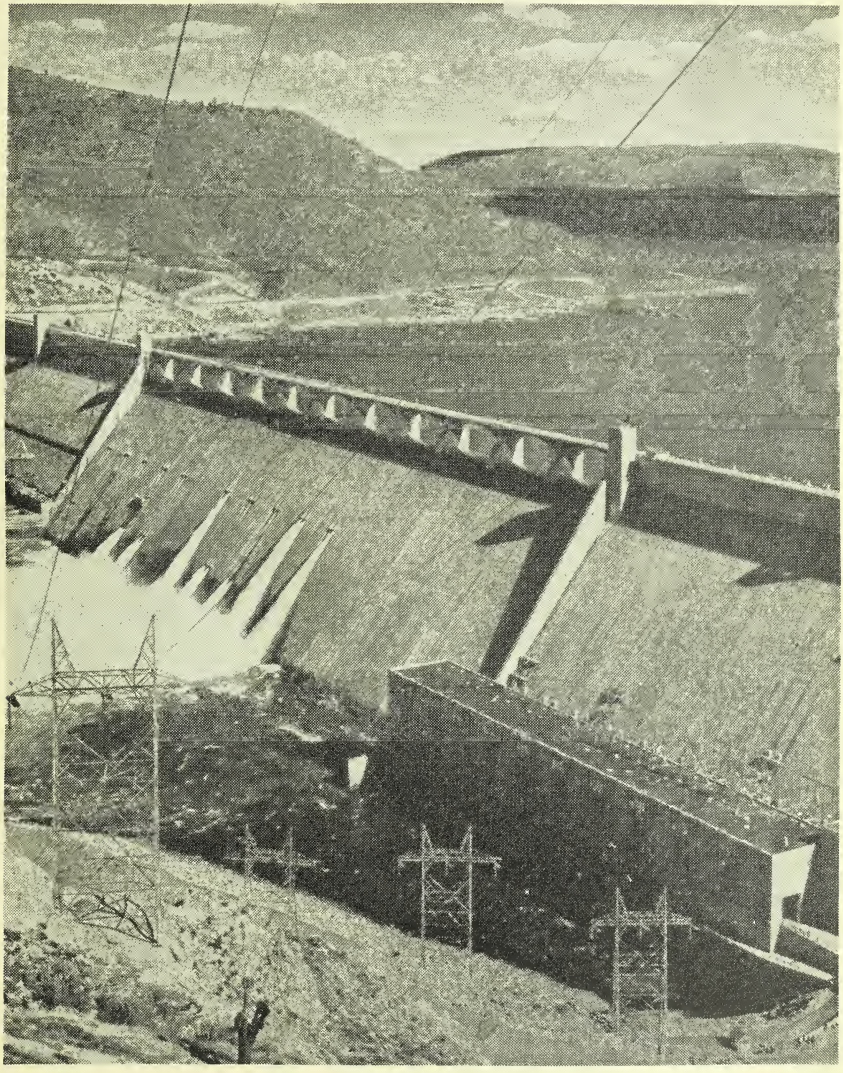
With the construction which was under way in 1941, the largest program in the Bureau's history, water could be provided for 2,370,925 additional acres of raw desert lands, transforming them from sagebrush wastes into productive farms to support another million people, and 5,164,674 additional acres would be served a supplemental supply.

Low-Cost Power

In connection with and incidental to the main purpose of creating homes by irrigating lands, Reclamation projects also serve through ap-

plication of broad conservation ideals to develop cheap hydroelectric power, control floods, improve navigation, provide domestic water supplies for urban areas, curtail pollution, and create recreational opportunities and wildlife refuges.

Power is the most important byproduct.



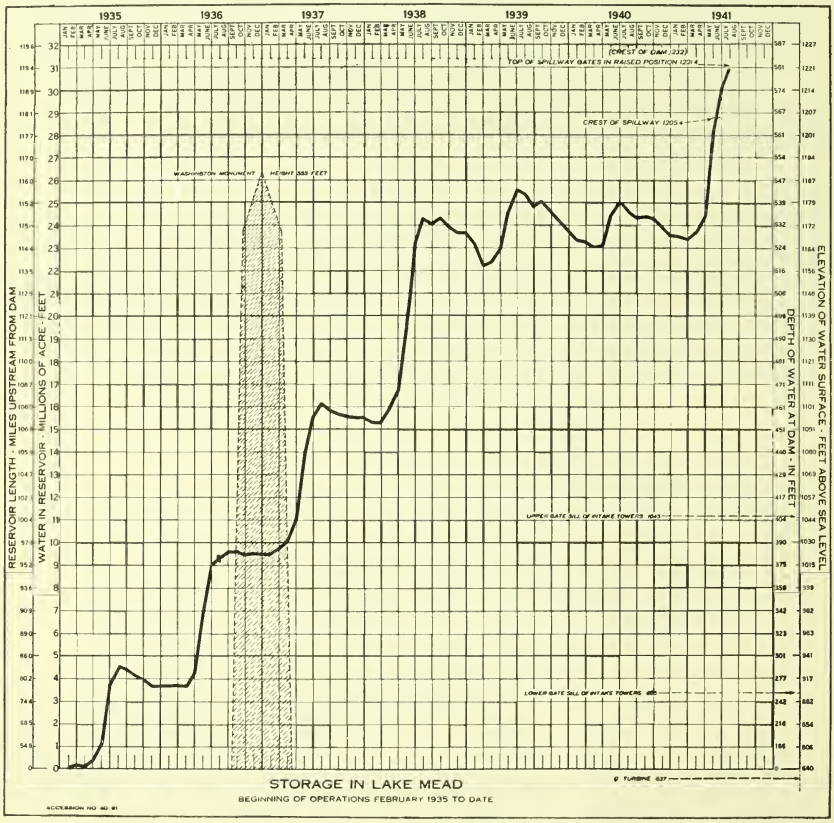
Grand Coulee dam and power plant, Washington—the most massive masonry dam and the largest hydroelectric plant in the world

The total output of plants on Reclamation projects during the fiscal year 1941 was 3,544,171,535 kilowatt-hours. The gross revenues from power amounted to $7,328,116.

In 1941 the Bureau of Reclamation had over 100 principal contracts for the sale of power generated on its projects. They were about equally divided between public agencies and privately owned utilities.

Power plants under construction or authorized in 1941, when completed, will bring the number of power plants on Bureau of Reclamation projects to 46 and their capacity to 4,701,175 kilowatts—equivalent to the entire western hydroelectric development in that year.

In addition to the use of power for irrigation and drainage pumping, and rural and urban consumption, power production assumed a major role in 1942, for war industry. Defense industries in the West used low-cost hydroelectric power for the manufacture of such important defense products as aircraft and ships, and the processing of aluminum, magnesium, and other important strategic materials.



Other Benefits

The dams and reservoirs which are constructed to conserve water for irrigation in many instances bring other benefits in addition to low-cost power. For example, they serve at the same time to regulate and to smooth out the peaks and valleys of the flow chart of a stream. Floods are curtailed and navigation improved.

Flood Control

Flood control for the protection of the lives and property of 100,000 people who live in the valleys below Boulder Dam is of major importance in connection with the Boulder Canyon project. Lake Mead, the 120-mile reservoir created by Boulder Dam, has a capacity of 32,359,274 acre-feet. The annual average run-off of the river at Boulder Dam exceeds 15,000,000 acre-feet of water, an acre-foot being sufficient to cover an acre 1 foot deep. Lake Mead, therefore, can impound the entire average flow of the river for more than 2 years.

The upper 72 feet, or 9,500,000 acre-feet of the capacity of Lake Mead, is reserved for its flood-control work. This capacity is not encroached upon for the storage of water except as required to control the discharge below the dam to an amount that can safely be carried through the lower valleys without expenditure of excessive amounts of money for protective work.

With Lake Mead functioning, the large floods passing the dam site are reduced from 200,000 cubic feet per second to 45,000 and the extreme floods from 300,000 cubic feet per second to about 75,000. With this control established, the homes and highly productive farms, representing property values of $250,000,000, in the Imperial, Coachella, Yuma, and Palo Verde Valleys can be protected from the damaging floods which previously threatened the area.

Improvement of Navigation

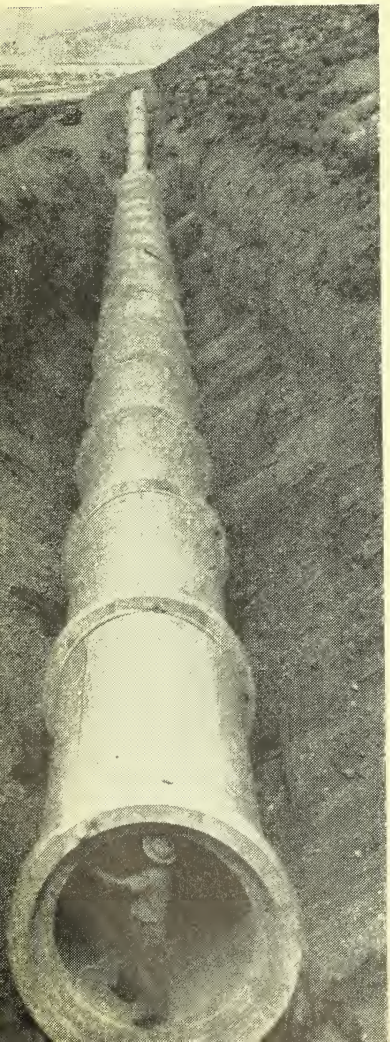
The Central Valley project in California contemplates the operation of Shasta reservoir, incidentally to its irrigation functions, not only to develop power and control floodwaters but also to improve navigation on the Sacramento River. Ocean-going craft navigated the Sacramento River in the gold-rush days, and boats then were regularly operated as far north as Red Bluff, 150 miles above the river mouth. But large-scale hydraulic mining, before it was restricted by the courts, virtually put an end to upstream navigation by choking river channels with silt. Year-round commercial navigation since then has been confined to lower sections of the river.

The control of the river by Shasta Reservoir will maintain a minimum river flow at Knights Landing of 5,000 second-feet, permitting restoration of navigation above the city of Sacramento in a channel at least 6 feet deep to Colusa, 5 feet deep to Chico Landing, and 4 feet deep to Red Bluff. California authorities estimate that an improved waterway in the Sacramento River, with dependable all-year navigation, will effect savings in transportation costs on commodities moving between the Sacramento Valley and the San Francisco Bay region, of $2,250,000 annually.

In addition to making possible the irrigation of 1,200,000 acres of land and the generation of huge blocks of hydroelectric power, Grand Coulee Dam will regulate the flow of the Columbia River for the benefit of

downstream power plants and navigation. The release of stored water from the reservoir behind the dam during periods of low flow not only will increase the minimum navigable channel depths by 2 feet below the Bonneville Dam and 4½ feet below the Grand Coulee Dam, with corresponding increases at intermediate points, but it will also double the amount of firm power that can be developed at the six power sites on the Columbia River between Grand Coulee Dam and the point where the Snake River joins the Columbia, and increase by 50 percent the firm power that can be generated at the various sites below this point, including Bonneville.

The reservoir formed by Marshall Ford Dam on the Colorado River in Texas is used jointly for flood control, power, and river regulation to augment the low water flow for irrigation purposes along the Colorado River below Austin. The Bureau of Reclamation has built a high dam, essential in the control of the Colorado River, a particularly dangerous stream, subject to quick floods of great height. With an average capacity of 3,120,000 acre-feet, 1,160,000 acre-feet will be reserved for flood control.



Municipal Water Supply

Parker Dam, 155 miles downstream from Boulder Dam on the Colorado River, provides a metropolitan water supply to 13 southern California coastal cities—Los Angeles, Burbank, Glendale, Pasadena, Anaheim, Beverly Hills, Compton, Fullerton, Long Beach, San Marino, Santa Ana, Santa Monica, and Torrence. In these 13 cities and their suburban and rural sections reside nearly 3,000,000 people. Property values were assessed at $2,800,000,000. This supply of water was required to sustain this area and to provide for its future growth.

The Contra Costa Canal, a feature of the complex Central Valley project, conveys fresh water 46 miles to serve an agricultural area on the south shore of Suisun Bay, many industrial plants in the upper San Francisco Bay region, and a number of municipalities. With 20 miles of the canal completed in August 1940, domestic water service was also started on a temporary basis to the city of Pittsburg, where brackish water intruding from San Francisco Bay had caused damage and inconvenience for years.

