# SAN JUAN-CHAMA PROJECT

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I am happy to tell you that construction progress on the San Juan-Chama Project is excellent and that in the spring of 1971 the State of New Mexico will have a new source of water available for its use. For those who may not be familiar with the project I will give you some background information, a description of the project, the present status of construction, and the allocation of water. And should you have any questions, I will attempt to answer them in the discussion period.

The first in a series of events that are of prime importance to New Mexico was the Upper Colorado River Compact of 1949, which allocated to the State a portion of the waters of the Colorado River. Most of you are aware, I am sure, that this water is the only sizeable block of undeveloped water remaining in the State. As a practical matter, all other waters are fully appropriated.

The second event in this series was authorization of the Colorado River Storage Project in 1956. This Project consists of the Glen Canyon, Flaming Gorge, Curicanti, and Navajo Reservoirs, all of which, except the Navajo, produce hydro-electric power. The purpose of this project is to provide the upstream storage that will control the river flows, so that the required deliveries can be made to downstream users, and, in addition, will provide power revenues. The power revenues, in excess of those required to repay power costs with interest, are used to assist projects such as the San Juan-Chama where in some instances the payment ability is little more than enough to cover annual operation and maintenance costs. Consequently, the storage project not only makes it possible for New Mexico to use its allocated share of Colorado River water, but provides part of the funds required to make the State's project financially feasible.

The third event was the authorization of the San Juan-Chama Project under a bill passed by Congress and signed by the President in June 1962. The project will import, through the Continental Divide, an average of 110,000 acre-feet of water annually from the Upper San Juan River tributaries for use in the Rio Grande. The water is allocated by law, 52,500 acre-feet for Albuquerque; 29,900 acre-feet for the four tributary units; 22,600 acre-feet for the Middle Rio Grande Conservancy District; and 5,000 acre-feet for a recreation pool in the planned Cochiti Reservoir. The State of New Mexico has wisely planned use of its water and put in a lot of hard work in developing its entitlement of Colorado River water. Our state's water authorities are to be highly commended for their part in bringing about the project.

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1/ Project Construction Engineer

# SAN JUAN–CHAMA PROJECT
## COLORADO–NEW MEXICO

(REGION 5)

