

PUEBLO WATER RIGHTS ON THE
UPPER RIO GRANDE

by

William J. Balch, Graduate Student
Civil Engineering Department

and

John W. Clark, Professor
Civil Engineering Department

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ABSTRACT

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William J. Balch, Graduate Student
Civil Engineering Department
New Mexico State University

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John W. Clark, Professor
Civil Engineering Department
New Mexico State University

This study concerns the water rights of the Pueblo Indians on the Upper Rio Grande using the Tesuque Pueblo as a case study. The Tesuque Pueblo is one of four Indian pueblos involved in a legal dispute over the water rights of the Pojaque Drainage Basin, located in Santa Fe County, New Mexico. First, a general background affecting this dispute is presented. This background includes the general legal status of Indian water rights in the United States at the present time and the past usage of water by the Pueblo Indians. Using this information, the Pueblo's case is discussed. Then the possible allocation of water rights between the Tesuque Pueblo and their non-Indian neighbors is considered. Lastly, the effect of utilization of these water rights on the immediate hydrological system is discussed.

Chapter 1

INTRODUCTION

The Pueblo Indians of the Pojoaque Drainage Basin, located north of Santa Fe and south of Espanola, are presently involved in a major legal dispute over the determination of their water rights. This thesis concerns the possible allocation of waters between the Tesuque Pueblo and their non-Indian neighbors. At the present time, the surface waters in this basin are over-appropriated and insufficient to meet the water rights the Indians are requesting. This has led to a major conflict between the Indians and other water appropriators who have historically used the surface waters in the basin.

The Pueblo Indians are basing their case on the Winters Doctrine. The Winters Doctrine was originally stated in the Winters Case of 1908 where the U. S. Supreme Court recognized that a federal treaty with an Indian tribe, silent on the subject of waters, had implied a reservation of waters for the Indians' present and future usage. These reserved water rights for the Indians were exempt from state law and based on the power of the Federal government to reserve waters for

Federal lands. Since that time, the Winters Doctrine has been upheld in other similar cases and also has undergone numerous modifications. One of the more important modifications is the qualification of the Indians' reserved waters in terms of "all practicably irrigable acreage" in the Arizona vs California case by the U. S. Supreme Court in 1963. This ruling only applied to the Indian tribes involved in the case, but will probably be used in other cases of this type.

The Pueblo Indians have claimed Winters Doctrine rights in this legal dispute, while the State of New Mexico has claimed the Pueblo Indians, due to their unusual legal past, should have their water rights determined by the prior appropriation laws of the state. The Prior Appropriation Doctrine, the water doctrine of most western states, is based on the premise that the first person to beneficially use a particular water on a continuous basis has a superior right to that water over a later appropriator. The State of New Mexico is claiming this doctrine should be applied to the Pueblo Indians for two reasons. The first reason is that the Pueblo Indians had been under the legal system of Spanish and Mexican law which had traditionally recognized the prior appropriation doctrine. As such, the Pueblos' case is different from other lawsuits involving Indian water

rights where there had been no legal system prior to the arrival of American pioneers. The second argument was that the Pueblos had lost any reserved rights to water by the payments made to them under the Pueblo Land Acts of 1924 and 1933. These payments were made to the Indians to compensate them for loss of lands and water due to illegal acquisition by non-Indians and also due to the failure of the United States government to protect the Indians.

This legal dispute has been a long and complex one and is still in the process of being litigated. Initially, the U. S. District Court for New Mexico ruled in favor of the State of New Mexico, indicating the Pueblo Indians were subject to the prior appropriation laws of the state. Later, in 1976, the U. S. Tenth Circuit Court reversed the lower court's ruling and recognized that the Pueblo Indians were entitled to Winters Doctrine rights. At the present time, the Pueblo Indians have the legal advantage and are claiming they are entitled to sufficient waters to irrigate "all practicably irrigable lands" within the boundaries of the Pueblos.

In past cases of this type the courts have generally ruled in favor of the Indians, but have not awarded them the entire quantity of water they have

requested. Quantification of the Pueblos' water rights will probably involve a compromise whereby the Pueblo Indians will receive water rights considerably greater than they would have under the prior appropriation doctrine of the state, but less than the maximum right they are requesting.

This thesis covers the general legal status of Indian water rights in the United States and discusses the past usage of water by the Pueblos. The present legal dispute is discussed. Then the available legal and technical data are used to determine the possible allocation of waters between the Tesuque Pueblo and their non-Indian neighbors. Using the available data, which is limited, estimates were made of the effect of utilization of these water rights on the hydrological system of the basin.

Chapter 2

GENERAL LEGAL STATUS OF INDIAN WATER RIGHTS IN THE UNITED STATES

History of Indian Water Rights

One of the most important legal questions in the West yet to be fully resolved is the problem of Indian water rights. The American Indians have a federally protected right to a sufficient amount of water for both present and future water needs. This reserved right to water clashes with the prior appropriation doctrine of most of the western states. Basically, the prior appropriation doctrine means the first person to beneficially use a water, on a continuous basis, has a superior right to that water over later appropriators. The problem is that in many water-short regions when the Indians have attempted to use their reserved water rights, other appropriators -- many of them of long-term standing -- are deprived of the water they have traditionally used. On the other hand, the Indians desperately need these waters for the development of their economically depressed lands. The disposition of future court battles resulting from these disputes are going to have a major effect on the economic course of the West, considering the large quantity of water involved. These

court decisions will affect both disputed and "unclaimed" waters.

The single most important case, and the basic starting point in American Indian water rights litigation, is the case of Winters vs United States (1). This case involved the Gros Ventura and Asiniborne tribes who had been reserved a tract of land by treaty with the United States in the territory of Montana in 1888. This property was designated as the Fort Belknap Reservation. Later, in the early 1900's, a dispute arose over the use of the water in the Milk River, which was the northern border of the reservation. The upstream landowners, who acquired the land under the Desert Land Act (Homestead Act), had constructed dams and reservoirs in the year of 1900 to divert the majority of the flow of the Milk River to their lands for the purpose of irrigation. The United States, fulfilling its duty as guardian of the Indians, filed suit to halt the construction of additional water control works and also to halt maintenance of existing water works (1).

Basically, the settlers' case was that they had a legal right to appropriate the "unused" water in the Milk River under the laws of the State of Montana (prior appropriation law).

On the other hand, the Indians claimed the entire flow of the Milk River should be reserved for the future agricultural use of the reservation. The Indians based their claim to this water on the implied reservation of irrigation waters by the Treaty of 1888, even though irrigation waters were not mentioned in the treaty.

This case involved two appeals to the U. S. Ninth Circuit Court of Appeals and one to the United States Supreme Court. The first appeal to the Circuit Court decided in favor of the Indians, stating:

We are of the opinion that, when all the facts, circumstances, conditions, surroundings of the Indians at the time the treaty was entered into are considered, it cannot judicially be said that no portion of the waters of the Milk River was reserved by the terms of that treaty for the use and benefit of the Indians residing on the reservation. Such a construction would be in violation of the true intent and meaning of the terms of the treaty. We must presume that the government and the Indians, in agreeing to the terms of the treaty, acted in utmost good faith toward each other; that they both understood its meaning, purpose and object; that they knew that 'the soil could not be cultivated' without the use of water to irrigate the same. Why was the northern boundary of the reservation located 'in the middle of the Milk River' unless it was for the purpose of reserving the right to the Indians to the use of said water for irrigation, as well as for other purposes. (2)(143 9th District Court, p. 745).

This court also held that the power to reserve the waters for benefit of the Indians was based on the

riparian right of the United States to control of the waters of a stream bordering federal land for use on those lands. The court specifically cited the case of United States vs The Rio Grande Ditch & Irrigation Co

(3). In this case, the court stated:

That in the absence of specific authority from Congress, a state cannot by its legislation destroy the right of the United States, as owner of lands bordering on a stream, to the continued flow of the water, so far at least as may be necessary for the beneficial uses of the government property. (3)(174, U. S. Supreme Court, p. 690)

The second appeal to the U. S. Ninth Circuit Court led to affirmation of the first appeal. The upstream landowners then appealed to the United States Supreme Court in 1907. In January 1908, the Supreme Court affirmed the lower courts' ruling in its entirety and also added some additional comments of its own.

One of the more interesting of these comments was the fact that the Indians gave up their extensive land holdings and retained a smaller tract of land for the express purpose of changing from a nomadic existence to an agricultural one. Since the lands were arid then, the government must have reserved waters so the Indians could successfully farm the land.

Another important comment concerned a rule for liberal interpretation of Indian water rights with the court making this observation:

. . . ambiguities occurring will be resolved from the standpoint of the Indians. And the rule should certainly be applied to determine between two inferences, one of which would support the purpose of the agreement and the other impair or defeat it. (1) (207, U. S. Supreme Court, p. 576)

In summary, the Winters decision construed a federal treaty with an Indian tribe, silent on the subject of waters, as carrying with it a reservation of an unspecified quantum of water from streams to which the lands were riparian, and based on the power of the United States to exempt these waters from appropriation under state laws (4).