The Salt Lake Aqueduct, a unit of the Provo River project in Utah, will convey storage water

Left: Salt Lake City aqueduct, Provo project, Utah

from Deer Creek Reservoir, under construction in Provo Canyon, to Salt Lake Valley for supplemental irrigation, and industrial and domestic uses by the Metropolitan Water District of Salt Lake. The aqueduct will have a capacity of 150 cubic feet per second. In addition to Salt Lake City, the cities of Provo and Orem will receive a domestic and industrial water supply.

Boat race on Elephant Butte reservoir, Rio Grande project, New Mexico-Texas

Recreational Areas

A majority of the 80 reservoirs[1] operating on Reclamation projects offer recreational facilities to vacationists and sportsmen. An increasing number of local residents are taking advantage of these recreational opportunities and are constructing summer cottages along their shores. These pleasure resorts and playgrounds are being recognized as of increasing importance to the social life of the project settlers as well as to the general public.

Boulder Dam has created a new national playground, a recreational area that draws more than half a million visitors a year. Lake Mead is considered worth the travel of hundreds of miles to enjoy. The 120-mile lake stretches up through Boulder Canyon past Mount Wilson (6,000 feet elevation) through Virgin Canyon, Iceberg Canyon, and other rockwalled gorges with high coloring and spectacular geological formations. It reaches up into the Grand Canyon itself, opening up new unseen scenic beauty. The lake has 550 miles of shore line for camping, bathing, boating, and fishing. Although hot during the summer months the climate during the remainder of the year is ideal for outdoor enjoyment.

[1] See Appendix, table 10, p. 90.

The recreational area created by Boulder Dam is a day's drive by automobile from Salt Lake City, Phoenix, Los Angeles, and other cities in the Southwest. Precautions have been taken by the Bureau of Reclamation for the comfort and enjoyment of visitors. Roadways to the dam itself have been widened, protective safety walls built, and special guides provided. Motorboats are available for lake trips. A special visitor's building contains a large elaborate model of the project area, complete in every detail.

Elephant Butte Reservoir, created by Elephant Butte Dam on the Rio Grande project in New Mexico, is becoming one of the State's most popular recreational spots. As a drawing card for visitors, it is reported second only to Carlsbad Caverns. Thousands of New Mexicans and Texans from El Paso and other towns go there to fish, camp, swim, boat, and picnic along its 200 miles of wooded shore line. Once yearly the reservoir is the scene of a regatta attended by 5,000 to 6,000 spectators. Numbers of motorboat races, with hydroplanes, inboard and outboard motorboats are held.

Lake Walcott, a reservoir formed by the construction on the Snake River of the Minidoka Dam in Idaho, affords good fishing, boating, and bathing. Jackson Lake, also on the Minidoka project, is the largest of several beautiful bodies of water lying along the eastern slope of the Teton Mountains, south of Yellowstone National Park in Wyoming. The glacier-capped form of Mount Moran, rising from its shores, is reflected in the mirror-like surface of the lake. Around the shore are many inviting spots for camping. Boating and fishing are favorite sports.

Wild ducks on snow-covered lake, Boise project, Idaho

Waterfowl and Wildlife Refuges

Twenty-nine reservoirs [2] on Reclamation projects have been set aside by Executive order as wild waterfowl and wildlife refuges and are operated

[2] See Appendix, table 11, p. 91.

cooperatively by the Bureau of Reclamation and the Fish and Wildlife Service. They range in size from the 1,120-acre refuge at the Conconully Reservoir in Washington to the great 649,000-acre refuge around Boulder Dam in the Colorado River.

These refuges are of double value to wild waterfowl in the West because they are strung out along the migration ways and also because there are few natural bodies of water. Irrigation projects in the wide, arid West are about the only places where many wild birds can be found.

Havasu Lake, the reservoir created by Parker Dam, on the Colorado River 155 miles downstream from Boulder Dam, is an ideal wildbird refuge. Located on the main fly way, the shallow water of the lakeshore marshes is a haven for bird migrants.

Rainbow trout in troughs at Leavenworth hatchery, Columbia Basin project, Washington

Fish Propagation

Of the 163 dams built by the Bureau of Reclamation, many have been valuable aids to fish life. All the reservoirs in accessible localities have been stocked with fish and many of them are among the most popular fishing spots for many miles around.

A sweeping program for the conservation of migratory fish in the Columbia River was launched by the Bureau of Reclamation in connection with the Grand Coulee Dam project. Because the dam was so high that salmon bound upstream to spawn could not pass, the Bureau has carried out the greatest single fish-conservation scheme that has so far been undertaken. More than 35,000 big salmon and fighting steelhead trout were successfully trapped at Rock Island Dam in 1939 and trans-

planted for spawning to tributaries entering the Columbia River below Grand Coulee Dam. When the program is completed it is believed that these streams will furnish sufficient spawning areas and support the young of more salmon than migrated previously to the upper Columbia River above Grand Coulee Dam.

The newer reservoirs of the Bureau of Reclamation are all designed to retain carry-over dead storage so that they cannot be drawn down too low for fish life.

Through impounding floodwaters and releasing stored water to increase low flows of rivers and streams, many of the irrigation dams serve to ameliorate pollution or improve the quality of the water in the streams. Examples are found at Boulder Dam, where Lake Mead desilts the Colorado River, issuing the regulated stream clear and cold; and on the Central Valley project where regulation of the flow of the Sacramento and San Joaquin Rivers will provide a summer flow sufficient to flush out the channels of the delta area and to keep the salty ocean water backed up in San Francisco Bay.

These examples indicate briefly the scope of Bureau of Reclamation activities directly related to irrigation system and power plant construction. All bring benefits whose value to the country cannot be measured by a dollar yardstick. These activities add their benefits to those resulting directly from irrigation project construction.

Chapter 10

Widespread Benefits From Federal Reclamation

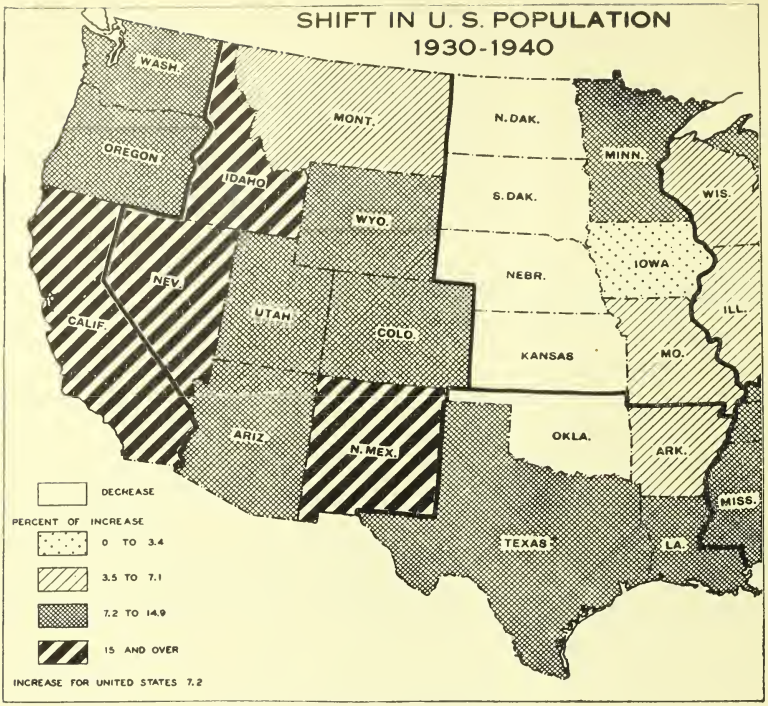
The benefits from Federal Reclamation projects are not confined to the counties or States in which projects are establishing permanent, self-sustaining communities and providing power and water for factories, farms, and homes.

Irrigated lands are helping to relieve the population pressure of migrants and other worthy citizens seeking homes in the West. Each project area continually affords a market for the industrial products of the Midwest, East, and the South, while at the same time it purchases quantities of foodstuffs grown and processed in other areas. Most Reclamation projects produce specialty crops, such as sugar beets, winter vegetables, and citrus fruits, which are not in competition with eastern produce. The widespread distribution of expenditures for construction is an important phase of the national benefits accruing from Reclamation development. Taxable wealth is being created by these irrigated lands which contributes greatly to the stabilization of local and state governments. Reclamation projects are paving the way for the Nation's continual expansion.

Increased Population in Irrigated Areas

While the increase in population for the United States as a whole in the decade covered by the 1940 census was 7.2 percent, the gain in the population of the 11 Mountain and Pacific States, generally considered the irrigation States, was 14.8 percent, twice the national average rate. Figures show that typical dry-farmed counties in the semiarid and arid regions lost in population during the 10-year period, while the irrigated areas continued their unbroken growth.

Scotts Bluff County, Nebr., which lies in the heart of the Great Plains, is a good example. In 1900 the county had 2,552 residents. It was at that time largely a county of dry farming and cattle raising. In it was



located the North Platte Federal Reclamation project, begun in 1905. By 1910 the population of Scotts Bluff County had increased to 8,355; by 1920 to 20,710; by 1930 to 28,644, and through the 10-year drought by 1940 to 33,875, a gain of about 13 times. The increase from 1930 to 1940 was 18.3 percent, as compared with a net loss for the whole State of Nebraska of 4.7 percent. In 1940 there were irrigated in Scotts Bluff County 190,000 acres. At least 80 percent of the population derives its income directly or indirectly from irrigated agriculture. The only industries are those engaged in processing farm products. The city of Scottsbluff, the largest municipality in the county, reflected the stability of the farming area. Its population increased 41.5 percent from 1930 to 1940.

If one compares the population records for irrigation counties, one with another, and then contrasts these figures with the records of the dry farm counties, the importance of irrigation in the development and the secure growth of these Western States becomes clear.

Markets Created

Among the national benefits which have followed the development of the Federal Reclamation program has been the market created and sustained for the products of nonwestern industrial and agricultural operations. When the Congress had under consideration 40 years ago the adoption of a national irrigation policy, substantial support for the move-

ment came from eastern and midwestern business and industrial interests which saw in the planned development of the West the opening and maintenance of new markets for the products of their factories.

While it may seem like carrying coals to Newcastle to suggest that newly established agricultural areas offer markets for the products of other farm sections, official records demonstate this has been a result of Federal Reclamation. None of the major crops of which the United States has an exportable surplus are produced in large quantities on irrigated land. Wheat and corn are planted to very few irrigated areas, cotton is produced on only a few projects to the southward, while tobacco is not grown on land served by irrigation works. Consequently, Reclamation projects, through increased purchasing power, have enlarged the market in the West for products of farms of the Midwest, South, and East.

President Theodore Roosevelt recognized the possibilities in this direction when he wrote the Congress in December 1901 that Reclamation "would enrich every section of our country just as the settlement of the Ohio and Mississippi Valleys brought prosperity to the Atlantic States." Thirty years later, President Herbert Hoover commented on results when he wrote western Governors that Reclamation projects "furnish extensive markets for manufactured goods as well as for farm products not grown under irrigation."