UNITED STATES
DEPARTMENT OF THE INTERIOR
STEWART L. UDALL SECRETARY

BUREAU OF RECLAMATION
FLOYD E. DOMINY COMMISSIONER

MAP NO. 465-528-786

MARCH 1967

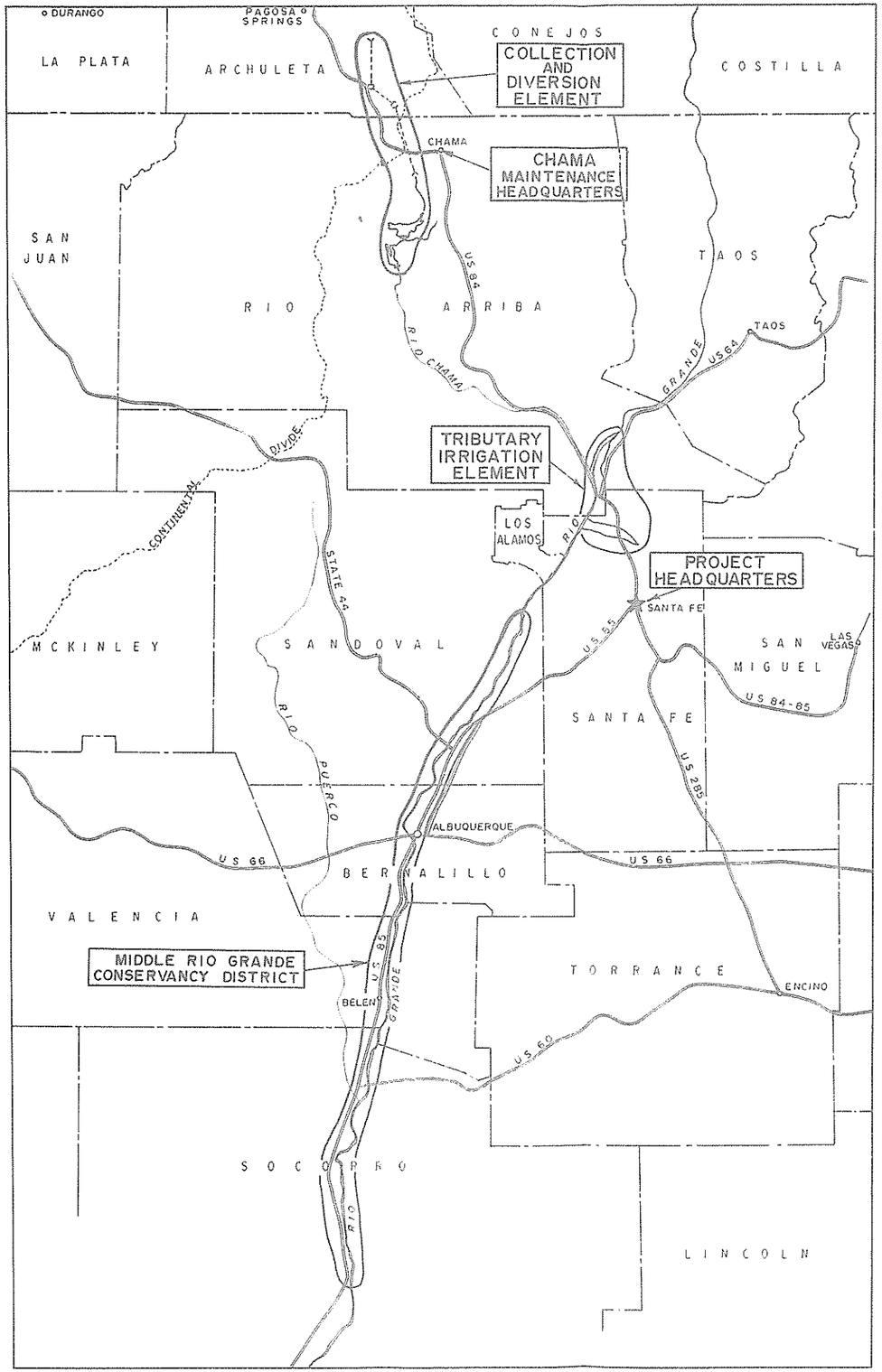
### EXPLANATION

BUREAU OF RECLAMATION
COMPLETED AND AUTHORIZED WORKS

- TUNNEL
- CHANNELIZATION
- TRANSMISSION LINE
- PROJECT HEADQUARTERS
- IRRIGATED AREA

SCALE OF MILES
8 0 8 16 24

VICINITY MAP




# FACTUAL DATA—SAN JUAN-CHAMA PROJECT—COLORADO-NEW MEXICO

## HISTORY

The upper San Juan River area was long considered Indian territory. Because of its inaccessibility and the proximity of hostile tribes, it was not settled until shortly before the turn of the present century. The population within the San Juan area and immediately south is sparse. Pagosa Springs, Colorado, the only major town in the vicinity, has a population of about 1,500. Much of the land in the San Juan River Basin in New Mexico is still inhabited by Indian tribes. The Navajo, Southern Ute, and Jicarilla Apache Indian Reservations occupy a considerable portion of the basin, and Navajo Indian allotments control the greatest part of the remaining watershed lands.

In contrast, the Rio Grande Valley is the oldest continuously occupied area in the United States, and the site of the first Spanish settlement. Ethnically, it contains three groups—the native Indians, the descendants of the Spanish settlers, and people of Anglo extraction who came after the American occupation.