Closely following the Winters case, the case of Conrad Investment Co. vs United States arose in 1908. This case was also in the state of Montana, involving a similar dispute concerning the water of Birch Creek. Birch Creek flowed through the Blackfeet reservation, a treaty reservation, and the Indians were entirely dependent on its flow for irrigation of approximately 10,000 acres of its 900,000 acre reservation. The Indians, with government help, had begun irrigating their lands when the investment company dammed off the stream and diverted its entire summer flow to off-reservation lands (5).

This case was heard by the U. S. Ninth Circuit Court of Appeals which ruled in favor of the Indians,

citing the Winters case. The court stated:

The law of that case (Winters) is applicable to the present case and determines the paramount right of the Indians of the Black-foot Indian Reservation to the use of the waters of Birch Creek to the extent reasonably necessary for the purposes of irrigation and stock raising and domestic and other beneficial purposes. (6)(161, 9th Circuit Court, p. 832)

The court also provided for the future needs of the reservation, saying:

What amount of water will be required for these purposes may not be determined with absolute accuracy at this time; but the policy of the government to reserve whatever water of Birch Creek may be reasonably necessary, not only for the present uses, but for future requirements, is clearly within the terms of the treaties as construed by the Supreme Court in the Winters Case. (6)(161, 9th Circuit Court, p. 832).

Thus, the Conrad Investment Company case reaffirmed the Winters decision and also provided for future water requirements for the Indians.

The Winters and Conrad cases involved Indian reservations formed by treaties with the United States. Reservations formed by treaties involve the ceding of lands by the Indians to the United States. In many cases, the United States paid monies to the Indians for the lands ceded, with the stipulation that the monies would be controlled by government agencies for the benefit of the Indians. But many Indian lands were reserved for the Indians by acts of Congress or executive proclamations.

As to whether these lands were entitled to the same water rights as treaty lands was decided in United States vs. Walker River Irrigation District, a case that occurred in Nevada in 1939. The U. S. Ninth Circuit Court of Appeals found in favor of the Indians of the Walker River Reservation, even though the reservation was a non-treaty reservation (7).

In 1956, the Ninth Circuit Court made a significant and somewhat inconsistent decision in United States vs. Ahtanum Irrigation District in the state of Washington. This case involved Ahtanum Creek, the northern boundary of the Yakima Indian Reservation. There was a major complication in this case that clouded its settlement. In 1905, when the Indians sought to use some of the water in Ahtanum Creek, lawsuits were brought against the Indians by non-Indians who had previously appropriated the entire flow of the creek under state law. At this time the Winters case had not been resolved and the Indians did not have its far-reaching power to rely on. Later in 1908 after the Winters decision, the Department of Interior sent its chief engineer, Mr. H. Code, to negotiate a settlement. Without any knowledge of participation by the Indians, he succeeded in negotiating an accord by which the Indians would receive 25 per cent of the natural flow

of the creek and the non-Indians the remaining 75 per cent of the flow (5).

Later, in the 1950's, the United States, acting on behalf of the Indians, brought suit to quiet title to the use of the water in Ahtanum Creek. The Indians claimed they should have title to the entire flow of the stream, and at the very least, 25 percent of the flow guaranteed to them in the 1908 agreement. On the other hand, the Irrigation District argued that the Indians had no rights whatever to the water, because the Yakima Treaty of 1855 was silent on the subject of waters.

Eventually, this case (U.S. vs. Ahtanum) was decided by the U. S. Ninth Circuit Court of Appeals in 1956. First the court recognized that the government had intended to reserve waters from Ahtanum for use by Indians under the Treaty of 1855. The court also stated the treaty implied reservation of waters not only for the present but for future usage as well. Lastly, the court recognized the deal promulgated by W. H. Code in 1908 as binding (8).

Thus, though the Indians were held to have lost some of their waters through the bad bargain negotiated by W. H. Code in 1908, the Ahtanum case stands as a modern enunciation and reaffirmation of the Winters Doctrine rights of reservation Indians (5).

The next major case to deal in Indian water rights was the case of State of Arizona vs State of California. This dispute involved the distribution of the water in the lower Colorado River with Arizona and California pitted against each other. Eventually this case was decided by the United States Supreme Court in 1963, with the court making a large number of precedent-setting decisions in many areas of water law.

The five Indian reservations, all non-treaty reservations, involved in the case were the Chemehuevi, Cocopoh, Yuma, Colorado River and Fort Mohave Reservations (4). In the determination of the quantity of water reserved for the Indians, the Supreme Court stated,

We also agree with the Master's conclusion as to the quantity of water intended to be reserved. He found that the water was intended to satisfy the future as well as the present needs of the Indian Reservations and ruled that enough water was reserved to irrigate all the practicably irrigable acreage on the reservations. (9)(373 U. S. Supreme Court, p. 600, 1963)

The most interesting part of this quote is the attempt to quantify the reserved water rights of the Indians in terms of all practicably irrigable acreage. Previously, the Indians' water rights were somewhat ambiguously stated as for both future and present usage, leading to confusion by both Indians and non-Indians as to the extent of the reserved water rights.

Another important decision resulting from this case is that the priority date of a water right on a federal Indian reservation is the date the reservation was created (9). In other words, a water right created by state law prior to the formation of the Indian reservation is superior to the reserved right of the Indians while state water rights created after the Indian reservation was formed are subordinate.

Legal Review of Indian Water Rights

Indian Rights to Groundwater

There has been little significant litigation concerning Indian rights to groundwater, although virtually all legal scholars agree that Indians do have a right to some of the groundwater under their reservations (10). The quantity of the groundwater the Indians are entitled to is unclear. There is also the question of whether Winters Doctrine rights or some other doctrine applies to groundwater.

One of the few cases involving groundwater is the recent case of United States (Papago Tribe) vs City of Tucson in the state of Arizona. This case was initiated by the United States Government on the behalf of the Papago Tribe to obtain relief from the mining of groundwater by adjacent groundwater users, which was

causing a significant lowering of the groundwater table underneath the reservation. Initially, the Papago Tribe had attempted to limit the suit to only the groundwater-users directly adjacent to the reservation, but the Federal District Court (Case No. 75-39, 1975) ruled that all water-users within the Santa Cruz drainage basin must be involved so as to adjudicate the water rights of all of the claimants. This means that this case will take much longer to reach a conclusion, but all water rights within the basin will be legally determined and quantified.

Quantity of Water Reserved for the Indians

The quantity of water reserved for the Indians is based on the question of "for what purposes will the courts find the Indian reservation was established?" In virtually all of the court cases to date, the courts have maintained that the intent of the government was to convert the Indians from a nomadic, hunting existence to an agricultural economy (5) (11) (12). This interpretation of the usage of the Indians' reserved water rights as being agriculturally based is reinforced by the predominantly agricultural economy of the country when the reservations were being formed.

The actual quantity of water reserved usually has been described by the courts in rather indefinite

terms, leading to confusion among Indians and non-Indians. For instance, in the Winters case of 1908, the Supreme Court left the Indians with an open-ended reserved water right for both present and future water usage for the purpose of " . . . the use of said water for irrigation as well as other purposes." (1) In further discussions the court also stated " . . . to insure the Indians the means wherewith to irrigate their farms and it was so understood by the respective parties to the treaty at the time." (1)

A short time later the U. S. Ninth District Court in the Conrad case determined the Indians reserved water rights in terms of " . . . the use of the waters of Birch Creek to the extent necessary for the purposes of irrigation and stock raising and other beneficial purposes." This court also mentioned that it was not possible for the court to decide the exact quantity of water required for future usage by the Indians, although the court did acknowledge the Indians' right to additional waters in the future (6).

Some legal scholars, especially Mr. W. Veeder, have argued that the "other beneficial purposes" mentioned in both the Winters and Conrad decisions should entitle the Indians to a larger quantity of water than that required for irrigation purposes for the most

profitable development of certain Indian reservations (13). Still, virtually all court decisions to date have reviewed the intent of the treaties at the time they were promulgated and quantified the reserved water rights of the Indians on an agricultural basis.

The most recent decision affecting Indian water rights was Arizona vs California in 1963. In this case the U. S. Supreme Court quantified the water reserved for the five Indian reservations, for both future and present usage, in terms of "all practicably irrigable acreage on the reservations," (9) The wording of this decision is very significant, in that the court actually specified the quantity of water that was reserved for better usage in terms of irrigable acreage instead of leaving the future water right as an open-ended right. This case only determined the water rights of the five reservations involved in the dispute, but this approach to quantifying Indian water rights will probably be used in other similar cases, since this is the most recent ruling on the subject by the Supreme Court.

If Indian water rights are quantified on the basis of all practicably irrigable lands, which is likely, then the additional question is whether the Indians may use this water right for other purposes. There is also the question of whether the Indians may

sell or lease this water right to non-Indian users for off-reservation usage. Even though no court cases have addressed these questions, virtually all legal writers agree that the Indians may use the water allotted to them for any purpose they wish, even though the quantity of water was determined on an agricultural basis (11) (12) (13). The writers also agree that the Indians may sell or lease the water allotted to them, with permission from the federal government, for off-reservation usage (11) (12) (13). Most of these writers base their argument on the fact that the majority of western states allow water rights to be sold separately from the land the water was originally allotted to. These states also allow for changes in type of usage of the water right.

