

NAVAJO INDIAN IRRIGATION PROJECT

Bert Levine^{1/}

PEOPLE

The transition of 25 percent of the Navajo Indian population from the pastoral age to one based on agricultural food production can be accomplished by the agricultural potential provided by the Navajo Indian Irrigation Project. During the past years, a number of small irrigation projects have been constructed for the Navajo. However, many of these have proved unsuccessful while the others have been only partially successful. Basically, today the Navajo lives in the pastoral era as his forefathers had since their return to the Navajo Reservation in the northwest part of New Mexico and northeast Arizona some 100 years ago. The 100,000 Navajo Indians live on a reservation, comparable to the size of West Virginia, with several small towns, the largest of which is only 5,000 population. The opportunity for advancement from their sheepherding environment has been quite limited throughout the years and has been recognized by the Government to be one of the necessary early needs to achieve a higher economic standard of living for these people. Several industrial plants have been established on the reservation which offer limited employment opportunities for the Navajos.

The irrigation of lands by Indians is not new to this country. In the period between 500 and 600 A. D. the Hohokums Indians, who were living at that time in the Gila and Salt River areas of southern Arizona, constructed more than 200 miles of ditches and canals. The creation of irrigation works of such large magnitude required inter-village cooperation and regional control. Yet the Hohokums did not reach a level of social cultural complexity comparable to the early civilizations to the south. This may have been a major factor in the ultimate failure of this project.

Historically, from ancient civilizations to the present, the construction of irrigation works has been associated with the desire for national wealth and power. But today, with the expenditure of public funds, broad social goals are also included, which incorporate a balanced concern for the welfare of the farmer and the region in which he lives. These social goals incorporate the notion of combination of best use of water and land resources. The success of irrigation enterprises is the product of careful use of a well designed system by well trained and equipped farmers. To assure that the investment in physical resources will be properly managed, it is becoming increasingly common to select, train, and provide assistance to project settlers.

^{1/} Project Engineer, Navajo Irrigation Project

The degree of assistance given to settlers varies as widely as the criteria for selection of the settlers. In the United States, services available to irrigation farmers are similar to those available to all farmers, including assistance of farm advisers, cooperative credit and cooperative markets; however, special assistance may be available in certain irrigation developments.

To develop the Navajo Indian Irrigation Project, the assistance offered the Navajo will be more extensive. Colonizing families may be provided with credit for the purchase of homes and farm equipment. An education program is especially important. In this project, the colonists will have been subsistent farmers who lived in almost totally isolated communities. When these people become a part of the developmental project, they will be thrust into the market economy, and are expected to become participants in the national economy and culture. To accomplish these ends, the colonists are encouraged to develop new desires and will be provided with the means to achieve these desires through the improvement of farm techniques and commercialization of agriculture. The type of educational program that becomes an integral part of this scheme must be administered with great care and patience. Such changes come as a shock to colonists from traditional societies and require cultural adjustments on their part. Changes of this magnitude have taken centuries to accomplish through the normal evolution to more advanced economies.

Yet, in the desires for results from national investment in irrigation projects, the time element required for cultural changes may seem extensive. The evolution of the Navajo from the pastoral to the agricultural production era will be a complex procedure, but must be recognized as an essential element of the development of the irrigation project.

WATER

The San Juan River which runs through the northwest corner of New Mexico and west of the Continental Divide contains the only large quantity of undeveloped water in New Mexico. This river now has been tamed and the water stored and available for use behind the Bureau of Reclamation's Navajo Dam. Based on the apportionment under the Upper Colorado River Compact, the State of New Mexico obtains 11.25 percent of Colorado River water available to the Upper Basin States. On the basis of long-term records, this compact allocation is expected to average about 838,000 acre-feet annually. A diversion of approximately 508,000 acre-feet is estimated to be required for the Navajo Indian Irrigation Project. The remaining water will be used for prior rights irrigation, industrial, and municipal usages, as well as for the potential Animas-LaPlata Irrigation Project. In addition to the excellent water supply available for the Project, the quality is outstanding for water in the western United States. The total dissolved solids in the water from Navajo Dam will be approximately 161 parts per million containing about 27 percent sodium with a low salinity hazard

and a low alkalinity hazard. This should provide water for the project that would be suitable for continued use for irrigation of the crops expected to be grown on the project. It will further assure that the full range of adaptable crops can be grown on the project.

LANDS

The lands to be irrigated by the development of the Navajo Indian Irrigation Project are located on the high mesa south of Farmington, ranging from 5,400 feet in the northwest to 6,480 feet in the southeast part of the project, and lying 200 to 800 feet above the entrenched San Juan River. Vegetation of sagebrush, Galleta, Indian Rice, Blue Grams, ring Muhly and Mormon tea are sufficient for year-round grazing; however, the carrying capacity is low, permitting one sheep unit per 22 acres.