The first Spanish exploration into the area was made in 1540 by Coronado in search of the Seven Cities of Cibola. Colonization was started in 1598, and by the middle of the 18th century Spanish settlements were scattered throughout the basin. More than 900 years ago the Pueblo Indians of the Rio Grande Valley had used simple irrigation systems and methods to supply irrigation water to their lands. The early Spanish colonists adopted the same type irrigation methods practiced by the Indians. Each community constructed and maintained its own ditches, diverting water directly from the river without benefit of storage.

The Indians revolted in 1680 and drove the Spaniards as far south as the present site of Juarez, Mexico. In 1692 De Vargas reconquered the region for Spain and again Spanish colonists entered the area. Settlement spread gradually along the Rio Grande and its tributaries.

In 1821 Mexico, which included most of the project area, declared her independence from Spain. Trade with the United States began in 1823, and by 1840 American merchants were firmly established in the basin. Actual occupation by Americans did not occur until after 1848 when the Rio Grande Valley lands were ceded to the United States by the treaty of Guadalupe Hidalgo.

The population of the Rio Grande Basin in New Mexico has shown a marked increase in the last three decades with most of the growth in the counties containing the larger cities and towns. Important cities and towns include Santa Fe, the state capitol; Albuquerque, the largest city; Las Cruces; Los Alamos; Taos; Espanola; Bernalillo; Belen; Socorro; and Truth or Consequences. From 1930 to 1960 the population of these cities and towns increased more than fivefold, and the present tempo of growth indicates continued population increase.

## PURPOSE OF THE PROJECT

In the State of New Mexico, with its arid climate, water is the most precious natural resource and a limiting factor in its development. Throughout the Rio Grande, the uses of water have been developed to the extent that they far exceed the available supplies and there is a pressing need for additional supplies. Serious droughts and general decreased river flows have characterized the period since 1942 and have accentuated the widespread problem of water shortages.

The initial stage of the San Juan-Chama Project was authorized for construction under a bill passed by Congress and signed into law by the President on June 13, 1962. The project, authorized as a participating project of the Upper Colorado River Storage Project, will make possible an average annual diversion of about 110,000 acre feet from the upper tributaries of the San Juan River in the Upper Colorado River Basin, through the Continental Divide, for utilization in the Rio Grande Basin in New Mexico.

The imported waters are used to serve the city of Albuquerque with urgently needed additional water for municipal and industrial purposes (48,200 acre feet annually), provide supplemental water for irrigation of lands in the 81,610-acre Middle Rio Grande Conservancy District, and replace depletion in the Rio Grande Basin caused by furnishing a firm water supply to 6,960 acres of land in the Llano and Pojoaque tributary irrigation units in the Rio Grande Basin. Recreation and the preservation and propogation of fish and wildlife are also purposes served by the project. An annual allocation of 5,000 acre feet of water is made available for fish and wildlife and recreation purposes at Cochiti Reservoir.

## WATER SUPPLY

The project water supply comes from the share of Colorado River water allocated to New Mexico by the Upper Colorado River Basin Compact. Water is obtained by diversion of part of the flows of the Rio Blanco, Little Navajo, and Navajo Rivers, all of which are tributaries of the San Juan River. The total mean annual flow of the streams at the proposed diversion sites for the period 1935 through 1957 was 167,500 acre feet.

Criteria for determination of stream flows to be reserved for downstream uses and not available for project diversion were established by representatives of the States of Colorado and New Mexico. These uses included prior water rights, maintenance of sufficient flows to preserve fish and wildlife values, and maintenance of sanitary conditions. The water bypassed averages 45,800 acre-feet per year, leaving for diversion a total of 121,700 acre-feet annually. After subtraction of the various losses due to transportation, evaporation, and capacity of the siphons, a net amount of 110,500 acre-feet is divertable to the Rio Grande Basin.