Effect of Indian Water Rights on Non-Indian Appropriators

Indian water rights are rarely established in the initial instrument creating the reservation; rather, their existence is implied after the fact by agencies and the courts (12). This can cause difficulties for non-Indian appropriators who acquired their water rights after the establishment date of the reservation but prior to the Winters decision in 1908. Under these circumstances, the prior appropriators or their ancestors are often unaware that the water they are using has

been reserved for Indian usage. Non-Indian appropriators after the Winters decision of 1908 also appropriated waters either ignoring any possibility of reserved right to the water by the Indians or out of ignorance of Indian water law.

Usually when the Indians have gone to court to obtain usage of their reserved water rights, the courts have agreed in theory with the argument presented for the Indians, but in actuality only given them a portion of the water they sought to gain. For instance, the Fort Belknap Reservation in the Winters case, the Yakimas in the Ahtanum case, and the Walker River Reservation in the Walker case each secured a positive declaration of the Indians paramount, inherent, implied right to the waters from the respective streams. However, in each instance they received a firm award to only a portion of the stream involved, and the remainder was effectually awarded to the non-Indian appropriators who built their economies on the Indians' water (5) (12).

As can be seen by the above examples, it is imperative to inventory and quantify Indian reserved waters, both to protect Indian water rights and to enable development of the remaining waters.

Federal Government Guardianship of Indian Water Rights

The federal government, as trustee to the Indians, has a major conflict of interest in that it is responsible for the management of public resources while at the same time protecting Indian interests in land and water rights. This conflict is especially serious in the Interior Department, which contains both the Bureau of Indian Affairs and the Bureau of Reclamation, the Bureau of Mines and many other similar subunits (12).

Another factor that needs to be considered is that the United States' attorneys are somewhat more inclined to arrange questionable but quick solutions to Indian water right disputes than would private attorneys who would be directly accountable to the Indians (14).

As a result of this state of affairs, on numerous occasions the United States as trustee has not acted in the best interest of the Indians, and when it has acted it has often been much too late (12).

In order for the Indians to have adequate legal counsel in matters concerning water rights, it would seem that the present situation needs to be changed. A possible solution would be to have the federal government set up funds for the Indians to use to obtain private legal counsel.

Chapter 3

HISTORY OF PUEBLOS WITH EMPHASIS ON WATER USAGE

In order to fully understand the present legal dispute concerning the Pueblo Indians' water rights within the Nambe-Pojoaque drainage basin, which includes Tesuque Pueblo, it is necessary to have some basic knowledge of past water usage by the Pueblos. The history that follows emphasizes the role of water in the Pueblos' economy while neglecting other interesting but not directly pertinent subjects.

Pueblos at the Time of the Spanish Exploration

At the time of the initial Spanish exploration, there were several concentrations of Pueblo Indians in what is now the American Southwest. These included the Zuni, Hopi, Acoma, Pecos and several groups living along the Rio Grande and its tributaries. The western Pueblos (Zuni, Hopi, Acoma) had been living for many centuries at their present locations while the Rio Grande Pueblos were relative newcomers to the river basin, having migrated from the Colorado Plateau and the San Juan River Basin in the 1300's (15).

The Pueblo Indians were a sedentary, agrarian people with an agricultural tradition that was centuries old when the Spanish arrived. The importance of agriculture was emphasized by the extensive religious and ceremonial practices surrounding the growing of a crop.

In adjusting to the low rainfall of the Southwest, the Pueblo Indians had evolved a number of specialized farming techniques utilizing either floodwater farming or irrigation (16).

Floodwater farming involves the planting of a crop in an area that will receive a sheet of water whenever it rains. The sites chosen fall into three main types: (1) gentle slopes below rock or shale escarpments, (2) valley floors inundated by sheet floods, and (3) arroyo mouths where floodwaters may be spread out to inundate planted fields. In order for floodwater farming to succeed, the field must be flooded, but the sheet of water must not obtain sufficient velocity as to wash out the crop nor carry such a load of silt as to bury the growing plants (17). Floodwater farming was of major importance to the Pueblo Indians in the past and is still practiced in many of the present-day western pueblos (Acoma, Zuni, Hopi, etc.) (17).

The Pueblo Indians were practicing irrigation at the time of the Spanish Exploration. A number of early

explorers mention the irrigation systems of the Pueblo Indians.

The first major expedition in the area was Coronado's group in 1540-42. Captain Juan Jaramillo, an officer under Coronado, kept a running narrative of his observations in New Mexico. One of his observations was on the irrigation by the Pueblo Indians: "There is an irrigation stream and the country is warm . . . They have corn, beans, and melons for food which I believe never fail them." (18) (Winship, 1896, p. 585)

Espejo's expedition in 1582, the third expedition in the region, provided additional comments about irrigation ditches in the vicinity of Socorro and above:

They have fields of maize, beans, gourds, and herbs in large quantities, which they cultivate like the Mexicans. Some of the fields are under irrigation, possessing very good diverting ditches, while others are dependent upon the weather. (19) (Bolton, 1930, p. 178)

Later in the expedition Espejo commented on the irrigation practices of Acoma Pueblo:

These people have their fields two leagues distant from the Pueblo, near a medium-sized river, and irrigate their farms by little streams of water diverted from a marsh near the river. (20) (Hammond, 1966, p. 224)

In 1591-92 the DeSosa expedition explored the northern Pueblos of the Rio Grande and Pecos Rivers. This expedition moved up the Pecos River until it

encountered a pueblo at the present-day location of the town of Pecos. The expedition then traveled to the Rio Grande River Basin and eventually returned to Mexico by way of the Rio Grande.

In his journal, DeSosa made this observation concerning the first six pueblos (Pecos, Tesuque, Cuyamunge, Nambe, Pojoaque, Jacona) he encountered:

All these six pueblos are irrigated and have irrigation ditches, a thing not believed if we had not seen it with our own eyes. A very great amount of maize, beans, and other vegetables is harvested. (21) (Schroeder, 1966, p. 117)

Later, upon reaching San Ildefonso Pueblo, Espejo recorded this brief note, "This pueblo has a very large area under irrigation." (21) (Schroeder, 1966, pp 117-118)

All experts in the area agree that at the time of the Spanish Exploration, the Pueblo Indians were practicing agriculture using both floodwater and irrigation techniques. Unfortunately, there is considerable disagreement among the experts as to which of these two methods was the most widely used by the Pueblo Indians during this time period. Evidently, additional field work will be required before this controversy will be resolved,

Spanish and Mexican Period

The Spaniards, in establishing their settlements in what is now New Mexico, necessarily chose localities

for which irrigation waters were available due to the low rainfall of the region. The first Spanish settlement was established at San Gabriel in 1598 across the river from the San Juan Pueblo. One of the most pressing items of business was the construction of a community acequia or irrigation ditch. On August 11, 1598, work was begun on an irrigation ditch with Spaniards being assisted in their labors by some 1500 Indians (22). Eventually the town of San Gabriel was abandoned and the colony moved to the site of the present town of Santa Cruz in 1603. In 1609 the town of Santa Fe was established, becoming the Spanish capital for the region. Other settlements were established, although the overall growth of the colony was rather slow.

The sudden revolt of the Pueblo Indians in 1680 caused the abandonment of the entire Spanish colony in New Mexico. During the revolt, the Pueblos killed 21 missionaries, about 380 settlers and forced the remaining survivors to flee the region of the present-day town to Juarez (15). The Pueblo Indians had just cause to hate the Spanish in that they had demanded massive amounts of labor for mission and colonial activities, exacted heavy tributes in the form of foodstuffs, punished the Indians for practicing their native religion, and had even enslaved some of them (23).

For twelve years the Pueblo Indians were left in undisputed possession of the Rio Grande Valley. In 1692 Diego de Vargas led a Spanish army into Pueblo country. By 1694 he had reconquered the Pueblo Indians, thereby opening the valley to resettlement by the Spanish. After the Pueblo Revolt and the subsequent reconquest, the Spanish were considerably more humane in their treatment of the Pueblo Indians (15).

Upon colonization of the Rio Grande Valley, the Spanish developed community acequias or irrigation systems based on the processes developed by peasants of southern Spain, who in turn were influenced by Moorish techniques. These community acequias were also influenced by the methods used by the neighboring Pueblo Indians in their irrigation systems (24).

The construction of the acequias was a community affair involving all settlers that would benefit from the water. Due to the lack of surveying instruments, heavy tools and engineering skills, the irrigation works were simple and were not as efficient as they might have been. For instance, in testing the fall of an acequia under construction, water had to be turned into it frequently to observe the grade since no surveyors were available. Also, the acequias were seldom straight, due to zigzagging to avoid rocks, trees, small hills and other obstructions (25).