$200,000,000 of Purchases Yearly

Concrete evidence of the importance of the market that Reclamation project areas offer to nonwestern products is summarized as follows:

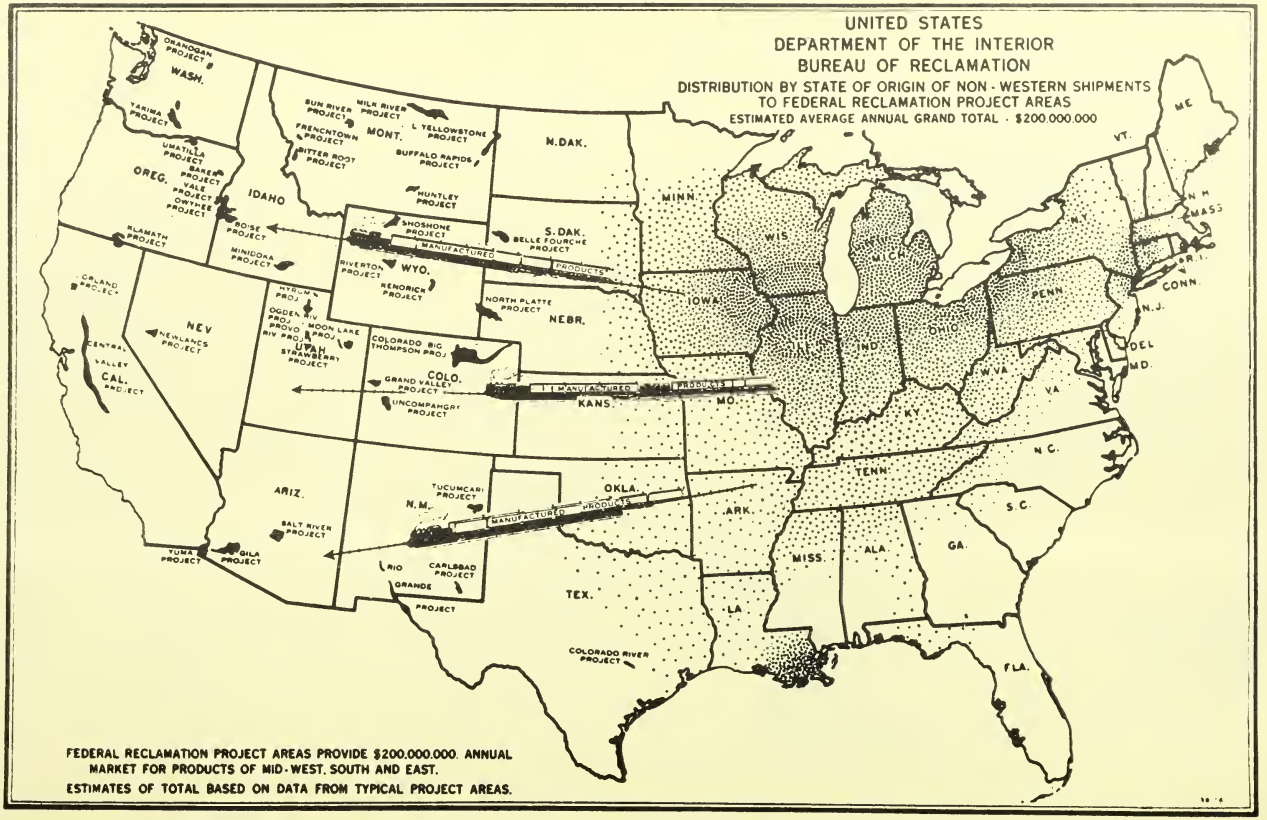
The annual value of the market for nonwestern products, manufactured and agricultural, created by the projects alone, averages from $200,000,000 to $250,000,000 annually.

With the completion of the current Reclamation program, which will nearly triple the purchasing power of areas served by these Federal works, the annual value of the market for nonwestern products in these will be increased to more than $600,000,000.

Of wholesale purchases of $35,125,000 annually in the Salt River Valley, Ariz., where nearly 300,000 acres are dependent on Reclamation irrigation, 80 percent was made up of commodities originating east of the Rocky Mountains.

Surveys of typical areas show that from 50 to 80 percent of incoming shipments is produced outside the Reclamation states. While the outgoing shipments of agricultural products from a typical general farm project area average in value from $400 to $500 a carload, the incoming nonwestern commodities of industrial and other commodities, including processed foods, range in value from $2,500 to $3,000 per carload.

In Yuma County, Ariz., where Reclamation developments provide practically all of the purchasing power, 80 percent of the wholesale purchases covered commodities produced in nonwestern States.


UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
DISTRIBUTION BY STATE OF ORIGIN OF NON-WESTERN SHIPMENTS
TO FEDERAL RECLAMATION PROJECT AREAS
ESTIMATED AVERAGE ANNUAL GRAND TOTAL - $200,000,000
WASH.
OREG.
CALIF.
NEV.
IDAHO
MONT.
WYO.
N.DAK.
S.DAK.
NEBR.
COLO.
UTAH
ARIZ.
N.M.
KANS.
OKLA.
TEX.
MINN.
IOWA
MO.
ARK.
LA.
WIS.
ILL.
MICH.
IND.
OHIO
KY.
TENN.
MISS.
ALA.
GA.
FLA.
S.C.
N.C.
VA.
W.VA.
PENN.
N.Y.
MD.
DEL.
N.J.
CONN.
R.I.
MASS.
VT.
N.H.
ME.
MANUFACTURED PRODUCTS
FEDERAL RECLAMATION PROJECT AREAS PROVIDE $200,000,000. ANNUAL MARKET FOR PRODUCTS OF MID-WEST, SOUTH AND EAST.
ESTIMATES OF TOTAL BASED ON DATA FROM TYPICAL PROJECT AREAS.

A survey of purchases of typical farmers of the Boise and other Idaho projects shows that 75 percent of their average annual income is expended for the purchase of manufactured articles and products of Eastern industries.

Boise agricultural products shipped eastward in 1939 had a total value of about $2,000,000, compared with an estimated value of incoming shipments originating east of the Rocky Mountains of approximately $13,000,000. In estimating the value of incoming shipments, due consideration is given midwestern and eastern products shipped to California and other western centers for fabrication or reshipment. Practically every State in the Union found a market for its industrial and agricultural products in the Boise area.

The Western Market

Estimates based on purchasing power show that the 11 Mountain and Pacific States as a whole offer a market for nonwestern manufactured and agricultural products worth from 1½ to 2 billion dollars annually. This amount approximated the average value of the Nation's total exports to all foreign countries from 1931 to 1935. A review of foreign trade statistics shows that the western market as a whole has had more value to American manufacturers and farmers than has the country's normal exports to any country or group of countries since 1930.

As the purchasing power of the West is largely dependent on the stabilizing effect of irrigation, the importance of Federal Reclamation developments as a contributing factor has long been recognized.

A few outstanding examples of the market the West affords may be cited:

Comparison of the production of corn and hogs with consumption requirements shows that the Mountain and Pacific States require twice the volume of corn and three times the amount of hogs produced in the area. Thus it has been estimated on the basis of averages for a recent 10-year period that these far Western States offer a market for corn, live hogs and pork products worth more than $100,000,000 annually to the farms and meat processors of the Midwest.

Conservative estimates are that these 11 States purchase flour and processed cereals worth nearly $15,000,000 annually. Although they produce more wheat than their population requires, the consumption of flour and processed cereals is greater than is manufactured in the area.

With less than 4 percent of the cotton produced in the United States grown on irrigated land, the West has a heavy deficiency in this commodity. After deducting the value of the comparatively small amount of cotton produced in the area, the West's annual expenditures for cotton, its byproducts and textiles average from $95,000,000 to $100,000,000 annually. Of the expenditures for cotton required in the West, from $20,000,000 to $25,000,000 annually went directly to the planters of the South and the remainder to the textile mills in that area and in the East.

As tobacco is not grown on irrigated land or anywhere in the West, the area offers an annual market worth about $82,000,000 to the planters and farmers of the South and other sections of the country. In addition to manufactured tobacco, the States buy large quantities of spray materials produced from tobacco.

Crop Production

When the Congress over 40 years ago had under consideration a national irrigation policy, President Theodore Roosevelt asserted that wider home markets would consume larger food supplies and "thus effectually prevent competition with eastern agriculture." Nearly half a century of experience has shown he was right. Irrigation farming carries no threat for the farmers of other sections of the country.

From 1900 to 1940, the population of the Mountain and Pacific States increased 195 percent compared with a gain for the country at large of 70 percent. At the same time agricultural production, even with irrigation developments expanding, has not kept pace with the increasing population.

Irrigation farmers have found it uneconomical to use their land and water for the commercial production of wheat and corn—two major crops of which the country has had exportable surpluses which have proved burdensome to the farmers of other sections. Only a few projects, to the southward, produce cotton—a third crop in this category. Part of this cotton production consists of the long staple variety imported from abroad by industry for its high tensile strength in rubber tires, machine belts, etc. Tobacco, the fourth crop in this classification, is not produced on irrigated land.

The acreage on Federal Reclamation projects planted to corn, wheat, and cotton in 1939 was less than one-fourth of 1 percent of the Nation's total area in these crops. In value the amount returned to Reclamation farmers was less than 1 percent of the total received by the farmers of the country at large for these crops.

An analysis of crop production records of Federal Reclamation projects, which to a large extent are typical of all irrigation developments, shows that two types of crops dominate on irrigated land. First from the standpoint of acreage are pasture, hay, and forage crops, which provide about half of the feed for the livestock industry of the West. From the standpoint of returns to the farmers are sugar beets, vegetables, and fruits, none of which is generally competitive with the products of other sections of the country.

Great areas of the western ranges could not be used for grazing sheep and cattle were it not for the irrigated areas which produce hay for winter feeding. Irrigated agriculture complements the farm operations of the humid regions to the eastward through its contribution to the livestock industry by providing feeds for the stock pens of the grain producing humid regions and in other ways.

Irrigation farmers on Reclamation projects produce more than $100,000,000 worth of food and forage crops annually, not including livestock and dairy products, poultry and eggs, and miscellaneous products such as honey, which if included in the annual total would raise the figure a very substantial amount.

The cumulative value of food and forage crops alone produced on Reclamation projects and contributed to the Nation's economic wealth during the past 3 dozen years has reached $2,750,000,000.

In war time, in addition to necessary food itself, and long staple cotton which is difficult to import on submarine infested sea lanes, Reclamation project land grows other essential crops, such as sugar. In 1941 the projects produced enough sugar beets for an army of 10,000,000 men, at three-fourths of a pound a week per man. Expanded acreage could double the amount.

Rubber can be supplied by Reclamation project land in the Southwest. Guayule, native to that region, thrives under irrigation.

Winter vegetables, peculiarly a product of irrigated areas, are marketed eastward when the produce of farms near the great consuming centers is not in season. The distance from irrigated land to the big cities of the Midwest and East serves as a virtual tariff barrier that bars competition when the truck farmers nearby are able to fill the demand.

Seasonal considerations control the marketing of practically every fruit produced on irrigated land that is shipped eastward. When local production is available to eastern markets, the irrigated crop is canned. California and Arizona citrus fruits have a world-wide reputation and are not classed as competitive with products of other sections.

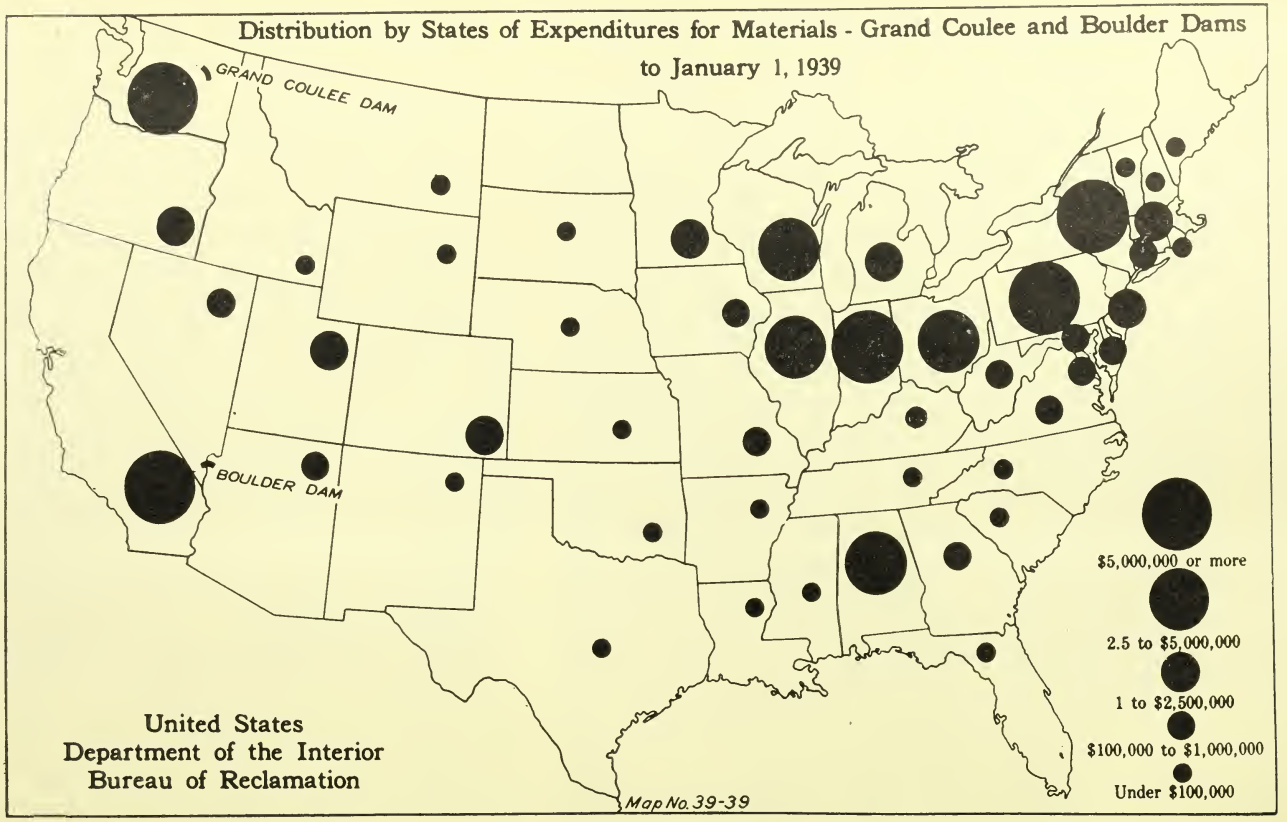
Reclamation Expenditures

More than $700,000,000 had been expended to June 30, 1941, by the Federal Government for 75 projects or divisions of projects, which either had been completed or were under construction at that time.[1] The benefits from construction expenditures on these projects are widespread, and not confined to the State or immediate area in which the particular project is located. Nearly every State in the Union has shared in the expenditures for materials and for labor on and off the site of construction.