## COLLECTION, DIVERSION AND STORAGE FEATURES

The collection and diversion facilities, located in the San Juan River Basin above Navajo Reservoir, consist of three diversion dams, two siphons, and a tunnel system to bring San Juan River Basin water through the Continental Divide. The imported water will be stored and held for release in Heron Reservoir, located on Willow Creek, a tributary of the Rio Chama. The outlet works of El Vado Dam on the Rio Chama has been enlarged to permit passing project water without interfering with the normal operation of El Vado Reservoir and to permit compliance with the Rio Grande Compact. Deliveries of San Juan-Chama Project water will be made in accordance with the provisions of the Rio Grande Compact.

The three diversion dams have concrete, ogee-type overflow sections, appropriate gates and headworks to divert water, and a sluicing facility to permit passing sediment downstream. The dams are the Blanco on the Rio Blanco, the Little Oso on the Little Navajo River, and the Oso on the Navajo River. Bypasses of water will be made as necessary at each diversion point to maintain a live stream for fishing and to furnish water to downstream water users who have prior water rights.

The conduit system consists of three concrete-lined tunnels, varying in size from 8-feet 7-inches to 10-feet 11-inches in diameter, and two siphons with 8-foot diameters. The Blanco Tunnel extends from the Rio Blanco to the Little Navajo River, a distance of about 9 miles, and has a capacity of 520 cubic feet per second. Oso Tunnel extends from the Little Navajo River to the Navajo River, a distance of about 5 miles and has a capacity of 550 cubic feet per second. Azotea Tunnel lies under the Continental Divide and extends from the Navajo River to Azotea Creek in the Rio Grande Basin, a distance of about 13 miles. Azotea Tunnel has a capacity of 950 cubic feet per second.

Approximately 7.25 miles of stream channel on Azotea Creek and Willow Creek between the outlet portal of Azotea Tunnel and the headwaters of Heron Reservoir were included under the heading of channelization. Prevention of erosion due to the increased flow in these streams was accomplished by channel re-alinement; installation of concrete drop structures; and riprap bank protection.

Heron Dam is located on Willow Creek just above its confluence with the Chama River and provides a regulating and storage reservoir with a capacity of about 400,000 acre-feet. The dam is an earthfill structure rising 263 feet above the streambed.

Heron Dike, also a rolled earthfill structure, contains the uncontrolled concrete spillway and is located approximately 1 mile northwest of Heron Dam. The dike has a height of about 75 feet and a crest length of 2,400 feet. The outlet works and the spillway have a combined capacity of about 4,700 cubic feet per second at maximum water surface.

The outlet works at El Vado Dam was enlarged to permit passing of the imported water through the reservoir without interfering with prior releases. The existing outlet works was plugged and a new outlet works having a capacity of 4,000 cubic feet per second was constructed. The new outlet works consists of a concrete-lined tunnel, four high pressure control gates and new intake structure.

## TRIBUTARY IRRIGATION ELEMENTS

### Llano Unit

The Llano Unit is located along a relatively narrow bench adjacent to the Rio Grande, extending from about 12 miles north to some 4 miles south of the town of Espanola. Supplemental water provided by the project insures an adequate supply of water for 4,669 acres of irrigable land of which 1,922 acres are Indian land. The average elevation of the irrigated area is approximately 5,700 feet above sea level.

The project works consist of Velarde Diversion Dam, located on the Rio Grande about 15 miles north of Espanola, about 19 miles of main canal, and the necessary appurtenant works to effect efficient water delivery. The average annual diversion requirement is about 2.37 acre-feet per acre of irrigable land in the Llano Unit, including only the supplemental supply of those lands receiving supplemental waters.

### Pojoaque Unit

The Pojoaque Unit, about 16 miles north of Santa Fe, is located in the bottom lands of the Pojoaque and Nambe Rivers, extending about 14 miles upstream from the confluence of the Pojoaque River and the Rio Grande. Supplemental water provided by the project insures an adequate supply of water for 2,300 acres of irrigated land. Both Indian and non-Indian lands are included. The average elevation of the irrigated area is approximately 5,800 feet above sea level.