The soils, formed from sandstone and shale, are typical of semi-desert soils occupying high plateaus and mesas of the intermountain West. Sand and gravel underlying the soil vary in depth from 8 to 70 feet. The irrigable soils are predominantly sandy loams with loamy sands occurring on the steeper slopes and loams and clay loams in flatter areas. Low in organic matter because of the sparse vegetation and low rainfall, the soil has good water holding capacity, moderate to moderately high infiltration rates, and is well drained. Water movement and root development are not limited, the soil is well aerated, and can be worked under a wide range of moisture conditions. These conditions allow a wide variety of adaptable crops, especially root-type crops and fruits.

Surface and subsurface drainage conditions are quite favorable for most of the project lands. Excess surface water will be diverted to natural or constructed collector drains. Deep collector drains will be provided in areas where the substrata material is not capable of carrying the excess groundwater to the natural outlets. Land will not be irrigated where subsurface drains are not feasible.

CLIMATE

The climate in San Juan Basin is conducive to successful agricultural production. The area enjoys abundant sunshine, low humidity, and considerable differentials between day and nighttime temperatures. Severe weather conditions, such as tornadoes, hurricanes, flooding, snowstorms, smog and hail are rare in the Four Corners area.

Winds present a problem in late winter and early spring. Short afternoon thunderstorms account for almost 50% of the annual rainfall of approximately 8 inches.

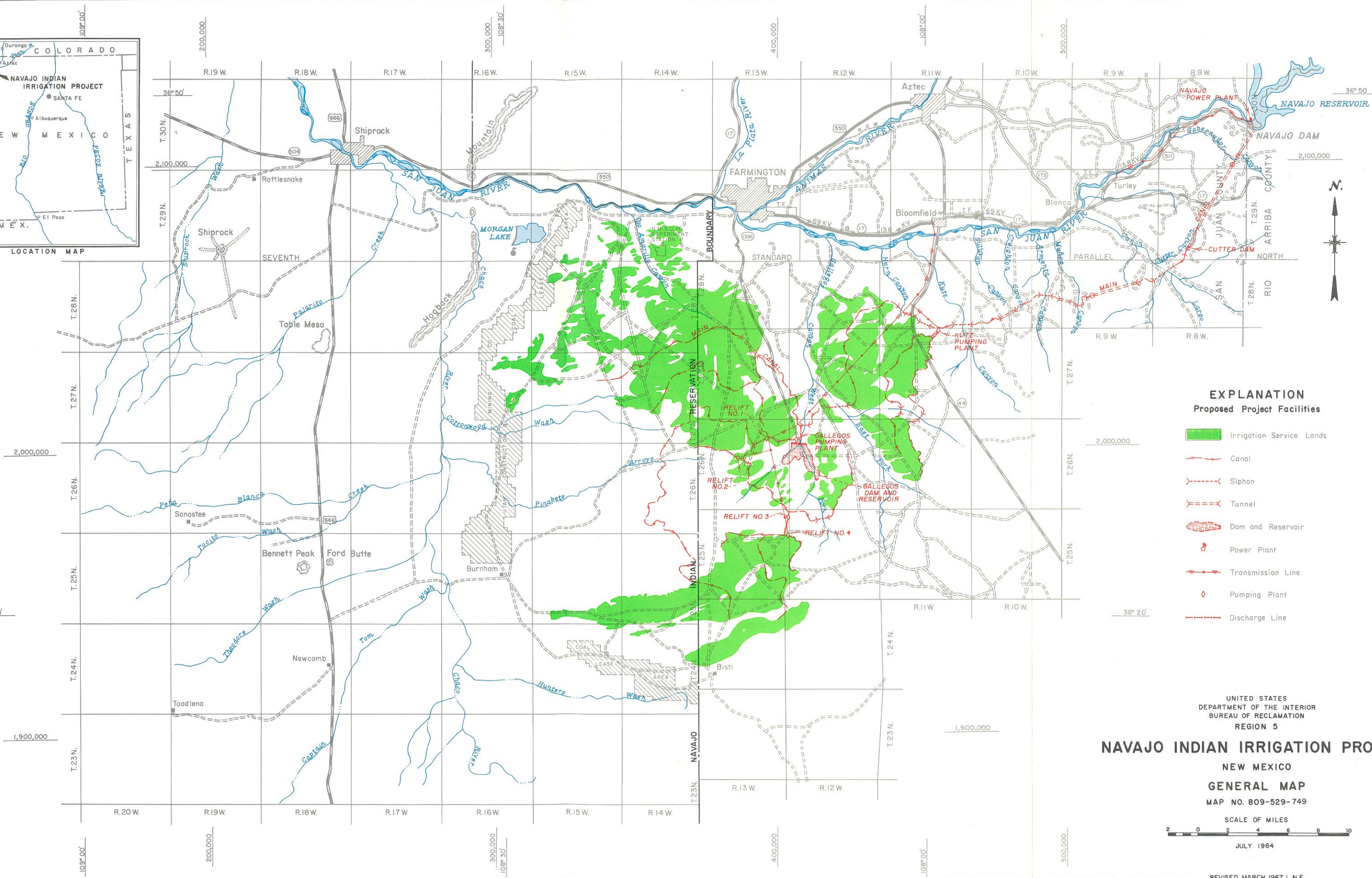
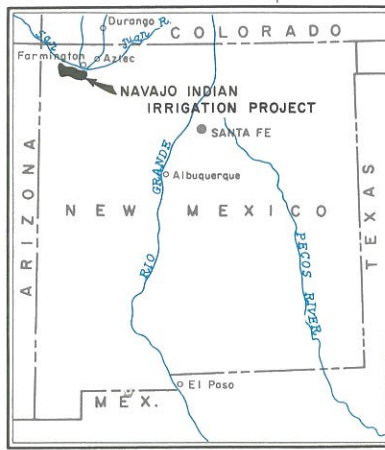
Mid-June through August, the daytime temperatures frequently exceed 90° F, but rarely are over 100°. However, the summer evenings are generally cool. The area experiences about 75 percent of possible sunshine throughout the year. Humidity normally ranges from less than 30 percent during the warmer portion of the day to 60 percent during the cooler early morning hours. The mean annual temperature of nearly 52° permits a growing season of from 146 to 166 days depending upon the elevation and location of the land.