The map on the following page showing the dollar distribution for materials on Grand Coulee and Boulder Dams, serves as an illustration. Purchases were made in 46 States and the District of Columbia.

Speaking at Grand Coulee, Wash., on October 3, 1937, President Franklin D. Roosevelt said that while Grand Coulee Dam was looked upon as something "benefiting this part of the country primarily * * * we must remember one-half of the total cost of this dam is paid to the

[1] See Appendix, tables 2, 3, and 4, p. 81–83. Also see Addenda, Chart BB, investment in Federal and non-Federal irrigation.


Distribution by States of Expenditures for Materials - Grand Coulee and Boulder Dams
to January 1, 1939
GRAND COULEE DAM
BOULDER DAM
$5,000,000 or more
2.5 to $5,000,000
1 to $2,500,000
$100,000 to $1,000,000
Under $100,000
United States
Department of the Interior
Bureau of Reclamation
Map No. 39-39

factories east of the Mississippi River * * *. So in every correct sense it is a national undertaking and doing a national good."

Analyses of reports of the National Industrial Conference Board, the United States Department of Labor, and the California State Chamber of Commerce, show 45.5 percent of the expenditures on the Central Valley undertaking go to States other than California. Like the distribution at Boulder Dam and Grand Coulee, a substantial part of the outlay finds its way to the industrial States of the Midwest, the East, and the South. Twenty-nine percent of the expenditures for direct labor on the job in the construction of the Central Valley project will go to the markets of other States for food supplies and other necessities of life.

An analysis of the distribution of construction expenditures on Public Works projects shows that for every person employed on the site of a construction job, two or more are given employment in the production of raw materials, in the fabrication of goods, or in the transportation of these materials.[2]

Creation of Taxable Wealth

The stabilization of local and State governments in the West through the creation of taxable wealth is a further indication of the importance of the Federal Reclamation developments.

Projects in operation have created actual values in farm lands and improvements of half a billion dollars. Assessed values on which taxes are paid for the support of public services are from 30 to 50 percent of the actual values.

Cities and towns which have grown in the wake of projects or expanded with their development have property values equal to those of the farm lands on many projects.

Including the metropolitan area of Southern California that is being served with power and domestic water through the Boulder Canyon project, developments under the Bureau of Reclamation have created and are protecting taxable values in excess of four and one-half billion dollars. Projects under construction will add a billion dollars or more in farm land values to this total, while values in cities and towns will be increased proportionately.

Irrigated land has an assessed valuation in most western states 10 to 15 times the value of adjoining dry land. In eastern Wyoming Federal project land is assessed at $30 an acre while unirrigated areas nearby pay taxes on a valuation of $2.35 an acre.

In South Dakota, the valuation of irrigated land for purposes of taxation is $30 an acre and the best dry land in the vicinity of a Federal project in that state is assessed at $4.50 an acre. The average is much less.

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[2] "P. W. A. and Industry," Bureau of Labor Statistics, Department of Labor, Bulletin 468.

The assessed values of Reclamation project land where specialty crops are grown average as high as $200 or $300 an acre, while the actual worth is $500 to $1,000 an acre.

Values, assessed and actual, of land within projects or served with supplemental water by project works reflect only a part of the tangible results arising in localities in the West from Reclamation developments. It has been estimated that each irrigated acre supports in the immediate vicinity three to four acres of dry farm land, while from 20 to 30 acres of range land are dependent for winter feed on each irrigated acre in alfalfa or other forage crops.

The great bulk of the values directly traceable to the irrigation developments in the Reclamation program have followed contribution to the national wealth of more than 2½ billion dollars in crop values in a little more than 30 years. In these States of vast areas the social value of such development is incalculable. Local and State government and institutions are bolstered. Educational, welfare, and public improvement programs are made possible on a scale which otherwise could not be approached. The resultant higher standards of citizenship are of national significance.

The internal improvement of these great arid and semiarid States by irrigation has other national phases. The irrigation projects have made possible the construction and maintenance of networks of coast-to-coast communication systems. Railroads, highways, telephone, and telegraph lines use these widely separated irrigation projects as piers for bridging the desert.

It has been estimated that irrigation of 1,200,000 acres in the Columbia Basin, Wash., will increase the franchise value of railroads operating in the area by $33,000,000.

Two out of every three dollars of new wealth created in the West and used for insurance goes east of the Mississippi River.

For the year ending December 31, 1936, which may well represent an average year, the net premium income reported to the commissioner of insurance for all companies doing business in Washington was $65,682,215.[3] Of this total, the net income of Washington companies was $7,242,208; and other companies west of the Mississippi River, $9,276,330; and of companies east of the Mississippi, $49,163,676. If the insurance transactions of the other ten states of the Mountain and Pacific groups should be apportioned on the same basis, companies east of the Mississippi River would have an annual net premium income from this section of $373,643,937. The net losses paid in Washington for the same year totalled $22,327,275, of which $16,775,036 was paid by eastern companies.

Reclamation Paves Way for Expansion

The 20,000,000 acres of land irrigated by all types of irrigation enterprises represent about 3 percent of the land in the arid and semiarid

[3] Congressional Record, 75th Cong. 3d sess., p. 3369.

States of the West. When projects under construction are completed there will be left approximately 20,000,000 acres which might be irrigated with water resources as yet undeveloped and under policies now in effect. That would make a total of more than 40,000,000 acres irrigated, by present standards of economic feasibility, out of 700,000,000 acres of land, or about 6 percent of the total.

This limited acreage emphasizes the need for carefully planned irrigation developments to conserve the water, choosing prudently from among the lands, and making these resources serve best the future needs of a growing Nation. A future which holds the possibility through conservation of developing more than 20,000,000 acres of irrigated land is promising. The West now supports nearly 14,000,000 people with 20,000,000 acres irrigated. There is no reason to believe that its population could not be doubled comfortably through the irrigation of 20,000,000 more. Here then, is the elbow room of America, a place for expansion, for creating new opportunities for American citizens, and new markets for American goods.

APPENDIX

Table 1.—RECLAMATION PROJECTS AND DIVISIONS, 1941

State	Operated by bureau	Operated by water users	Under construction	Authorized for construction
Arizona	Yuma	Salt River	Gila	
Arizona-California	All-American Canal [1]			
Arizona-Nevada	Boulder Canyon [1]			Davis (Bullshead).
California	Orland		Central Valley	Kings River.
California-Arizona			Parker Dam Power	
Colorado	Grand Valley	Uncompahgre [1]	San Luis Valley	
	Pine River [1]	Orchard Mesa	Colorado-Big Thompson.	
		Fruit Growers	Paonia	Mancos.
Idaho		Boise [2]	Boise-Payette	
		Minidoka [1]	Anderson Ranch	Mann Creek
		Minidoka-Gooding		
		Upper Snake Storage.[3]		
Montana	Milk River	Bitter Root		Saco Divide.
	Buffalo Rapids No. 1.[1]	Frenchtown	Buffalo Rapids No. 2.	Fort Peck Power.
		Huntley		
		Sun River [1]		
Montana-North Dakota		Lower Yellowstone		
Nebraska			Mirage Flats	
Nebraska-Wyoming		North Platte		
Nevada		Newlands		
		Humboldt [2 3]		
Nevada-California		Truckee Storage		
New Mexico	Carlsbad		Tucumcari	
New Mexico-Texas	Rio Grande [1]			
North Dakota			Buford-Trenton	Bismarck.
Oklahoma			Altus	
Oregon	Vale	Umatilla	Deschutes	
		Baker [3]		
		Burnt River [3]		
		Westland [2 3]		
		Stanfield [2 3]		
Oregon-California	Klamath [1]		Klamath-Modoc	
Oregon-Idaho	Owyhee			
South Dakota	Belle Fourche		Rapid Valley	Angostura.
Texas			Colorado River	Valley Gravity and Storage.
Utah		Strawberry Valley	Provo River	
		Sanpete	Newton	
		Moon Lake		
		Odgen River [1]		
		Weber River [3]		
		Hyrum		
Washington	Yakima	Yakima-Kittitas [2]	Columbia Basin	
	Sunnyside	Okanogan	Yakima-Roza	
	Tieton			
Wyoming	Shoshone	Shoshone-Garland [2]	Shoshone-Heart Mountain.	Eden.
	Willwood	Frannie		
	Riverton [1]			
	Kendrick [1]			
	21	32	22	9

[1] Additional construction in progress.
[2] Operated by water users. Bureau retains control of storage reservoir
[3] Supplemental storage.

Table 2.—RECLAMATION PROJECTS IN OPERATION, 1941

State	Project	Construction cost to June 30, 1941	Estimated completed cost	Full supply of water			Supplemental supply	
				Irrigable acreage [1] 1940	Irrigated acreage 1940	Estimated ultimate irrigable acreage	Maximum irrigable acreage [1]	Irrigated acreage 1940
Arizona	Salt River [2]	20,227,628	29,227,628	243,125	214,025	243,125	90,543	62,967
Arizona-California	Yuma [2]	10,275,467	10,275,467	68,030	52,960	68,030		
California	Orland	2,448,670	2,483,670	20,574	15,335	20,643		
Colorado	Fruitgrowers	199,058	213,000				2,540	[4] 2,083
	Grand Valley [2]	5,020,690	5,320,691	50,520	27,554	50,520	8,400	[4] 8,349
	Pine River	3,200,375	3,300,000			31,400	37,680	26,273
	Uncompahgre	8,880,349	8,968,000	91,633	60,982	110,245	3,895	3,278
Idaho	Boise [2]	16,931,283	16,931,283	203,274	161,002	176,029	128,032	113,500
	Minidoka [2]	19,745,470	20,437,000	203,110	172,804	220,652	745,632	657,365
	Upper Snake	2,773,712	3,795,000				93,682	76,852
Montana	Bitter Root	947,641	947,641	16,426	15,995	22,113		
	Buffalo Rapids [5]	1,761,695	1,957,500	12,500	2,726	12,500		
	Frenchtown	272,484	295,000	4,878	2,094	4,878		
	Huntley	1,559,590	1,559,590	29,591	23,457	32,508		
	Milk River	8,658,858	8,674,000	125,633	60,920	147,061		
	Sun River	9,344,747	10,207,249	99,380	63,149	99,380		
Montana-North Dakota	Lower Yellowstone	3,685,433	3,685,433	57,200	46,178	57,200		
Nebraska-Wyoming	North Platte [2]	19,546,138	19,546,138	236,447	189,753	236,447	124,080	104,108
Nevada	Humboldt	1,283,037	1,310,000				31,138	11,695
	Newlands [2]	7,947,282	7,947,282	66,898	48,358	87,500		
	Truckee Storage	1,078,446	1,100,003				[4] 41,200	[4] 11,874
New Mexico	Carlsbad	3,880,684	3,964,650	25,055	20,218	25,055		
New Mexico-Texas	Rio Grande [2]	19,810,912	20,000,000	159,294	142,829	174,956	17,584	13,629
Oregon	Baker	281,591	281,591				[4] 25,000	7,250
	Burnt River	601,025	601,025				[3] 17,016	[4] 17,016
	Deschutes [6]	1,292,569	8,400,000		(7)	50,000	46,934	35,179
	Stanfield	97,830	97,830				5,193	4,740
	Umatilla	5,138,949	5,138,949	18,531	11,796	18,531	1,109	824
	Westland	(8)					[3] 9,044	[4] 5,407
	Vale	4,828,059	4,855,822	30,000	24,340	30,000		
Oregon-California	Klamath	6,841,251	7,159,300	66,650	56,406	74,081	66,969	42,022
Oregon-Idaho	Owyhee	17,941,049	18,150,000	100,945	79,922	100,945	13,960	11,700
South Dakota	Belle Fourche	4,631,146	4,631,146	72,746	38,649	79,593		
Utah	Hyrum	924,164	940,000				8,329	5,769
	Moon Lake	1,587,971	1,600,000				65,591	51,569
	Odgen River	4,223,227	4,440,000				18,581	11,891
	Salt Lake Basin (Weber River)	2,725,885	2,725,885				89,412	86,912
	Sanpete	374,498	374,498				12,478	10,275
	Strawberry Valley [2]	3,507,423	3,507,423	41,663	37,548	41,663	10,129	9,658
Washington	Okanogan	1,452,129	1,452,129	5,335	3,174	5,356		
	Yakima [2]	26,346,976	26,346,976	205,140	165,456	205,140	188,377	149,993
Wyoming	Kendrick [2] [9]	17,687,348	20,000,000			75,157		
	Riverton [2]	6,096,035	9,466,000	42,500	34,700	100,000	347	347
	Shoshone [2]	10,111,334	10,539,466	73,242	59,323	73,686		
Total		286,170,108	[10] 312,854,265	2,369,820	1,831,653	2,673,027	1,902,875	1,542,525

Acres irrigated by full supply, 1940	1,831,653
Acres furnished supplemental supply, 1940	1,542,525
Grand total	3,374,178
Irrigable acreage, full supply, 1940	2,369,820
Irrigable acreage, supplemental supply, 1940	1,902,875
Grand total	4,272,695
Ultimate irrigable acreage, full supply	2,674,027
Ultimate irrigable acreage, supplemental supply	1,902,875
Grand total	4,576,902

[1] Land for which Bureau was or will be prepared to supply water.
[2] Power facilities installed by United States included in costs and power revenues will pay a substantial part of the costs of each project.
[3] Includes Orchard Mesa District costs and acreage.
[4] Estimates from 1939 information.
[5] Original project authorized in 1937 under Emergency Relief Act, with $500,000 of costs reimbursable.
[6] Under construction; Civilian Conservation Corps contribution of $2,000,000 nonreimbursable.
[7] No new land irrigated.
[8] Included with Umatilla costs.
[9] In operation for power only which will repay about 80 percent of costs.
[10] Construction costs totalling $15,784,956 have been charged off by acts of Congress. Other nonreimbursable items and net power revenues reduce materially costs repayable by water users.