The administration of the acequia was by an elected mayordomo or ditch boss who was paid a set salary. Once elected, the mayordomo superintended the construction and repair of the acequia, regulated the number of days of labor required of each appropriator, distributed water, adjudicated disputes, and searched for infractions of regulations (25).

The irrigation practices of the Pueblo Indians were entirely compatible with Spanish institutions and therefore allowed to be continued (26). Gradually the Pueblo Indians adopted many Spanish irrigation practices, such as organization of labor under a mayordomo and techniques of dam and acequia construction. Still, they maintained many ancient ceremonial practices surrounding irrigation, such as planting of prayer sticks in the ditches and ritual dances following cleaning of the acequias in the spring. There were also a number of instances where the Indians and the Spanish practiced joint use of an acequia (25).

Under Spanish rule, the Indians' land and water rights were protected by a number of different laws and royal proclamations from Spain concerning Indian rights in the Americas. The laws for the administration of the Spanish colonies in the Americas were compiled in the monumental Recopilacion de leyes de los Reznos de las Indias of 1681, a condensation of 100,000 royal

pronouncements concerning the Americas since 1492 (27). One of the most important statements in the Recopilacion was that ancient laws and customs of the New World would be respected so far as practicable (26).

Under Spanish rule, the Pueblo Indians were involved in a number of legal disputes concerning land and water. Most of these disputes concerned the infringement of Spanish settlers on land the Pueblos claimed to belong to them. While no proof of formal land grants exist, the Spanish governors for the most part attempted to apply the many measures in the bulky Spanish laws for the protection of all the lands the Pueblo Indians used and occupied (28). In many of these disputes, the phrase the "Pueblo league" or "the given league" is used. This phrasing is thought to have meant there was a recognized minimum right-to-land that the Indians were entitled to. In most of these disputes the courts and officials usually found in favor of the Pueblo Indians (28).

In 1821, Mexico established its independence from Spain and took over jurisdiction of New Mexico. During the relatively short period of Mexican rule, a time period of 25 years, the Mexican government basically retained the same laws and regulations as Spain concerning water rights. By this time the community acequia was well-established, with both the settlers and the Pueblo Indians having a stake in maintaining the status quo.

There was one major change in the status of the Indians during this time period. This change was that the Indians were changed from wards of the government to full-fledged citizens. As citizens, the Indians were entitled to sell their lands, which led to major problems for the Indians in the future (29).

Anglo-American Period to Present

Upon arriving in Santa Fe in 1846, Stephen W. Kearney, a general of the United States Army, proclaimed that New Mexico was now under American rule. One of his first orders was the preparation of a code of laws for administration of New Mexico. The Kearney Code, presented on September 22, 1846, contained a special section concerning water rights, stating:

The law heretofore in force concerning water courses . . . should continue in force except so much of said laws as required the azuntamientos of the different villages to regulate these subjects, which duties and powers are transferred and enjoined upon the alcalades and perfects of several counties.
(30) (1897 Compiled Laws of New Mexico, pp. 89-90)

This section provided for the retention of the basic laws of community acequias with few minor changes in administration of the acequias.

Later, the Treaty of Guadalupe Hidalgo in 1848 and the Gadsden Purchase in 1853 officially placed New

Mexico under United States jurisdiction. These treaties contained provisions to protect Mexican citizens, including Pueblo Indians living within the territory ceded to the United States. So far as community acequias were concerned, what these treaties did was to protect the valid water rights of the acequias then existing (26).

In 1851-52 the territorial legislature enacted the first legislation on acequias. Some of the more important laws enacted were:

1. The course of ditches or acequias established prior to July 20, 1851 shall not be disturbed.(31) (NM Statute 75-14-6)

2. All rivers and streams of water in this territory known prior to January 7, 1852 as public ditches or acequias are established and declared to be public ditches or acequias.(31) (NM Statute 75-14-9)

Later, in 1907, the territorial legislature enacted a comprehensive surface water law for New Mexico. This legislation embodied all of New Mexico's water law up until that point in time, with a few minor exceptions. The major provisions of the water law were that waters belonged to the public; waters were subject to appropriation for beneficial use by the State Engineer who was appointed by the Governor and confirmed by the senate; and also that prior appropriation of water gave superior right over later appropriators (31).

In 1912 the constitution of the new state of New Mexico confirmed a number of provisions in the Water Law of 1907. The first three sections of Chapter XVI of the New Mexico Constitution dealt with water rights and are restated below (32).

Section 1. All existing rights to the use of any water in this state for any useful or beneficial purpose are hereby recognized and confirmed.

Section 2. The unappropriated water of every stream, perennial or torrential, within the State of New Mexico, is hereby declared to belong to the public and to be subject to appropriation for beneficial use, in accordance with the laws of the state. Priority of appropriation shall give better right.

Section 3. Beneficial use shall be the basis, the measure, and the limit of the right to use of water.

All of the above sections are self-explanatory, with the exception of the statement "priority of appropriation shall give better right" which requires additional comment. Prior appropriation means the first person in time to beneficially use a particular water, on a continuous basis, has a superior right to that water than a later appropriator. This means a downstream user of prior appropriation has a "better right" to the water than an upstream landowner. In other words, just because a stream passes through the land of an upstream landowner does not necessarily mean that this landowner has a right to any of the water in that stream.

The present-day water law for New Mexico, with a few minor exceptions, is based on the Water Law of 1907 and the state constitution (32). The biggest addition to the water law of the state since that time has been the Ground Water Law of 1931. The major provisions of this act are:

All ground waters are declared to be public property and to be subject to appropriation for beneficial use (NM Statute 75-11-1); all existing groundwater usage is constituted as a water right (NM Statute 75-11-4); and no license or permit is required to appropriate underground water except in basins declared by the State Engineer to have reasonably ascertainable boundaries. (NM Statute 75-11-21)

All of these laws and regulations protected public acequias of both the Spanish-Americans and the Pueblo Indians. Still the Spanish-Americans and Pueblo Indians experienced major problems in alienation of their lands and sometimes even their water.

The problems surrounding the land claims of the Pueblo Indians during the initial period of United States jurisdiction were very complex. When the United States first took control of New Mexico, there were land grant papers in the Spanish archives for a number of Pueblo Indian communities dated in 1692. These grants were issued in Juarez prior to the reconquest of the Pueblo Indians by the Spanish. The amount of land granted to each of the Pueblos was described in these terms:

" . . . north one league, east one league, on the west one league and on the south one league, to be measured from the four corners of the temple which stands in the center of the Pueblo." (33) (Twitchell, 1914, p. 452)

Not all of the Pueblos could find their grant papers but all claimed to have had grants issued to them. The United States Congress ratified these land grants in 1859. It is interesting to note that later in New Mexico's history, about 1890, these documents were found to be forgeries (33). The evidence supporting this statement is:

1. The signatures on the documents were found to have been falsified.
2. A grant was issued to the Pueblo of Laguna ten years before it was even founded.
3. In certain of the grants several phrases were taken bodily from a book written in 1832 (33). Still, even though formal grants did not exist, it is likely that Congress would have issued land grants to the Indians considering the constant mention of the "Pueblo League" in many disputes adjudicated in the past (28) (33).

During the latter half of the 19th century, Anglos bought or otherwise appropriated the old Spanish and Mexican land grants and took up any available unclaimed land. This led to increased competition for land resulting in the problem of squatters on Pueblo Indian lands. Most of the squatters were Spanish Americans, although increasing

numbers of Anglos became involved as the latter acquired lands formerly held by the Spanish Americans (15).

The problem of Pueblo land dispute was additionally complicated by the legal status of the Pueblo Indians. Under Spanish rule the Indians were wards of the Crown, but became citizens of Mexico in 1821. Being Mexican citizens at the time of the signing of the Treaty of Guadalupe, the Pueblo Indians were given the same rights as other Mexican citizens, including the right to sell their lands. This was an unusual situation since most Indians in the United States were considered to be wards of the federal government and therefore could not sell their lands (34). In several cases, the territorial courts of New Mexico and the United States Supreme Court (U.S. vs Joseph) ruled that the Pueblos had been Mexican citizens and therefore they should have free title to their lands and the right to dispose of it as they saw fit (34).

As previously mentioned, the majority of non-Indian inhabitants on Pueblo lands were illegal squatters, whose descendants later claimed the lands were obtained by purchase (15). Still, a few of these non-Indian land users had purchased lands from the Pueblos in good faith (29).

It was not until 1913, in the case of United States vs. Sandoval (231 U. S. Supreme Court, p. 28), that the United States Supreme Court reversed itself and declared the Pueblos to be Indians. As Indians, the Pueblos were wards of the federal government and therefore incapable of alienating their lands. This decision meant that all lands lost to the Pueblos in the past were without legal basis (23).