The storage feature of the unit is the Nambe Falls Dam and Reservoir located immediately above Nambe Falls on Nambe Creek. The dam is an earthfill and concrete structure rising about 120 feet above streambed. The reservoir has a conservation capacity of 1,500 acre-feet at the end of 50 years and a surface area of 49 acres at normal water surface elevation. Two diversion dams are used in water distribution, an existing dam on Nambe Creek at the upper end of the area, and a new concrete structure below the village of Pojoaque. The canal system has been enlarged and the ditches have been consolidated. The average annual diversion requirement is about 3.80 acre-feet per acre of irrigated land in the Pojoaque Unit.

Principal crops grown in the Pojoaque and Llano Units include apples, hay, corn, small grains, and a variety of vegetables.

The average annual precipitation at Espanola, New Mexico, is 10.11 inches. Temperature extremes range from −23°F. to a maximum of 106°F. The average frost-free period of 164 days occurs between April 29 and October 10.

Inquiries for additional information may be addressed to:

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Post Office Box 1609
Amarillo, Texas 79105

GPO 830-074

The overall cost of the San Juan-Chama Project is expected to be $75.5 million. The joint use facilities which consist of the storage and diversion elements are estimated to cost $56.5 million, of which about $24.5 million is allocated to Albuquerque's water supply; $25.7 million to irrigation, and $6.2 million is a non-reimbursable allocation to recreation and fish and wildlife. Thus, some 90 percent of the joint costs will be repaid by water users or by power revenues. I should like to add that on all Reclamation projects constructed, an average of 90 cents out of every dollar is repaid to the Federal Treasury by the beneficiaries of the project. Repayment contracts have been signed with the City of Albuquerque and the Middle Rio Grande Conservancy District for their proportionate share of the project costs.

These joint use facilities originate in southern Colorado. The diversion works consist of three long tunnels starting on the Rio Blanco in Colorado, siphoning under the Little Navajo and Navajo Rivers, and discharging into a tributary of Willow Creek in New Mexico. Diversion dams and feeder conduits at all three streams will divert the available water into the tunnel system. The first two tunnels, designated Blanco and Oso, will be 8 feet 7 inches in diameter with capacities of 520 and 550 cubic feet per second. Azotea, the third tunnel, will be 10 feet 11 inches in diameter with a capacity of 950 cubic feet per second. All tunnels will be circular in shape and lined with concrete. Tunnel lengths are approximately: Blanco -- 9 miles; Oso -- 5 miles; and Azotea -- 13 miles. Other features in the element are a new outlet works for the existing El Vado Dam and Reservoir, Channelization for Willow Creek, and Heron Dam and Reservoir. The imported water will flow into Heron Reservoir where it will be stored and regulated. The dam will be an earth and rockfill structure about 270 feet in height constructed in a canyon on Willow Creek at its confluence with the Chama River. The reservoir will have a capacity of 400,000 acre feet. Recreational development on the reservoir will be constructed by the National Park Service.

Water purchased by Albuquerque and the Middle Rio Grande Conservancy District will be released from Heron Reservoir as needed and will flow down the Chama River and Rio Grande to the point of use. Delivery of Albuquerque's water will be in the river, and the Conservancy District's water will be diverted from the Rio Grande through its existing irrigation system.

Also authorized under the San Juan-Chama Project were four tributary units -- Pojoaque, Llano, Taos, and Cerro. The additional water for these units is Rio Grande water already appropriated by downstream users. As Rio Grande water or water from tributaries of the Rio Grande is stored or diverted for use, equivalent amounts of imported water will be released from Heron Reservoir. It will flow down the Rio Chama into the Rio Grande and, in effect, will restore the Rio Grande flows at the Otowi gage, and give downstream users the same water supply by exchange that they would have received if the San Juan-Chama Project had not been built. I will discuss the tributary units more in detail later.