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Table 3.—RECLAMATION PROJECTS UNDER CONSTRUCTION, 1941

[No lands irrigated by project works in 1940]

State and project	Construction cost to June 30, 1941	Estimated completed cost	Irrigable acreage on completion	
			Full supply (acres)	Supplemental [1] (acres)
Arizona:				
Gila	$5,143,881	$20,500,000	139,000	11,000
California:				
All-American Canal [2]	30,704,161	65,000,000	536,525	525,000
Central Valley [2]	70,726,381	264,990,000	175,000	2,000,000
Klamath (Modoc)		884,000	31,000	
Kings River [3]		52,944,000		800,000
Colorado:				
Colorado-Big Thompson [2]	7,383,673	54,918,000		615,000
Paonia [3]	34,937	1,203,000		8,674
San Luis Valley	51,292	17,887,000		400,000
Idaho:				
Boise-Payette	3,891,451	8,888,000	51,400	
Boise-Arrowrock [2] (Anderson Ranch)		13,040,000		160,000
New Mexico:				
Tucumcari [4]	2,927,034	8,155,000	45,000	
Oklahoma:				
Altus [5]	348,266	5,600,000	70,000	
Texas:				
Valley Gravity & Storage [6]		65,200,000		550,000
Utah:				
Provo River [4]	6,235,269	16,202,000	10,000	95,000
Washington:				
Grand Coulee [2]	136,925,344	436,344,000	1,200,000	
Yakima-Roza [2]	8,316,021	18,085,000	72,000	
Wyoming:				
Shoshone-Heart Mountain	4,011,673	6,500,000	41,000	
Total	276,699,383	1,056,340,000	2,370,925	5,164,674

[1] Lands for which Bureau will be prepared to supply water or benefit otherwise.
[2] Includes power developments which in some instances will pay 50 to 75 percent of the costs.
[3] Authorized for construction.
[4] Includes cost of municipal water supplies.
[5] Includes flood control, W. P. A., or other nonreimbursable costs.
[6] Authorized for construction for river regulation, flood control, irrigation, and power.

Table 4.—RECLAMATION PROJECTS, SPECIAL TYPE [1]

[In operation and under construction, 1941]

State and project	Construction cost to June 30, 1941	Estimated completed cost	Purpose
Arizona-Nevada:			
Boulder Dam [2]	$125,874,421	$148,000,000	Flood control, power, navigation, irrigation, municipal water supply.
Davis Dam [3]		41,200,000	Power.
Arizona-California:			
Parker Dam Power Project [4]	5,503,000	15,032,992	Power system only.
Montana:			
Fort Peck Power [5]		6,839,000	Transmission lines to distribute Fort Peck power for irrigation pumping and commercial purposes.
Texas:			
Colorado River—(Marshall Ford Dam) [6]	21,924,888	24,991,000	Flood control, power, and downstream irrigation.
	153,302,309	236,062,992	

[1] Projects where none of the costs will be repaid directly by irrigation.
[2] Boulder Dam is key structure in development of Colorado River in Pacific Southwest, with power paying practically all of costs. It provides storage of irrigation water for from 1,500,000 to 2,000,000 acres. Power operations began in 1936.
[3] Davis Dam will serve to reregulate the Colorado River below Boulder Dam. A power plant will have a capacity of 225,000 kilowatts.
[4] Parker Dam constructed by Bureau of Reclamation with funds advanced by Metropolitan Water District of Southern California as part of system to supply Los Angeles and 12 other cities with municipal water United States is developing power. Costs represent Federal funds only. Power operations begin September 1942.
[5] Construction authorized to serve areas in Montana and North Dakota.
[6] Marshall Ford Dam is operated by Lower Colorado River Authority of Texas, a State agency, under contract with United States. The Authority also installs power facilities. Power operations began in 1941.

Table 5.—WATER CONSERVATION AND UTILIZATION PROJECTS

[Approved under Water-Conservation and Utilization Program [1]—No lands irrigated by project works in 1940]

State	Project	Acreage	Construction cost to June 30, 1941	General fund (reimbursable) costs [2]	Contributed [8] (W. P. A.-C. C. C.) costs	Grand total costs
Under $5,000,000—appropriation 1940						
Montana	Buffalo Rapids No. 1 [3]	3,000	$1,761,695.56	$330,000	$230,000	$560,000
Montana	Buffalo Rapids No. 2	11,600	281,248.22	740,000	1,100,000	1,840,000
North Dakota	Buford-Trenton	13,400	371,837.67	630,000	870,000	1,500,000
Wyoming	Eden [4]	20,000	13,378.21	1,200,000	1,245,000	2,445,000
Nebraska	Mirage Flats	12,000	304,530.10	985,000	1,575,000	2,560,000
North Dakota	Bismarck	4,800		250,000	340,000	590,000
Montana	Saco Divide	9,400		585,000	490,000	1,075,000
Totals		74,200	2,732,689.76	4,720,000	5,850,000	10,570,000
Under Water Conservation and Utilization Act of 1940 [5]						
South Dakota	Rapid Valley [4 6]	12,000	69,920.06	1,230,000	1,680,000	2,910,000
Utah	Newton [4 7]	2,225	17,935.80	223,000	395,000	618,000
Colorado	Mancos [4]	10,000	8,748.39	680,000	920,000	1,600,000
South Dakota	Angostura	16,210	9,804.25	1,898,000	2,040,000	3,938,000
Idaho	Mann Creek [4]	4,300		430,000	570,000	1,000,000
Totals		44,735	106,408.50	4,461,000	5,605,000	10,066,000
Grand total		118,935	2,839,098.26	9,181,000	11,455,000	20,636,000

[1] Five projects—Mirage Flats, Buford-Trenton, Buffalo Rapids Nos. 1 and 2, and Rapid Valley projects were under construction June 30, 1941.

[2] Allotments to Department of Agriculture for land preparation and settlement activities included.

[3] E. R. A. grant in 1937 of $1,630,000 for Glendive Unit (Buffalo Rapids No. 1) of 12,500 acres is included in table 2. 3,000 acres listed represent an extension of original project.

[4] Supplemental water.

[5] $3,500,000 appropriation F. Y. 1941, under act which authorizes projects under this program.

[6] Includes $80,000 of reimbursable funds allotted from $5,000,000 appropriation.

[7] $135,000 of contributed funds are reimbursable, making grand total repayable $8,886,000.

[8] Includes labor and materials by W. P. A. and C. C. C.

Table 6.—HYDROELECTRIC PLANTS IN OPERATION ON RECLAMATION PROJECTS, JULY 1941

State	Project	Plant	Initial operation	Installed kilowatt capacity	Ultimate capacity	Ultimate number of generators and capacities
Arizona	Salt River	Chandler	1919	600	600	1–600
		Roosevelt	[1]1906	15,400	15,400	1–5,500 1–3,700 2–1,300 3–1,200
		Arizona Falls	1913	850	850	2–425
		Cross Cut	1914	5,100	5,100	1–3,000 3–700
		Stewart Mountain	1930	10,400	10,400	1–10,400
		Horse Mesa	1927	30,000	30,000	3–10,000
		South Consolidated	1912	1,600	1,600	2–800
		Mormon Flat	1926	7,000	7,000	1–7,000
	Yuma	Siphon Drop	1926	1,600	1,600	2–800
Arizona-Nevada	Boulder	Boulder	1936	704,800	1,322,300	15–82,500 2–40,000 2–2,400
Arizona-California	All-American	Drop 3	1941	5,400	10,800	2–5,400
		Drop 4	1941	9,600	19,200	2–9,600
Colorado	Grand Valley	Grand Valley	1932	3,000	3,000	2–1,500
Idaho	Boise	Boise River	1912	1,875	1,875	3–625
		Black Canyon	1925	8,000	8,000	2–4,000
	Minidoka	Minidoka	1909	8,400	13,400	1–5,000 1–2,400 5–1,200
Nebraska-Wyoming	North Platte	Guernsey	1927	4,800	4,800	2–2,400
		Lingle	1919	1,400	1,400	2–400 2–300
Nevada	Newlands	Lahontan	1911	1,500	1,500	3–500
New Mexico	Rio Grande	Elephant Butte	[2]1916	24,300	24,300	3–8,100
Texas	Colorado River	Marshall Ford	1941	45,000	67,500	3–22,500
Utah	Strawberry Valley	Spanish Fork	1908	1,150	1,150	2–450 1–250
Washington	Columbia Basin	Grand Coulee	1941	20,000	1,974,000	18–108,000 3–10,000
	Yakima	Prosser	1932	2,400	2,400	1–2,400
		Rocky Ford	1917	187	187	1–187
Wyoming	Kendrick	Seminoe	1939	32,400	32,400	3–10,800
	Riverton	Pilot Butte	1925	1,600	1,600	2–800
	Shoshone	Shoshone	1922	5,600	5,600	1–4,000 2–800
11	17	28		953,962	3,567,962	

[1] Original plant; present plant 1909.
[2] Old plant, capacity 150 kw.; present plant completed 1940.

Table 7.—SCHEDULED POWER INSTALLATIONS, 1942–45

State	Project	Date	Kilowatts	Totals
1941				
	Installed July 1941			953,962
Arizona-Nevada	Boulder	October	82,500	
Washington	Grand Coulee	do	108,000	
	Additional 1941		190,500	
	Total Dec. 31, 1941			1,144,462
Scheduled for 1942				
Washington	Grand Coulee	January	108,000	
Do	do	April	108,000	
Idaho	Minidoka	do	5,000	
Arizona-Nevada	Boulder	May	82,500	
Do	do	August	82,500	
Arizona-California	Parker [2]	September	30,000	
Do	do	October	30,000	
Do	do	November	30,000	
	Additional 1942		476,000	
	Total Dec. 31, 1942			1,620,462
Scheduled for 1943				
Montana	Fort Peck [1]	July	50,000	
Arizona-California	Parker	August	30,000	
Colorado	Green Mountain	do	21,600	
Washington	Grand Coulee	September	108,000	
California	Keswick [2]	November	25,000	
	Additional 1943		234,600	
	Total Dec. 31, 1943			1,855,062
Scheduled for 1944				
Washington	Grand Coulee	January	108,000	
California	Keswick	do	25,000	
Do	Shasta [2]	March	375,000	
Do	Keswick	do	25,000	
Arizona-Nevada	Boulder	do	82,500	
Washington	Grand Coulee	May	108,000	
Do	do	September	108,000	
	Additional 1944		831,500	
	Total Dec. 31, 1944			2,686,562
Scheduled for 1945				
Washington	Grand Coulee	January	108,000	
Do	do	May	108,000	
Arizona-Nevada	Davis [2]	July	180,000	
Idaho	Anderson Ranch [2]	August	27,000	
Colorado	Colorado-Big Thompson: [2]			
	Estes Park–Mary's Lake	December	53,100	
	Plant No. 2	do	50,000	
	Additional 1945		526,100	
	Total Dec. 31, 1945			3,212,662

[1] Plant installed by Corps of Engineers; power to be distributed by Bureau of Reclamation.
[2] New plant.