The effect of the Sandoval decision was to spread consternation among the people of New Mexico who held lands to which the Pueblos laid claim. A senator from New Mexico, Holm O. Bursum, introduced a bill into the Senate in 1921 to quiet title to lands within the Pueblo land grants. On the surface this bill seemed to be what was needed at the time, but closer inspection of the bill revealed that it would place non-Indian landholders of Indian land in a favorable position to obtain clear title to the lands they acquired. This bill seemed slated to be enacted since it had the backing of the Harding Administration. To the defense of the Indians, a strong opposition to the Bursum bill was organized by two groups, the New Mexico Association on Indian Affairs and the General Federation of Women's Clubs. Under the attack of these two groups and the Pueblo Indians themselves, the Bursum bill was eventually killed (29).

Finally, in 1924, the Pueblo Land Act was passed by Congress which provided for the establishment of the Pueblo Lands Board to investigate each non-Indian land claim. Where adverse occupation, with payment of taxes, had continued for 35 years without title papers, or 22 years with title papers, the United States issued a patent to the non-Indian landholder. In cases where the non-Indian landholder's claim was rejected by the Board, the claimant was paid for improvements to the land by the government with the lands reverting back to the Pueblos. For the lands that the Pueblos lost in these proceedings, the Indians were compensated by the federal government and in several instances replacement lands and waters were purchased by the Pueblos. Additional monies were provided to the Pueblo Land Board for monetary grants to individual pueblos by another act of Congress in 1933 (29).

The land holdings of the Pueblo Indians were increased between 1900 and 1940 by executive orders, acts of Congress or Resettlement Administration purchases. With government assistance, the Pueblos also improved existing irrigation systems, thereby increasing the irrigated acreage in the pueblos of Tesuque, San Ildefonso, Acoma, Laguna and Zuni (35). Also, when the Middle Rio Grande Conservancy District was set up, six pueblos (Cochiti, San Felipe, Santo Domingo, Sandia, Santa Ana

and Isleta) were incorporated into it, thereby increasing the irrigated acreage in these pueblos. It is interesting to note that the Bureau of Indian Affairs undertook the financial responsibility for the pueblos' share of the cost of the project (36).

Basically, the main goal of obtaining these additional lands and waters for the pueblos was to provide them with an adequate land-base to practice stock-raising and subsistence farming (35).

Chapter 4

PRESENT WATER RIGHTS STATUS OF TESUQUE PUEBLO

General View of the Problem

Tesuque, a Tewa-speaking pueblo, is located five miles north of Santa Fe. This pueblo has a total population of approximately 200 residents (15). The basic economy has moved from agriculture to wage work. The unemployment rate in the Pueblo is high (in 1964 it was estimated at 48 per cent) with fluctuations in the rate due to seasonal and temporary employment opportunities (36). Later information on the unemployment rate was not found, but a book written in 1976 estimates the unemployment rate in all pueblos to be close to 50 per cent (37).

The Pueblo Indians, as well as most other Indians in New Mexico, have philosophical as well as religious differences that directly conflict with western society. Some of the more important differences are the Indians' feelings of identity and harmony with nature, the emphasis of the group over the individual, the importance of the present as opposed to the future, and lastly, a great respect for age and the traditional ways of doing things. As a result, these people with few exceptions (which

fortunately are becoming more numerous) do not enter into the competition-oriented mainstream of America (38).

One of the major goals of virtually all the pueblos is to attract industry or other employers to the pueblos. The pueblos have a number of benefits for future employers such as tax-free land, certain water rights, funds available for training labor, a stable labor pool whose numbers are characterized by excellent eye-hand coordination, patience and finger dexterity. The Pueblos can also lease land for a 25-year period plus a 25-year renewal (26).

The ideal of most Pueblo Indians is to have a job and to be able to live at their pueblos. The Pueblo Indians who live off the pueblos usually experience a considerable amount of cultural shock and also a great deal of homesickness for the social group. As a result of these factors, they usually return to the pueblos, leaving the jobs behind that they have found (36).

Even though agriculture is not the dominant economic factor it used to be, it is rather interesting to note that the indigenous religion and ceremonialism connected with growing a crop is still very important to the pueblo village.

There are a number of factors leading to the decline of the importance of subsistence agriculture in

the pueblos. One of the more important factors is the method of transferring lands from one generation to the next. By law the lands belong to the pueblo, with the pueblo council controlling its use. In actuality, use rights of land are inherited. This practice over many generations has resulted in small, widely scattered land holdings, making it impossible for a man to make a living farming (36). Another factor is the decreased popularity of subsistence farming, due to the large effort required for a rather small rate of return (39). Lastly, small farms all over the United States are going out of business due to the expensive technological advances that have been utilized by larger farms, making smaller farms less competitive. All of these factors -- small, widely scattered lot size, decreased interest in subsistence farming, and the uncompetitive status of small farms -- has led to a decrease in agricultural activity at a number of pueblos.

At Tesuque Pueblo, the Indians are presently farming about 245 acres of irrigated land (40)(41). Most of the farming is of subsistence type, the main crops being corn, chile and beans. In the past as much as 320 acres were irrigated (40). The reason for the decrease in farming activity is due to the lack of irrigation waters and also a decreased interest in farming.

In 1962, the State Engineers Office started proceedings to adjudicate the water rights of all water-users in the Nambé-Pojoaque-Tesuque drainage basin. The reason the State Engineer's Office initiated these proceedings was to facilitate the administration of the waters that would soon be entering the Rio Grande upon completion of the San Juan-Chama Project from the San Juan River Drainage Basin. Prior to this time the amount of water used by the various appropriators was generally determined by the locally elected officials of the various community ditches. In other words, water-users within the drainage basin did not have formal water rights other than the fact that they had used these waters in the past.

The adjudication proceedings immediately led to a clash between the State Engineer's Office and the Pueblo Indians within the drainage basin. Basically, the State Engineer's Office claimed that the water rights of the Pueblo Indians should be determined by the laws of the State of New Mexico (prior appropriation), while the Indians claimed a Winters Doctrine right to as much water as was necessary to irrigate all irrigable lands on the pueblos.

The effect of the Winters Doctrine rights on the non-Indian users within the basin could lead to the loss

of water rights for a large number of water-users. This is especially true of water-users on the Rio Tesuque Creek, while the effect would not be so severe on the Pojoaque River and Pojoaque Creek due to the new Nambe Falls Dam. A solution to this problem may be to satisfy part of the Winters Doctrine demand by using groundwater, but this leads to additional problems in that withdrawing groundwater is likely to lower the quantity of water flowing in the streams of the area. This topic will be covered in greater detail in the technical section of this report.

The vast majority of non-Indian water-users in the drainage basin have Spanish surnames. Most of these water-users are irrigating five acres of land or less (41).

Legal Status of Tesuque Pueblo

The State Engineer's Office started the adjudication of the water rights of the Nambe-Popaque-Tesuque drainage basin by first determining the amount of land being irrigated and who owned this land. This process involved the photographing of the area from the air. These photos were then enlarged to the approximate scale of the finished maps. Next, field crews were sent out to walk the irrigation ditches and delineate irrigated acreage on

the photographs. These field crews also took notes on the source of the water, the extent of the land, past usage, crops being grown, and ownership of the land. Using the photographs and the field notes, it was then possible to draw a complete set of maps showing the agricultural usage of water within the basin.

At the same time the maps were being prepared, a survey report was also prepared. This report stated whether a water right was found and the extent of the water right. One of the more important factors determining whether a water right was found was whether the land had been irrigated within the last four years, since by state law a water right may be lost if it has not been used within this time period (31).

After completion of the maps and the survey report, the legal section of the State Engineer's Office then filed suit in United States District Court of New Mexico in order to legally establish the water rights of the users within the basin. This suit, New Mexico vs. Lee Aamodt (Case No. 6639), was initiated in 1966 (43)(see also (42)). In this suit, the State Engineer's Office filed against the four pueblos and hundreds of non-Indian parties in the basin. Basically, this procedure involved the State Engineer's Office making an offer of a water right which the water-user might accept or reject. If the water-user rejected

the water right offer, then the court was to decide the issue. In this suit, the State Engineer's Office alleged that all the users in the Pojoaque drainage basin, including the Pueblo Indians, were subject to New Mexico prior-appropriation law.

The United States filed a motion to dismiss the action for lack of jurisdiction of the court and then entered a motion to intervene in the lawsuit. The United States based these actions on its role as trustee for the Pueblo Indians and as owner of the Santa Fe National Forest (42). In the complaint to intervene in the lawsuit, the United States claimed Winters Doctrine rights to the use of the water for the Pueblo Tribe (14). As a result of the motion to intervene, the United States and the four pueblos were joined together as plaintiffs. What this did was to effectively split this case into two separate legal proceedings. The first proceeding was to determine the non-Indian water-users' rights in the standard legal method. The second action involved the determination of the Pueblo Indian water rights in the legal form of the Pueblo Indians versus private water-users and the State of New Mexico.

At that time, the Bureau of Indian Affairs determined there was a conflict of interest between the United States, as owner of the Santa Fe National Forest, and the

Pueblo Indians. Reacting to their findings, the Bureau of Indian Affairs obtained monies for the Pueblos to hire private legal counsel. The private attorneys obtained by the Indians filed a motion to intervene. The District Court then ruled that the Indians could not be represented by the private attorneys since they were already represented by government counsel (42).