The status of construction of the various features is as follows:

The Blanco Diversion Dam and the 9-mile long Blanco Tunnel are completed and ready for use. The 5-mile long Oso Tunnel is complete except for backfill grout behind the concrete tunnel lining. This should be finished in about 2 months. The two diversion dams located at the Little Navajo and Navajo Rivers are each about 75 percent complete. The siphons under the rivers and feeder conduits are yet to be constructed. The 13-mile long Azotea Tunnel which crosses under the state line and through the Continental Divide is about 85 percent complete. Excavation of the tunnel was completed in May 1968 and the placement of concrete lining is now in progress. About 6 miles of the concrete lining remain to be placed. A contract has recently been awarded to complete the channelization between Azotea Tunnel and the headwaters of Heron Reservoir. At the Heron damsite the diversion tunnel under the left abutment and operating shaft are practically completed. Progress on the excavation for the dam abutments and foundation grouting is such that diversion of Willow Creek should be accomplished about June 1 which in turn will permit start of embankment placing for the dam. Clearing of Heron Reservoir will be started this spring. The construction of a new and larger outlet works for the existing El Vado Dam has been completed. Overall the storage and diversion element is about 78 percent complete and the total project is 61 percent complete.

Perhaps one of the more interesting facets in the construction of the project was the use of a mechanical boring machine or mole for tunnel construction. Prior to this project a mole had never been used on a Bureau of Reclamation project. Geology reports indicated the rock to be encountered in the tunnels -- shale and sandstone -- could be economically excavated by a mole. An extensive exploration program was then undertaken consisting of geophysical investigations and subsurface drilling. The results of this program were then made available to all prospective bidders on the tunnels. When bids were opened on the first tunnel in March 1964, it was obvious that our exploration program had paid good dividends. Of the ten bids received, seven indicated a preference for the mole-driven tunnel and only three indicated performance by conventional methods. The difference between the low bids received for the mole tunnel and for the conventionally driven tunnel were in excess of $6.5 million. On bids received for the other two long tunnels, all indicated use of moles.

When I refer to conventional tunneling, I am speaking of the method used for many years which involves drilling a series of holes in the tunnel face, loading the holes with explosives, detonating the explosives, loading the loosened rock into muck cars, hauling the materials from the tunnel, and then repeating the cycle. Utilizing this method an average of about 50 feet of tunnel can be excavated in 24 hours, dependent somewhat on the size of tunnel, and in one month about 1,000 feet. As a comparison in the Blanco Tunnel on one 8-hour shift 135 feet of tunnel were excavated, in one day 375 feet, and in one month 6,713 feet. And not to be outdone, the contractor on Oso Tunnel

excavated 156 feet in one 8-hour shift, 403 feet in one day, and 6851 feet in one month. From the above statistics it is plain that use of the mole has been very successful and that the San Juan-Chama Project has materially contributed to the improvement of tunneling technology. Projects such as the San Juan-Chama are complex and expensive. The many water laws, compacts, and other contractual agreements which must be complied with make the planning, development, and operation of such projects difficult. Projects in the future will be even more complicated and expensive. However, I am sure with the added technology available to our planners, engineers, and scientists these new projects will be feasible and ways will be found to economically bring water to areas in short supply.

The other element of the San Juan-Chama Project consists of four tributary irrigation units -- Cerro, Taos, Llano and Pojoaque -- which were authorized under the project. Further investigation showed that the two larger units -- Cerro and Taos which are located north of and in the vicinity of Taos -- were infeasible due to unsound geological conditions at the proposed reservoir and dam sites. However, additional planning work is being done on a reduced size Taos unit. The two smaller units -- Llano and Pojoaque which are located in the vicinity of Espanola -- are programmed for future construction. As a result of the infeasibility of the two units 12,000 acre feet of water remains unallocated. On January 30 and 31, 1969, the Interstate Streams Commission conducted a public hearing and entertained requests for allocation of the surplus water. To show you what demand exists for water, some 30 applications were received from practically every city and town located adjacent to the Rio Grande or its tributaries, from potential and existing irrigation districts, from recreational organizations, and from military installations and these applications totaled about 170,000 acre feet. Your water is valuable. Conserve it and use it wisely.