Table 8.—RECLAMATION STORAGE DAMS

Project	State	Dam	Stream	Year completed	Height (feet) structural	Crest length (feet)
Altus	Oklahoma	Altus	North Fork Red		110	1,100
Do	do	Lugert Dikes	Offstream		9 to 45	15,750
Baker	Oregon	Thief Valley	Powder	1932	70	390
Bells Fourshe	South Dakota	Belle Fourche	Owl Creek	1911	112	6,262
Boise	Idaho	Anderson Ranch	South Fork Boise		444	1,300
Do	do	Arrowrock	Boise	1915	354	1,100
Do	do	Deadwood	Deadwood	1931	165	750
Do	do	Deer Flat, Forest	Offstream	1911	16	950
Do	do	Deer Flat, Lower	do	1908	40	7,200
Do	do	Deer Flat, Upper	do	1908	70	4,000
Boulder Canyon	Arizona-California-Nevada.	Boulder	Colorado	1936	726	1,244
Burnt River	Oregon	Unity	Burnt	1937	83	694
Carlsbad	New Mexico	Alamogordo	Pecos	1937	148	2,933
Do	do	Avalon [1]	do	1907	58	1,025
Do	do	McMillan	do	1894	57	2,114
Central Valley	California	Friant	San Joaquin		320	3,430
Do	do	Keswick	Sacramento		130	910
Do	do	Shasta	do		602	3,500
Colorado-Big Thompson.	Colorado	Granby	Colorado		300	880
Do	do	Granby Dikes	Offstream		15 to 70	5,380
Do	do	Green Mountain	Blue		274	1,150
Colorado River	Texas	Marshall Ford	Colorado (Texas)		270	5,015
Columbia Basin	Washington	Grand Coulee	Columbia	1942	550	4,173
Deschutes	Oregon	Crane Prairie	Deschutes	1940	36	315
Do	do	Wickiup	do		100	14,200
Eden	Wyoming	Big Sandy	Big Sandy Creek		80	2,280
Do	Do	Big Sandy Dike	Offstream		15	7,500
Fruit Growers	Colorado	Fruit Growers	Alfalfa Run	1938	55	1,520
Humboldt	Nevada	Rye Patch	Humboldt	1936	75	800
Huntley	Montana	Anita	Offstream	1937	42	1,008
Hyrum	Utah	Hyrum	Little Bear	1935	98	540
Kendrick	Wyoming	Seminoe	North Platte	1938	295	525
Klamath	Oregon-California	Clear Lake	Lost	1910	39	840
Do	do	Clear Lake Dikes	Offstream	1910	13	2,800
Do	do	Gerber	Miller Creek	1925	88	485
Do	do	Link River	Link	1921	22	435
Milk River	Montana	Fresno	Milk	1939	109	1,855
Do	do	Nelson Dikes	Offstream	1922	28	9,900
Do	do	Point of Rocks	do	1910	14	900
Do	do	Sherburne Lakes	Swift Current Creek	1921	98	900
Minidoka	Idaho-Wyoming	American Falls	Snake	1927	89	5,227
Do	do	Jackson Lake	do	1916	59	4,920
Do	do	Minidoka [1]	do	1909	73	4,133
Mirage Flats	Nebraska	Box Butte	Niobrara		66	5,400
Moon Lake	Utah	Midview	Offstream	1937	54	663
Do	do	Midview Dike	do	1937	21	2,575
Do	do	Moon Lake	West Fork, Lake Fork.	1938	110	1,108
Newlands	Nevada-California	Lahontan	Carson	1915	129	1,400
Do	do	Lake Tahoe	Truckee	1913	16	112
North Platte	Nebraska-Wyoming.	Guernsey	North Platte	1927	105	560
Do	do	Lake Alice, Lower	Offstream	1912	23	2,550
Do	do	Lake Alice, Upper	do	1912	30	3,100
Do	do	Minatare	do	1915	63	3,700
Do	do	Pathfinder	North Platte	1909	214	432
Do	do	Pathfinder Dike	Offstream	1911	38	1,650
Ogden River	Utah	Pine View	Ogden	1936	103	443
Okanogan	Washington	Conconully	Salmon Creek	1910	67	1,000
Do	do	Salmon Lake	Offstream	1921	40	1,260
Orland	California	East Park	Little Stony Creek	1910	136	250
Do	do	East Park Dikes	Offstream	1910	3 to 20	625
Do	do	East Park Spillway	do	1911	17	414
Do	do	Stony Gorge	Stony Creek	1928	130	868
Owyhee	Oregon-Idaho	Owyhee [1]	Owyhee	1932	417	833
Pine River	Colorado	Vallecito	Pine	1941	152	3,985
Provo River	Utah	Deer Creek	Provo River	1941	235	1,300
Rio Grande	New Mexico-Texas	Caballo	Rio Grande	1938	96	4,590
Do	do	Elephant Butte	do	1916	301	1,162
Do	do	Elephant Butte Dike	Offstream	1915	59	2,000
Riverton	Wyoming	Bull Lake	Bull Lake Creek	1938	81	3,456
Do	do	Pilot Butte, No. 1	Offstream	1926	42	1,300
Do	do	Pilot Butte, No. 2	do	1926	25	1,200
Do	do	Pilot Butte, No. 3	do	1926	12	3,400
Salt River	Arizona	Bartlett	Verde	1939	287	1,063
Do	do	Cave Creek	Cave Creek	1923	107	1,648
Do	do	Horse Mesa	Salt	1927	300	660

[1] Also diversion.

Table 8.—RECLAMATION STORAGE DAMS—Continued

Project	State	Dam	Stream	Year completed	Height (feet) structural	Crest length (feet)
Salt River	Arizona	Mormon Flat	Salt	1925	224	380
Do	do	Roosevelt	do	1911	280	723
Do	do	Stewart Mountain	do	1930	207	1,260
Shoshone	Wyoming	Deaver	Offstream	1918	14	1,300
Do	do	Ralston	do	1908	35	2,200
Do	do	Shoshone	Shoshone	1910	328	200
Strawberry Valley	Utah	Indian Creek Dike	Offstream	1912	37	1,311
Do	do	Strawberry	Strawberry	1913	77	490
Sun River	Montana	Gibson	Sun	1929	195	960
Do	do	Pishkun Dikes	Offstream	1940	10 to 45	9,181
Do	do	Willow Creek	Willow Creek		85	600
Do	do	Willow Creek Dikes	Offstream		3 to 22	630
Truckee River Storage.	Nevada-California.	Boca	Little Truckee	1939	116	1,629
Umatilla	Oregon	Cold Springs	Offstream	1908	98	3,822
Do	do	McKay	McKay Creek	1926	165	2,700
Uncompahgre	Colorado	Taylor Park	Taylor	1937	204	613
Upper Snake River	Idaho-Wyoming	Grassy Lake	Grassy Creek	1939	118	1,170
Do	do	Island Park	Henrys Fork	1938	91	1,580
Vale	Oregon	Agency Valley	North Fork Malheur.	1935	103	1,785
Do	do	Warm Springs	Middle Fork Malheur.	1919	106	469
Weber River	Utah	Echo	Weber	1930	125	1,807
Yakima	Washington	Bumping Lake	Bumping	1910	44	2,925
Do	do	Clear Creek	Tieton	1918	80	400
Do	do	Cle Elum	Cle Elum	1933	135	701
Do	do	Kachess	Kachess	1912	76	1,400
Do	do	Keechelus	Yakima	1917	72	6,478
Do	do	Tieton	Tieton	1925	222	920

Table 9.—RECLAMATION DIVERSION DAMS

Project	State	Dam	Stream	Year completed	Height (feet) structural	Crest length (feet)
All-American Canal	Arizona-California	Imperial	Colorado	1938	31	3,475
Belle Fourche	South Dakota	Belle Fourche	Belle Fourche	1907	23	2,330
Boise	Idaho	Black Canyon [1]	Payette	1924	183	1,040
Do	do	Boise River	Boise	1908	45	500
Columbia Basin	Washington	Entiat	Entiat	1940	5	120
Do	do	Icicle Creek No. 1	Icicle Creek	1940	3	180
Do	do	Icicle Creek No. 2	do	1940	26	34
Do	do	Icicle Creek No. 3	do	1940	11	143
Do	do	Icicle Creek No. 4	do	1940	13	143
Do	do	Icicle Creek No. 5	do	1940	11	143
Frenchtown	Montana	Frenchtown	Missoula	1936	18	489
Fruit Growers	Colorado	Dry Creek	Dry Creek	1939	13	36
Grand Valley	do	Colorado River	Colorado	1916	36	543
Huntley	Montana	Huntley	Yellowstone	1934	15	324
Hyrum	Utah	Hyrum	East Fork, Little Bear.	1937	9	94
Kendrick	Wyoming	Alcova [1]	North Platte	1938	205	763
Klamath	Oregon-California	Lost River	Lost	1912	40	675
Do	do	Lower Lost River	do	1921	23	324
Do	do	Malone	do	1923	32	515
Do	do	Miller	Miller Creek	1924	10	290
Lower Yellowstone	Montana - North Dakota.	Lower Yellowstone	Yellowstone	1910	12	700
Milk River	Montana	Dodson	Milk	1910	31	319
Do	do	St. Mary	St. Mary	1915	13	198
Do	do	Swift Current	Swift Current Creek	1915	18	4,800
Do	do	Vandalia	Milk	1916	32	2,350
Moon Lake	Utah	Duchesne River	Duchesne	1939	9	243
Newlands	Nevada-California	Carson River	Carson	1905	23	240
Do	do	Derby	Truckee	1905	31	1,331
North Platte	Nebraska-Wyoming.	Horse Creek	Horse Creek	1923	15	720
Do	do	Whalen	North Platte	1909	35	2,300
Okanogan	Washington	Salmon Creek	Salmon Creek	1906	6	50
Orland	California	East Park FeedCanal	Stony Creek	1914	44	155
Do	do	North Side	do	1913	7	375
Do	do	South Canal	do	1916	8	895
Parker Dam	Arizona-California	Parker [1]	Colorado	1938	320	856
Rio Grande	New Mexico-Texas	American	Rio Grande	1938	18	9,306
Do	do	Arroyo	Percha Arroyo	1938	29	2,489
Do	do	Leasburg	Rio Grande	1908	10	2,865
Do	do	Mesilla	do	1916	22	3,445
Do	do	Percha	do	1917	14	2,720
Do	do	Riverside	do	1927	18	3,370
Riverton	Wyoming	Wind River	Wind	1923	37	2,285
Salt River	Arizona	Granite Reef	Salt	1908	29	1,000
Do	do	Joint Head	do	1914	6	517
Do	do	Power Canal	do	1906	11	500
Shoshone	Wyoming	Corbett	Shoshone	1908	18	835
Do	do	Willwood	do	1924	70	320
Strawberry Valley	Utah	Indian Creek Crossing.	Indian Creek	1913	17	1,350
Do	do	Spanish Fork	Spanish Fork	1908	28	74
Sun River	Montana	Sun River	Sun	1915	132	261
Umatilla	Oregon	Feed Canal (Echo)	Umatilla	1907	8	2,100
Do	do	Maxwell	do	1915	14	400
Do	do	Three Mile Falls	do	1914	24	800
Uncompahgre	Colorado	East Canal	Uncompahgre	1915	16	764
Do	do	Garnet	do	1918	8	75
Do	do	Gunnison	Gunnison	1912	16	244
Do	do	Ironstone	Uncompahgre	1916	14	58
Do	do	Loutsenhizer	do	1911	21	114
Do	do	Montrose and Delta	do	1915	25	68
Do	do	Selig	do	1915	22	96
Upper Snake River	Idaho-Wyoming	Cascade Creek	Cascade Creek	1937	14	140
Do	do	Cross Cut	Henrys Fork	1937	17	355
Vale	Oregon	Harper	Malheur	1929	24	700
Weber River	Utah	Weber River	Weber	1931	23	1,795
Yakima	Washington	Easton	Yakima	1929	66	248
Do	do	Prosser	do	1904	8	768
Do	do	Roza	do	1939	61	338
Do	do	Sunnyside	do	1907	8	500
Do	do	Tieton	Tieton	1908	5	510
Yuma	Arizona-California	Laguna	Colorado	1909	13	4,780

[1] Also storage.