The State of New Mexico based its case on two basic principles. The first principle was that the Pueblo Indians had been under the legal system of Spanish and Mexican law, which had traditionally recognized the prior-appropriation doctrine. As such, the Pueblos' case was different from other suits involving Indian water rights where there had been no legal system prior to the arrival of American pioneers. The second argument was that the Pueblos had lost any reserved rights to water by the payments made to them under the Pueblo Land Acts of 1924 and 1933 for the land and waters lost to them at that time (42).

On the other hand, the Pueblo Indians claimed that, as Indians, they were entitled to full Winters Doctrine rights. They also claimed that the monies paid to them under the Pueblo Land Acts did not cause forfeiture of reserved water rights on lands they presently owned.

This case was eventually decided by the United States District Court for New Mexico in 1973. Basically, the court decided in favor of the State of New Mexico and instructed the water master to determine the water rights of the Pueblo Indians in terms of the prior appropriation doctrine.

The United States, acting on behalf of the Pueblos, appealed this case to the United States Tenth Circuit Court of Appeals.

The United States Circuit Court decided this case in June of 1976. In all issues at bar this court found in favor of the Pueblos, thereby reversing the lower court's rulings.

The first question the court dealt with was the question of whether the Indians were entitled to private legal counsel. The court stated:

The claim that the Pueblos are adequately represented by government counsel is not impressive. Government counsel are competent and able, but they concede that a conflict of interest exists between the proprietary interests of the United States and the Pueblos. In such a situation, adequate representation of both interests by the same counsel is impossible. (42)(537, 10th Circuit Court, p. 1106)

Later in its decision the court also made this comment; "The District Court erred in denying the rights of the Pueblos to independent representation by private counsel." (42)(537, 10th Circuit Court, p. 1107)

This is an extremely important ruling, in that whenever a conflict of interest should occur between the Indians and the United States in any case involving water rights, the Indians may obtain independent legal counsel.

Next the court ruled that the Pueblo Land Acts of 1924 and 1933 did not cause the Pueblos to lose their right to claim reversed rights to water. The court specifically cited Chapter 9 of the 1933 act which reads as follows:

Nothing herein contained shall in any manner be construed to deprive any of the Pueblo Indians of a prior right to the use of waters from streams running through or bordering on their respective pueblos for domestic, stock water and irrigation purposes for the land remaining in Indian ownership, and such water rights shall not be subject to loss by nonuse as abandonment thereof as long as title to said lands shall remain in the Indians. (Pueblo Land Act of 1933, Chapter 9)

The court then stated,

The water rights of the Pueblos are not subject to the laws of New Mexico because the United States has never surrendered its jurisdiction and control. (42)(537 10th Circuit Court, p. 1112)

In other words, the Pueblo Indians do have a reserved right to water under the Winters Doctrine.

The court then discussed the relationship of Indian water rights versus non-Indian water rights. The court recognized three classes of non-Indian appropriators. The first class was those claimants who had been appropriating water prior to the act of Congress in 1858 which

confirmed the land titles of the Pueblo Indians. For this first class of appropriators, the court decided the laws of Spain and Mexico were to be used to determine between Indian and non-Indian appropriators of this class. With these instructions the court then referred actual determination of water rights for this group back to the District Court (42).

The second class of non-Indian appropriators are those who held lands within the drainage basin as the result of some circumstance occurring after 1858, other than failure of the United States to reasonably protect the rights of the Pueblos (42). The court refused to comment on this class of appropriators due to the lack of information concerning the claims of this group. The court then referred the determination of the relationship between this class of appropriators and the Pueblo Indians back to the District Court for solution.

The third class of non-Indian appropriators was those who obtained title to their lands by way of the Pueblo Land Acts. The court stated that the Pueblo water rights were superior to this class of non-Indian appropriators (42).

In summary, then, the United States Circuit Court reversed the United States District Court's rulings, thereby allowing the Indians to hire independent legal

counsel if they so desired. As a result of this ruling, the Indians have obtained private legal counsel who are presently working with federal government attorneys on the Indians' case. As for Winters Doctrine rights, the Circuit Court recognized that the Pueblos were entitled to these reserved rights and referred the case back to the District Court for actual quantification of these reserved water rights.

The State Engineer's Office, after the rulings by the U.S. Circuit Court, applied for a rehearing of the case by this court. The Circuit Court denied a rehearing in August of 1976. The State Engineer's Office then appealed to the U.S. Supreme Court. The Supreme Court reviewed the appeal and decided not to hear the case. This means that the State Engineer's Office is effectively blocked and must resign itself to the Circuit Court's rulings.

This case will now return to the U.S. District Court for final settlement. It will probably be resolved by having a number of hearings until a suitable compromise is worked out. In all probability, the Indians will receive water rights considerably in excess of the water rights they would receive by quantification in terms of presently and historically irrigated acreage. On the other hand, the Indians will probably not receive the absolute maximum water rights they are requesting. Basically, the Indians

are requesting water rights for virtually all lands that are relatively flat and have soils capable of growing a crop. This means that much of the smaller, isolated areas would not be practicably irrigable since these smaller areas would not justify the cost of drilling an irrigation well. There is an additional complication in that this case is dealing with groundwater. At the present time, it has not been determined whether the Winters Doctrine applies to groundwater or whether some other doctrine applies, such as the Prior Appropriation Doctrine or the Reasonable Use Doctrine.

Chapter 5

WATER RIGHTS

Quantity of Water Awarded Per Acre

The consumptive irrigation requirement for irrigated areas in the Pojoaque Drainage Basin has been determined by use of the Blaney-Criddle formula. This formula has been used extensively in New Mexico and is considered to provide reasonable estimates of water use (44).

The consumptive irrigation use (U) is the depth of water required by the crop over the entire growing season for transpiration, building of plant tissue and evaporation from adjacent surfaces. Consumptive use assumes the irrigation efficiency is 100% and does not take into account precipitation or stored soil moisture. The Blaney-Criddle formula is (45):

$$U = KF$$

U = consumptive use (in inches)

K = empirical crop consumption use coefficient for the growing season (see Table 1, K values)

F = sum of monthly consumptive use factors (f)
for growing season

$$f = \frac{t \times p}{100} = \text{monthly consumptive-use factors}$$

TABLE 1

Seasonal Consumptive-Use Coefficients (K)*
for Irrigated Crops in New Mexico

Crop	Normal growing season or period	Consumptive-use coefficient (K)	
		Frost-free period	Before and after frost-free period
Alfalfa	6 to 7 months	0.85	0.50
Beans	3 months	.60	
Broomcorn	4 to 5 months	.70	
Cantaloupes	4 to 5 months	.65	
Carrots	4 months	.65	.40
Chili	5 months	.70	
Corn (grain)	4 months	.75	
Cotton	7 months	.62	.40 [#]
Grain (small spring)	3 months	.70 [/]	
Grain (small winter)	---	.70 ^{**}	.35 ^{##}
Grass-hay	6 to 7 months	.75	.50
Lettuce	---	.65	.40
Onions	---	.65	.40
Orchard (deciduous)	Between frosts	.65	.40
Pasture (improved mixed)	6 to 7 months	.75-.85	.50
Pasture (unimproved & vega)	6 to 7 months	.70-.75	.50
Peanuts	---	.70	
Pecans	Between frosts	.70	
Potatoes (Irish)	---	.70	
Potatoes (sweet)	---	.70	
Sorghum (grain)	4 to 5 months	.70	
Sugar beets	6 months	.70	.40
Tomatoes	4 to 5 months	.70	

* $K = \frac{U}{F} = \frac{\text{Consumptive use}}{\text{Consumptive-use factor}} = \text{consumptive-use coefficient.}$

Between pre-plant irrigation and planting date.

/ Between planting and harvesting dates.

** Period March 1 to harvest date.

For months of Sept., Oct., Nov., Jan., and Feb.

(45) From Consumptive Use and Water Requirements in New Mexico, p. 25.

t = mean monthly temperature in degrees Fahrenheit

p = monthly percent of daytime hours of the year

(see Table 2, List of P values)

In metric units:

change $t = 45.7 t_c + 813$ if the mean monthly temperature (t_c) is in degrees centigrade,

then $U = KF$ = seasonal consumptive use in millimeters

Once the consumptive use for the growing season has been determined, it is possible to calculate the consumptive irrigation requirement. The consumptive irrigation requirement (CIR) is calculated by this equation:

$$CIR = U - R$$

CIR = consumptive irrigation requirement

U = consumptive use

R = sum of monthly effective rainfall in growing season.

Finally, the irrigation requirement is determined by this equation:

$$IR = \frac{U - R}{E} = \frac{CIR}{E}$$

U = consumptive irrigation use

CIR = consumptive irrigation requirement

R = sum of monthly effective rainfall in growing season

E = irrigation efficiency of farms in region.

Table 2

Monthly Percentage of Annual Daytime Hours
at Latitude of Espanola (36°56' North)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Total
	6.99	6.86	8.35	8.85	9.83	9.83	9.99	9.40	8.36	7.85	6.92	6.79	100

(41) From Nambe-Pojoaque-Tesuque Hydrological Survey Report, p. 5.