PROJECT DEVELOPMENT

The need for irrigation of lands to provide farming operations for the Navajos was realized 100 years ago. In signing the historic Treaty of 1868 between the Navajos and the Federal Government, one of the provisions stated that productive land would be provided for each Navajo farmer. The application of water to the lands is the major barrier to making the lands productive. The Congress, in passing the project's authorization, recognized this prior commitment of the Government. On June 13, 1962, with the construction of Navajo Dam under way, which is the water supply for the irrigation project, the 87th Congress authorized the construction of a 110,630-acre irrigation project for the primary use of the Navajos. In the legislative history it was stated that the construction of the irrigation project facilities would be performed by the Bureau of Reclamation and the land development facilities by the Bureau of Indian Affairs.

Early in 1963, the Bureau of Reclamation started preconstruction activities, including surveys, land classification and drainage studies, location and design of project works. One of the initial steps was the awarding of two aerial photogrammetric contracts, at a cost of approximately \$400,000, to obtain topographic maps on a scale of 1" = 400' with a 2-foot contour interval. Approximately 188,000 acres were mapped, providing maps for land classification, field layouts, structure locations, and design purposes.

Land classification and drainage studies were initiated on the project areas. These investigations determined drainage requirements, equilibrium salinity, and exchangeable sodium percentage levels, water requirements, soil productivity following land development, anticipated land use and management practices, and chemical suitability of irrigation soil and water erosion. Based on this data, farm layout investigations were also initiated on the project. Between Navajo Reservoir and the first lands there are 25 miles of very rugged country to be traversed with the irrigation facilities. Numerous tunnels, siphons and open canal sections are required to be constructed so that water could be delivered to the irrigable acreages. The diversion requirement is 1,800 c.f.s. of water by the main canal headworks, thus the tunnels are 18 feet in diameter, the siphons 17 feet 6 inches in diameter, and the open canal has a bottom width of 23 feet with 1-1/2 to 1 side slopes. Works of this magnitude width are expensive to



- EXPLANATION**
Proposed Project Facilities
- Irrigation Service Lands
 - Canal
 - Siphon
 - Tunnel
 - Dam and Reservoir
 - Power Plant
 - Transmission Line
 - Pumping Plant
 - Discharge Line

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
REGION 5

NAVAJO INDIAN IRRIGATION PROJECT
NEW MEXICO
GENERAL MAP
MAP NO. 809-529-749

SCALE OF MILES
0 2 4 6 8 10

JULY 1964

REVISED MARCH 1967 L.N.E.

construct and it is estimated that it will require approximately \$66 million for the construction of the first 25 miles of works.

Utilizing the maps previously obtained, it is possible to lay out the lateral distribution system so that the individual farms can be readily served. At the present, it is planned to construct an all pressure-pipe distribution system for the first block of 10,000 acres, thereby permitting sprinkler irrigation of these lands.

PROJECT CONSTRUCTION

To date, project works under construction extend from Navajo Dam to approximately midway to the first lands. The works completed consist of two tunnels, one 2 miles in length and the other 5 miles in length. In addition, work on three siphons and 2.7 miles of canal is practically completed. It will be necessary that five additional contracts be awarded and completed before water can be delivered to the first block of lands. Had funds been appropriated in accordance with the original schedule, it would have permitted irrigation of the first project lands seven years earlier than the now scheduled 1977. Since the first appropriation in 1963, a total of \$28,598,000 has been appropriated for use through June 30, 1969. This is only 16.3 percent of the total required to complete the project while the project has been under construction 39 percent of the original time scheduled for completion.

CONCLUSION

The four basic requirements for an irrigation project; namely, the people, the land, the water and the climate, are available in the project area. Upon completion of the irrigation project, estimated employment of 6,600 Navajos on the project farms, and related industries, will affect the standard of living for approximately 30,000 Navajos. The tremendous effect on the entire Navajo population, and the urgent need for early completion of the project is apparent. Although this project is only one of numerous projects and other items of cost to the Federal Government and must be evaluated in the overall Federal scheme, it appears that the economic evaluation of the benefits to the Navajos should lead to continuous efficient progress and early acquisition of the project benefits.