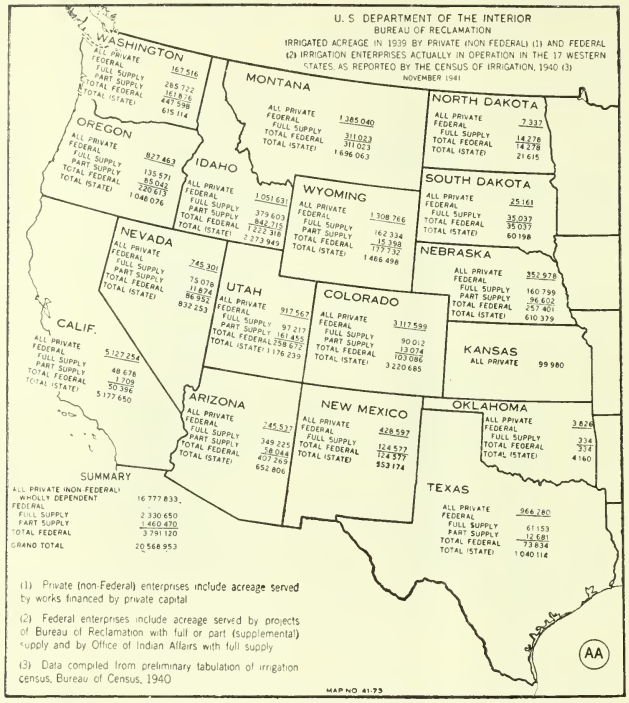
Table 10.—STORAGE RESERVOIRS ON RECLAMATION PROJECTS, JAN. 1, 1942

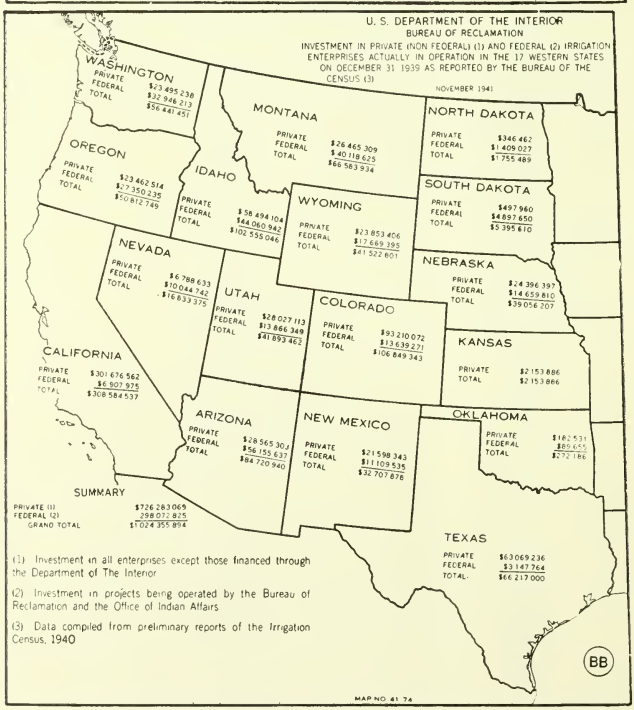
Reservoir	Project	State
Bartlett	Salt River	Arizona.
Horse Mesa	do	Do.
Mormon Flat	do	Do.
Roosevelt	do	Do.
Stewart Mountain	do	Do.
Havasu Lake	Parker Dam	Arizona-California.
Lake Mead	Boulder Canyon	Arizona-Nevada.
East Park	Orland	California.
Stony Gorge	do	Do.
Fruit Growers	Fruit Growers Dam	Colorado.
Vallecito	Pine River	Do.
Taylor Park	Uncompahgre	Do.
Arrowrock	Boise	Idaho.
Deadwood	do	Do.
Deer Flat	do	Do.
American Falls	Minidoka	Idaho-Wyoming.
Jackson Lake	do	Do.
Lake Walcott	do	Do.
Magic	do	Do.
Grassy Lake	Upper Snake River	Do.
Island Park	do	Do.
Como	Bitter Root	Montana
Fresno	Milk River	Do.
Nelson	do	Do.
Point of Rocks	do	Do.
Sherburne Lakes	do	Do.
Gibson	Sun River	Do.
Pishkun	do	Do.
Willow Creek	do	Do.
Guernsey	North Platte	Nebraska-Wyoming.
Lake Alice	do	Do.
Lake Minatare	do	Do.
Lake Winters Creek	do	Do.
Pathfinder	do	Do.
Rye Patch	Humboldt	Nevada.
Lahontan	Newlands	Nevada-California.
Lake Tahoe	do	Do.
Boca	Truckee Storage	Do.
Alamogordo	Carlsbad	New Mexico.
Avalon	do	Do.
McMillan	do	Do.
Conchas	Tucumcari	Do.
Caballo	Rio Grande	New Mexico-Texas.
Elephant Butte	do	Do.
Thief Valley	Baker	Oregon.
Unity	Burnt River	Do.
Crane Prairie	Deschutes	Do.
Cold Springs	Umatilla	Do.
McKay	do	Do.
Agency Valley	Vale	Do.
Warm Springs	do	Do.
Clear Lake	Klamath	Oregon-California.
Gerber	do	Do.
Upper Klamath Lake	do	Do.
Owyhee	Owyhee	Oregon-Idaho.
Belle Fourche	Belle Fourche	South Dakota.
Marshall Ford	Colorado River	Texas.
Hyrum	Hyrum	Utah.
Midview	Moon Lake	Do.
Moon Lake	do	Do.
Pine View	Ogden River	Do.
Deer Creek	Provo River	Do.
Echo	Salt Lake Basin	Do.
Strawberry	Strawberry Valley	Do.
Grand Coulee	Columbia Basin	Washington.
Conconully	Okanogan	Do.
Salmon Lake	do	Do.
Bumping Lake	Yakima	Do.
Clear Creek	do	Do.
Lake Cle Elum	do	Do.
Lake Kachess	do	Do.
Lake Keechelus	do	Do.
Tieton	do	Do.
Seminoe	Kendrick	Wyoming.
Alcova	do	Do.
Bull Lake	Riverton	Do.
Pilot Butte	do	Do.
Deaver	Shoshone	Do.
Ralston	do	Do.
Shoshone	do	Do.

Table 11.—NATIONAL WILDLIFE REFUGES ON RECLAMATION PROJECTS

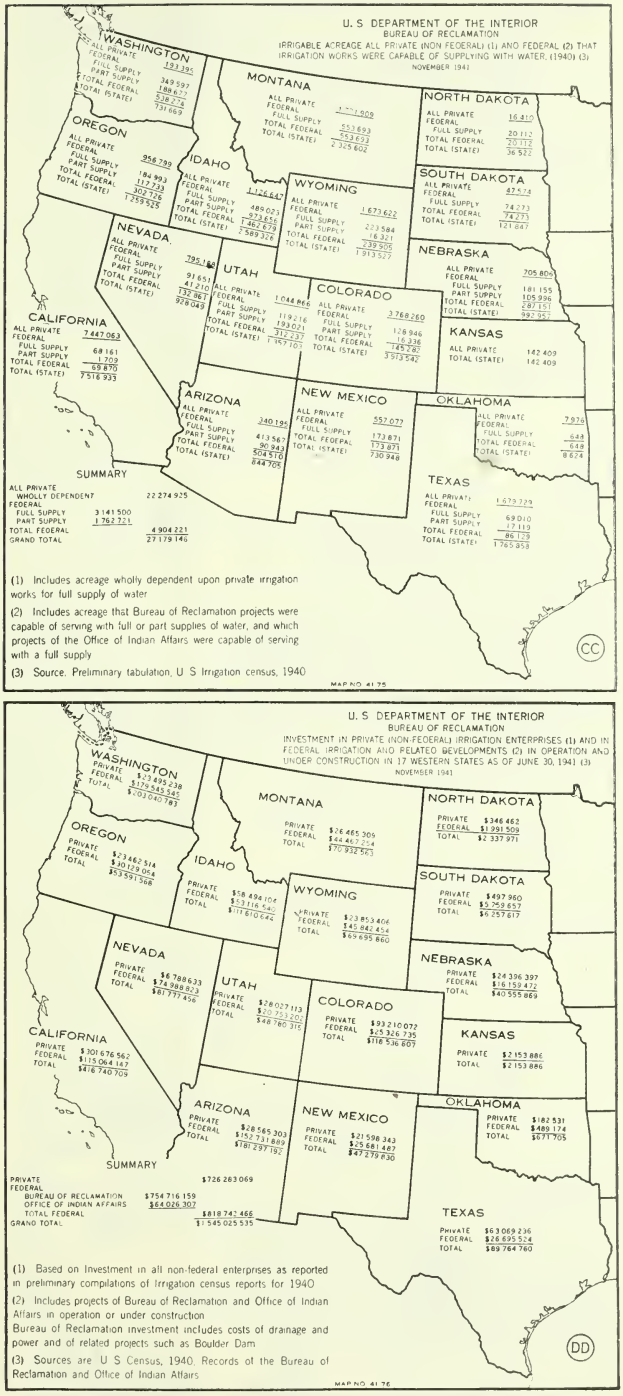
State	Reclamation project	Wildlife refuge	Date of executive order
Arizona	Salt River	Salt River	1909
Arizona-California	Boulder Canyon	Imperial	1941
Do	Parker Dam Power	Havasu Lake	1941
California	All-American Canal	Salton Sea	1930
Do	Klamath	Clear Lake	1911
Do	do	Tule Lake	1928
California-Oregon		Lower Klamath Lake	1908
Idaho	Boise	Deer Flat	1909
Do	Minidoka	Lake Walcott	1909
Montana	Sun River	Pishkun	1912
Do	do	Willow Creek	1909
Do	do	Benton Lake	1929
Do	Milk River	Lake Bowdoin	1936
Nebraska	North Platte	Lake Minatare	1916
Do	do	Lake Alice	1916
Nevada	Newlands	Fallon	1931
Do	Boulder Canyon	Lake Mead	1933
New Mexico	Carlsbad	Lake McMillan	1909
Do	do	Avalon Reservoir	1909
Do	Rio Grande	Rio Grande	1909
Oregon	Umatilla	Cold Springs	1909
Do	do	McKay Creek	1927
Do	do	Lake Malheur	1908
Do	Klamath	Upper Klamath Lake	1928
South Dakota	Belle Fourche	Belle Fourche	1909
Utah	Strawberry Valley	Strawberry Valley	1926
Washington	Okanogan	Conconully	1909
Do	Yakima	Lake Cle Elum	1909
Wyoming	North Platte	Pathfinder	1928