The irrigation requirement is the actual quantity of water that must be delivered to the farm gate to irrigate the land. As can be seen by the above equation, the irrigation requirement is dependent on the irrigation efficiency of the farms in the region. Farm irrigation efficiency depends on a number of factors such as the irrigation method used, porosity of soil, skill of the irrigator, and the slope of the land. Probably the factor having the greatest effect on irrigation efficiency, aside from the handling of the water by the irrigator himself, is the soil on the farm. For examples of the effect of different soils on efficiency, see Table 3.

The consumptive irrigation requirement for the Pojoaque Drainage Basin has been calculated using existing data for temperature, average growing season, type of crops being grown in the basin, and also the monthly percent of daytime hours. The consumptive irrigation requirement is approximately 1.5 acre feet of water per year (41). The State Engineer's Office then assumed the farm irrigation efficiency in the Pojoaque Basin was approximately 50 percent and determined the water requirement at the farm head to be 3.0 acre feet of water per year for successful irrigation within the basin (41). In its adjudication proceedings, this value, 3.0 acre feet of water per year, is the quantity of water the State Engineer is offering per acre of irrigated land.

Table 3

Examples of Water Application Losses and Farm Irrigation Efficiencies
for Different Soil Groups

Item	Open Porous	Medium Loam	Heavy Clay
	<u>Percent</u>	<u>Percent</u>	<u>Percent</u>
Farm Lateral Loss	15	10	5
Surface Runoff Loss	5	10	25
Deep Percolation Loss	35	15	10
Farm Irrigation Efficiency	45	65	60

(45) From Consumptive Use and Water Requirements in New Mexico, p. 31.

Quantity of Acreage Practicably Irrigable
on Tesuque Pueblo

The Tesuque Pueblo is presently irrigating approximately 245 acres (40)(41). They are claiming that they are entitled to sufficient water to irrigate 2,650 acres of land (46)(see inside back cover). This claim is based on the assumption that all relatively flat lands with soils capable of supporting a crop are entitled to water rights. Some of the lands the Pueblos are claiming water for are small, isolated bits of land or are long, thin strips of land that are not practicably irrigable. The majority of Tesuque Pueblo's water rights will be satisfied by groundwater rights since the surface water available to the pueblo is inadequate to meet the demand.

There are a limited number of wells on the pueblo, leading to problems of obtaining information about the groundwater situation beneath the pueblo. What information is known is from the town site of the pueblo itself, which is located on Tesuque Creek. Information about the rest of the pueblo's lands is lacking, and as a result of this, no water table contour maps are available.

Due to this lack of information, the calculation of the minimum acreage that would justify drilling an irrigation well involved a number of assumptions. One of the most important assumptions was to choose the average

depth of water to be 100 feet. This value was chosen using the height of the water table to be approximately equal to the elevation of Tesuque Creek and also using the contours of the ground surface. The calculation of the minimum number of acres that justifies drilling a well is shown below.

Assumptions

100 feet from ground surface to water table
 200 feet well-depth
 50 feet drawdown
 150 feet lift required
 350 gpm - this will place 3 inches of water on
 5 acres in 19.4 hours
 8" casing - 5½" to 6" bowl size on pump to pump
 350 gpm
 \$50 per acre foot - maximum cost of water (expensive water)

Capital Cost

\$4,400	drilling cost, grouting, well casing (\$22 per foot)
700	well piping (\$3.20 per foot for 3" steel pipe)
160	water meter
2,900	pump, meter, wiring, control panel
650	installation cost of pump, motor, wiring, etc.
<hr/>	
\$8,810	

8% interest rate with 20 year life = A/P = .10185
 (\$8,810) x (.10185) = \$897.34 = cost per year for
 amortization

Energy Costs for Pumping 1 Acre Foot of Water

$$\frac{(1 \text{ acre ft}) \times (3.26 \times 10^5 \text{ gal/acre ft})}{(350 \text{ gal/min}) \times (60 \text{ min/hr})} = 15.5 \text{ hours}$$

to pump 1 acre foot

$$(350 \text{ gal/min}) \times (1 \text{ min/60 sec}) \times (8.34 \text{ lbs/1 gal}) \\ \times (150 \text{ ft}) = 7,297.5 \text{ ft lb/sec}$$

Pump and motor together are 65 percent efficient

$$\frac{7,297.5 \text{ ft lb/sec}}{.65} = 11,227 \text{ ft lb/sec}$$

$$(11,227 \text{ ft lb/sec}) \times (1.356 \times 10^{-3} \text{ kilowatt/ft lb/sec}) \\ = 15.3 \text{ kilowatt used for pumping 1 acre foot}$$

Irrigation rate structure = 3.5 cents per kilowatt

$$(15.5 \text{ hr/acre ft}) \times (15.3 \text{ KW/hr}) \times (.035 \text{ dollar/KW}) \\ = \$8.30 \text{ per acre ft}$$

Energy cost for pumping = \$8.30 per acre ft

Operation and Maintenance Costs

Assume \$350 a year for operation and maintenance
 (greasing, cleaning, well screen, pump and motor repairs,
 alignment problems, etc).

Insurance Costs

\$210 a year to insure pump and motor (\$2900). These
 are high-risk items due to theft and lightning.

Minimum Acreage Calculations

$$\frac{\text{max cost}}{\text{acre ft}} = \frac{\text{capital cost}}{\text{acre ft}} + \frac{\text{energy cost}}{\text{acre ft}} + \frac{\text{op. \& main.}}{\text{acre ft}}$$

$$+ \frac{\text{ins.}}{\text{acre ft}}$$

$$\$50 = \frac{\$897.30}{x} + \$8.30 + \frac{\$350.00}{x} + \frac{\$210.00}{x}$$

$$x = 34.95 \text{ acre ft of water}$$

minimum acreage that justifies drilling a well =

$$\frac{34.95 \text{ acre ft}}{3 \text{ acre ft/acre}} = 11.65 \text{ acres}$$

Rounding off gives 12 acres

12 acres or more justifies drilling a well (taxes not included).

Assuming small, isolated acreages of less than 12 acres are uneconomical to irrigate, then 330 acres of land the Tesuque Pueblo is claiming water rights for is not practicably irrigable (46)(see map at back of thesis). There is an additional factor, in that much of this land is not practicably irrigable due to shape problems. Most of these lands are small bumps and protrusions projecting from larger tracts of arable land. Elimination of these lands would cause an additional 225 acres to be uneconomical to irrigate (46)(see map at back of thesis).

Subtracting 330 acres and 225 acres from the original 2,650 acres leaves 2,095 acres that are practicably irrigable. Assuming the criteria of practicably irrigable land is the only consideration, then the Tesuque Pueblo

will receive water rights for approximately 2,095 acres of 6,285 acre feet of water.

Surface Water

The principle source of surface water for Tesuque Pueblo is Tesuque Creek which passes through the pueblo and then empties into the Pojoaque River, which empties into the Rio Grande River (41)(see Figure 1). At the present time, irrigation water from Tesuque Creek is used to irrigate 109.5 acres upstream of the pueblo, 245 acres on the pueblo, and 114 acres below the pueblo (41). The water appropriators on Tesuque Creek have major problems of water scarcity during irrigation season. This problem is especially severe for the Tesuque Pueblo and water-users downstream from them. Looking at the estimated streamflow at the upstream boundary of the pueblo shows that the average flow entering the pueblo during the growing season (from May 12 to October 14) is approximately 620 acre feet (47)(see Table 4). Assuming the pueblo uses all of the water entering their pueblo means that they are using only 2.53 acre feet of water per irrigated acre. There is a further complication in that the streamflow varies to a large extent from year to year. Also, the streamflow tends to be fairly large during May and June but declines during July, August and September. The survey report for the Pojoaque Drainage Basin found no irrigation wells on the Tesuque