ADDENDA

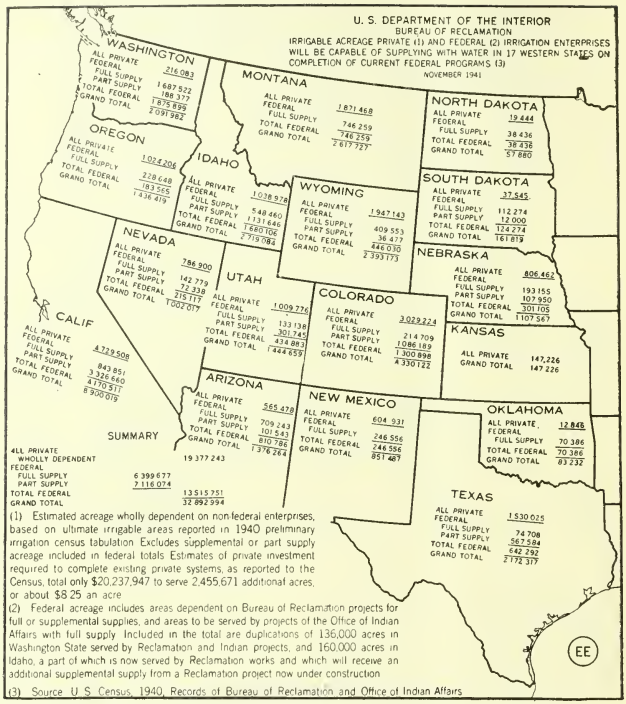


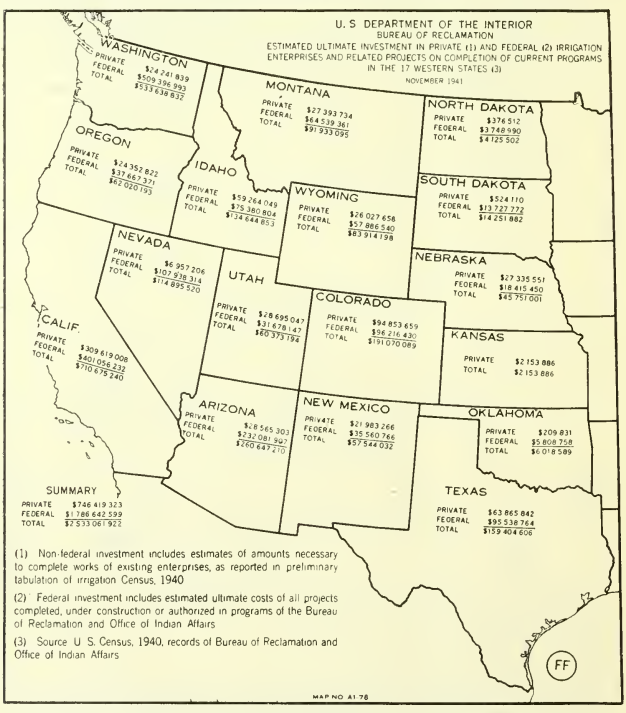


Irrigated areas, 1940, Western United States, and the investment in construction

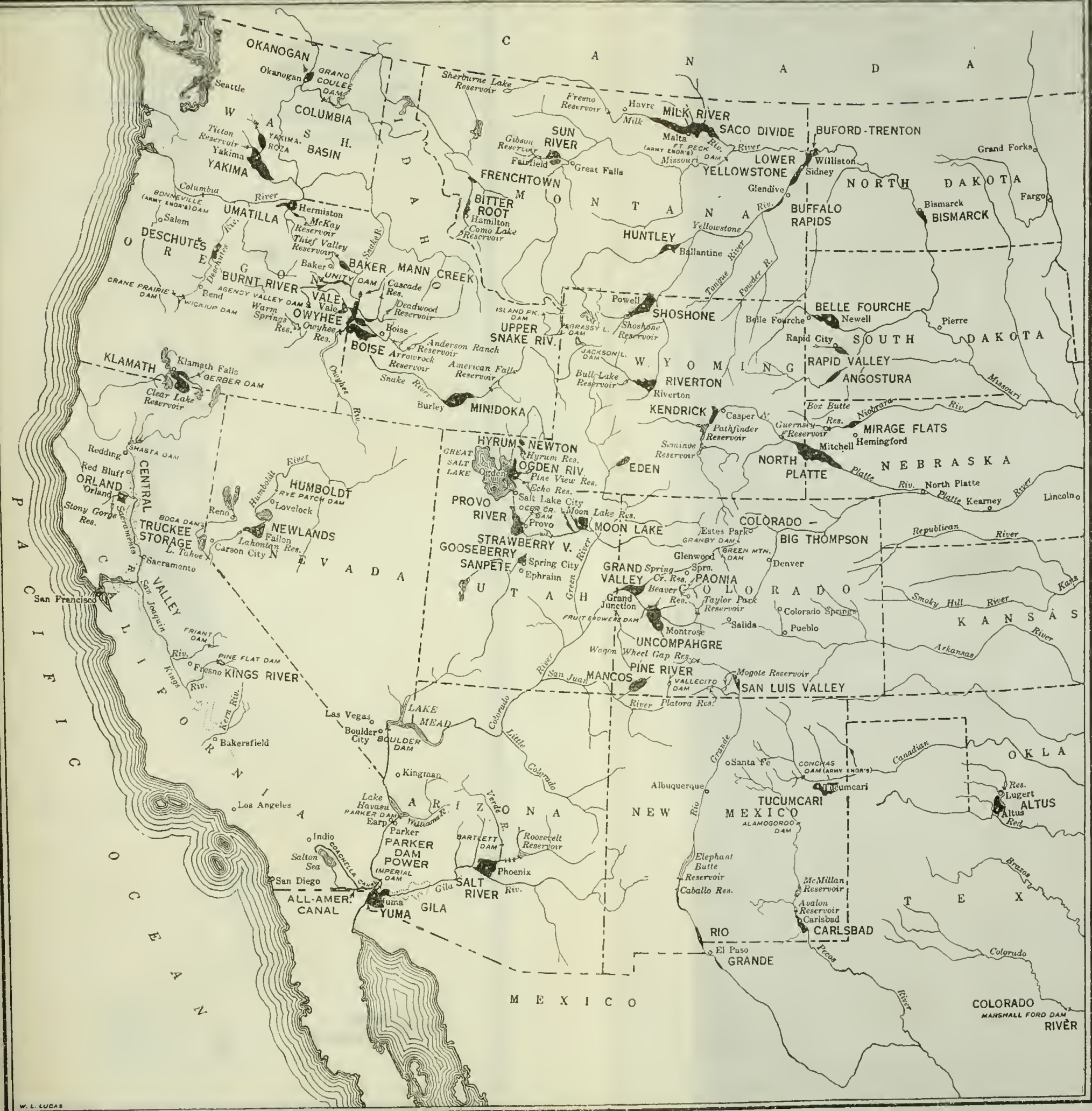


Irrigable acreage (top); investment in areas in operation and under construction (bottom)



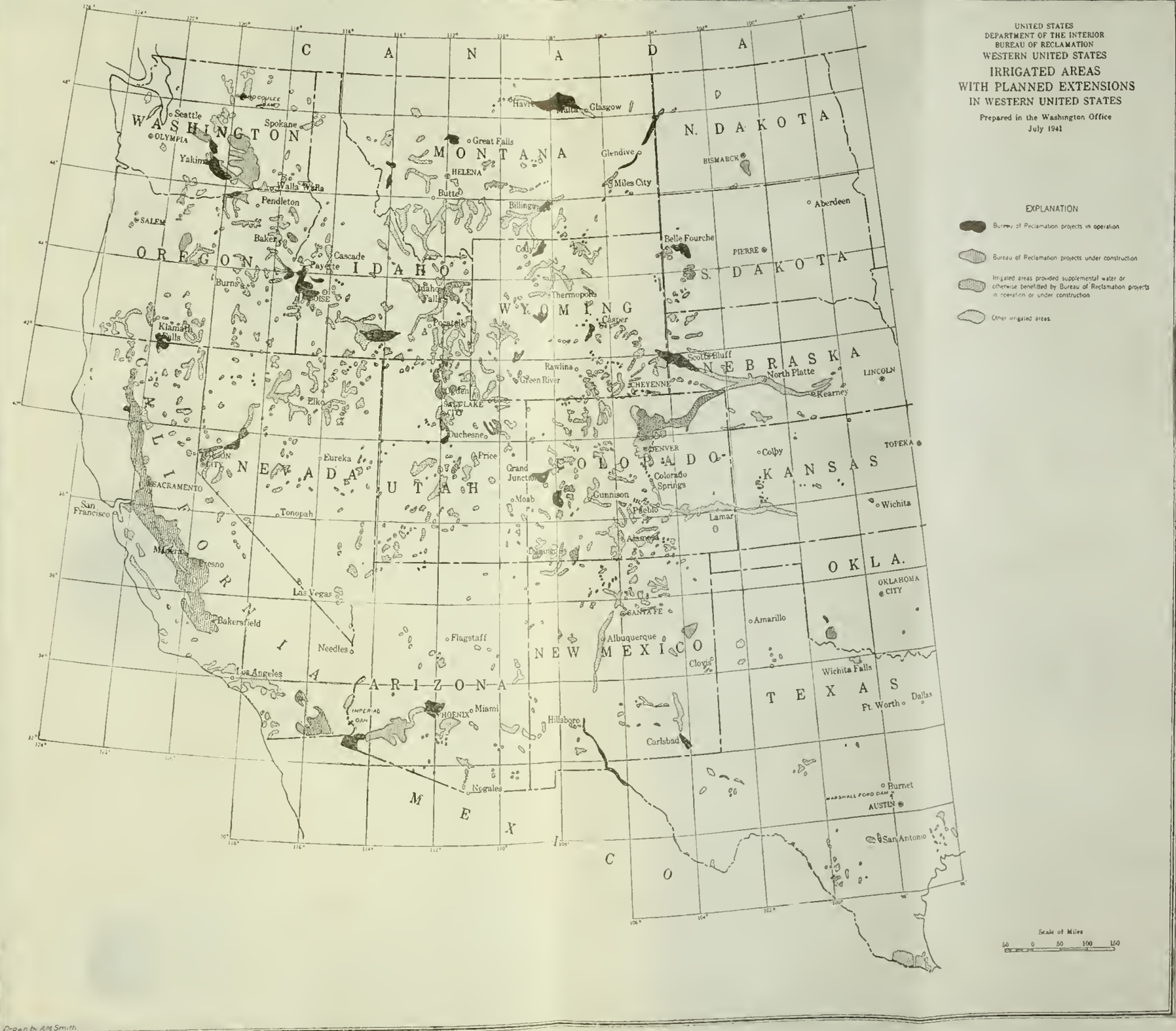


Total irrigable acerage on completion of Federal construction under way November 1941



Federal Reclamation projects in the West

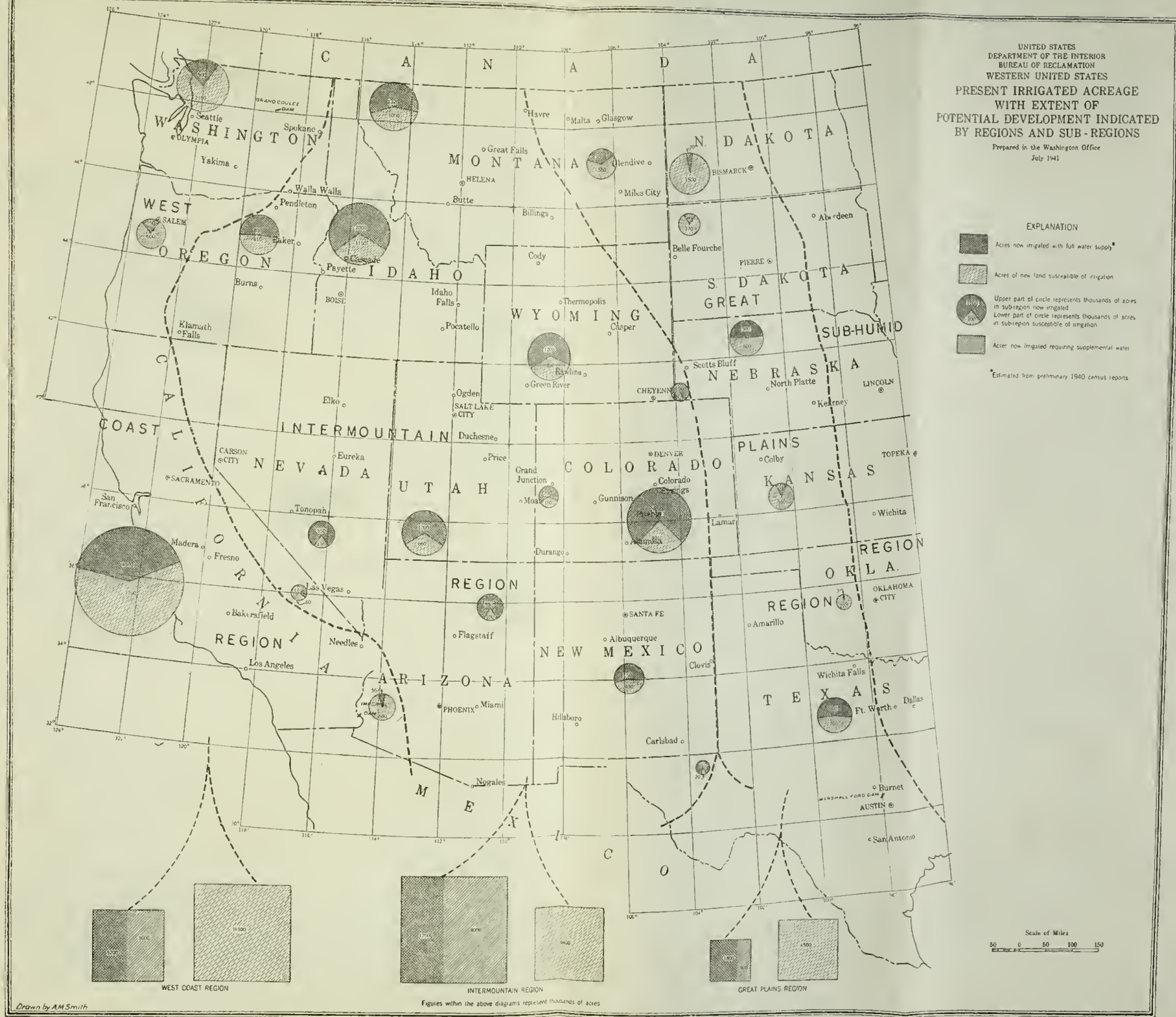
424428°—42—1 (Face p. 94)



Drawn by A.M.Smith

Irrigated areas and planned extensions, western United States

124428°—42—2 (Face p. 94)



Present and potential irrigation, western United States

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