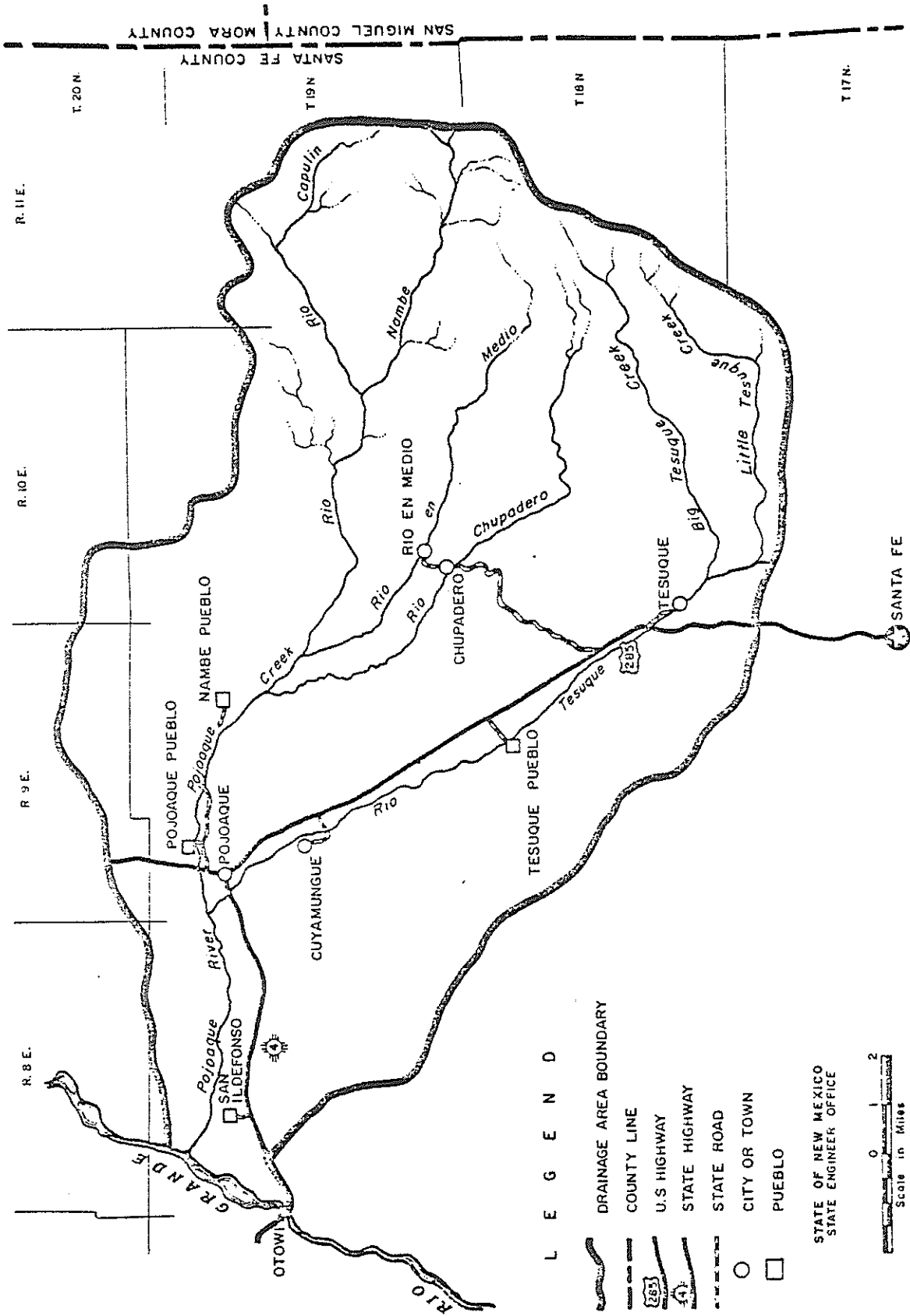


Table 4 --Mean-monthly and annual discharge, in acre-feet, of
Rio Tesuque at Tesuque Pueblo boundary (Site 5)

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual
1935	0	0	0	61	350	840	82	143	163	8	0	0	1,650
1936	0	0	0	164	276	90	0	55	21	43	13	0	662
1937	0	0	30	306	470	448	44	0	0	0	0	0	1,300
1938	0	0	0	52	137	53	16	18	13	18	0	0	312
1939	0	0	128	302	350	98	0	0	0	22	0	0	960
1940	0	0	133	256	400	153	0	0	0	0	0	0	942
1941	0	0	106	293	1,730	1,220	303	100	132	438	240	47	4,610
1942	12	0	43	1,180	1,120	505	25	0	0	0	0	0	2,830
1943	0	0	0	150	165	50	0	0	0	0	0	0	365
1944	0	0	0	124	515	303	197	86	0	1	0	0	1,230
1945	0	0	61	257	850	325	25	0	0	0	0	0	1,520
1946	0	0	0	97	33	0	0	52	0	0	0	0	182
1947	0	0	0	8	266	61	0	0	0	0	0	0	335
1948	0	0	0	188	388	323	29	0	0	0	0	0	928
1949	0	0	0	167	505	400	192	63	0	0	0	0	1,330
1950	0	0	0	0	0	0	0	0	0	0	0	0	0
1951	0	0	0	0	0	0	0	13	0	0	0	0	13
1952	0	0	18	235	455	365	23	0	0	0	0	0	1,100
1953	0	0	22	53	210	177	23	0	0	0	0	0	485
1954	0	0	0	86	115	7	0	0	0	0	0	0	208
1955	0	0	0	0	137	65	18	155	68	0	0	0	443
1956	0	0	0	0	0	0	0	0	0	0	0	0	0
1957	0	0	0	160	290	338	87	236	136	25	33	4	1,310
1958	0	2	73	600	930	512	42	0	0	0	0	0	2,160
1959	0	0	0	0	56	0	0	40	0	0	0	0	96
1960	0	0	325	580	294	254	110	3	0	0	0	0	1,570
1961	0	0	0	197	251	119	3	45	21	0	0	0	635
1962	0	0	21	330	294	31	0	0	0	0	0	0	675
1963	0	0	55	192	130	3	0	0	16	0	0	0	401
1964	0	0	0	31	137	43	0	0	0	0	0	0	216
1965	0	0	0	127	340	422	110	71	63	10	22	25	1,190
1966	0	0	71	164	240	104	7	57	0	0	0	0	643
1967	0	0	0	0	0	0	0	34	35	0	0	0	69
1968	0	0	4	25	157	254	55	110	13	0	0	0	618
1969	0	17	0	164	322	266	12	0	12	0	3	0	796
1970	0	0	0	0	130	92	13	61	21	0	0	0	317
1971	0	0	0	0	0	0	0	27	0	0	10	3	40
1972	0	0	56	8	18	27	0	0	0	0	31	13	153
Total	12	19	1,146	6,557	12,061	7,963	1,416	1,369	714	565	352	93	32,267
Mean	0.3	.5	30	173	317	210	37	36	18	15	9.3	2.4	849

(47) From Estimated Availability of Surface and Groundwater in the
Pojoaque River Drainage Basin, Santa Fe County, New Mexico,
p. 20.

Pueblo, indicating their irrigated acreage is dependent on streamflow and precipitation (41).

Downstream appropriators on the Tesuque Creek are presently dependent on excess streamflow not utilized by the pueblo, groundwater infiltration into the stream, surface waterflow entering the stream from precipitation, and supplemental irrigation wells.

Assuming the pueblo obtains sufficient water rights to irrigate all practicably irrigable lands, then there is a problem of how the water rights will be met. If all upstream users quit irrigating and the pueblo is allocated the entire streamflow during the growing season, then only one-sixth of the water right required to irrigate the pueblo's lands will be satisfied. The actual solution to the problem will probably be to allocate the pueblo sufficient surface waters to irrigate the lands they are presently irrigating and satisfy the remaining water right by use of groundwater. This means that the water right for about 200 irrigated acres (600 acre feet of water per year) will be satisfied by surface waters, and the remaining water right for about 1895 acres (5865 acre feet of water per year) will be satisfied by groundwater.

There are a number of complications in this solution in that pumping groundwater in the quantities

required to satisfy this demand may have major adverse effects on other water-users, both surface and groundwater, within the drainage basin. Also, there is the problem of decreasing streamflow reaching the pueblo due to groundwater pumping by the pueblo and upstream development of private home sites. These private home sites use groundwater for domestic use and return approximately 60 to 70 percent of the water they use back to the aquifer by way of septic tanks (48).

The way to alleviate a few of these problems would be to line the irrigation ditches with concrete and allow the pueblos to pump additional waters from the aquifer whenever surface waterflow is below the surface water right allocated to them. Unfortunately, there is no solution for offsetting the effects of heavy groundwater pumping and its effects on other water-users in the basin.

Groundwater

At the present time the pueblo is not using water wells for the purpose of irrigation, but they are using groundwater for household usage (41). If Tesuque Pueblo receives sufficient waters to irrigate all practicably irrigable lands on the pueblo, then approximately 600 acre-feet of water will be satisfied by surface waters

and 5,685 acre-feet of water will come from groundwater sources beneath the pueblo. Pumping sufficient groundwater to meet this demand will affect other water appropriators within the basin, especially groundwater-users adjacent to the pueblo and downstream surface water-users.

The information concerning the groundwater resources within the drainage basin is limited. The United States Geological Survey collected the available groundwater information for the drainage basin and presented its findings in a report issued in May 1975 (49). The basic geology beneath the pueblo involves two water-bearing formations, the alluvium beneath Tesuque Creek and the Tesuque formation (49)(see Figure 2).

The first formation is the alluvium, about which a fair amount of information is known. The alluvium is a strip of highly porous sand and gravel that is about 80 feet deep and 900 feet wide, passing through Tesuque Pueblo directly beneath Tesuque Creek. An apparent transmissivity value of $2808 \text{ ft}^3/\text{day ft}$ was determined from an aquifer response test of a well that taps the alluvium near Tesuque Pueblo (49). Unfortunately, this report did not mention the depth of the well, so it was not possible to determine the permeability of the aquifer. Still, it is obvious that the permeability would be extremely high. The average flow through this formation

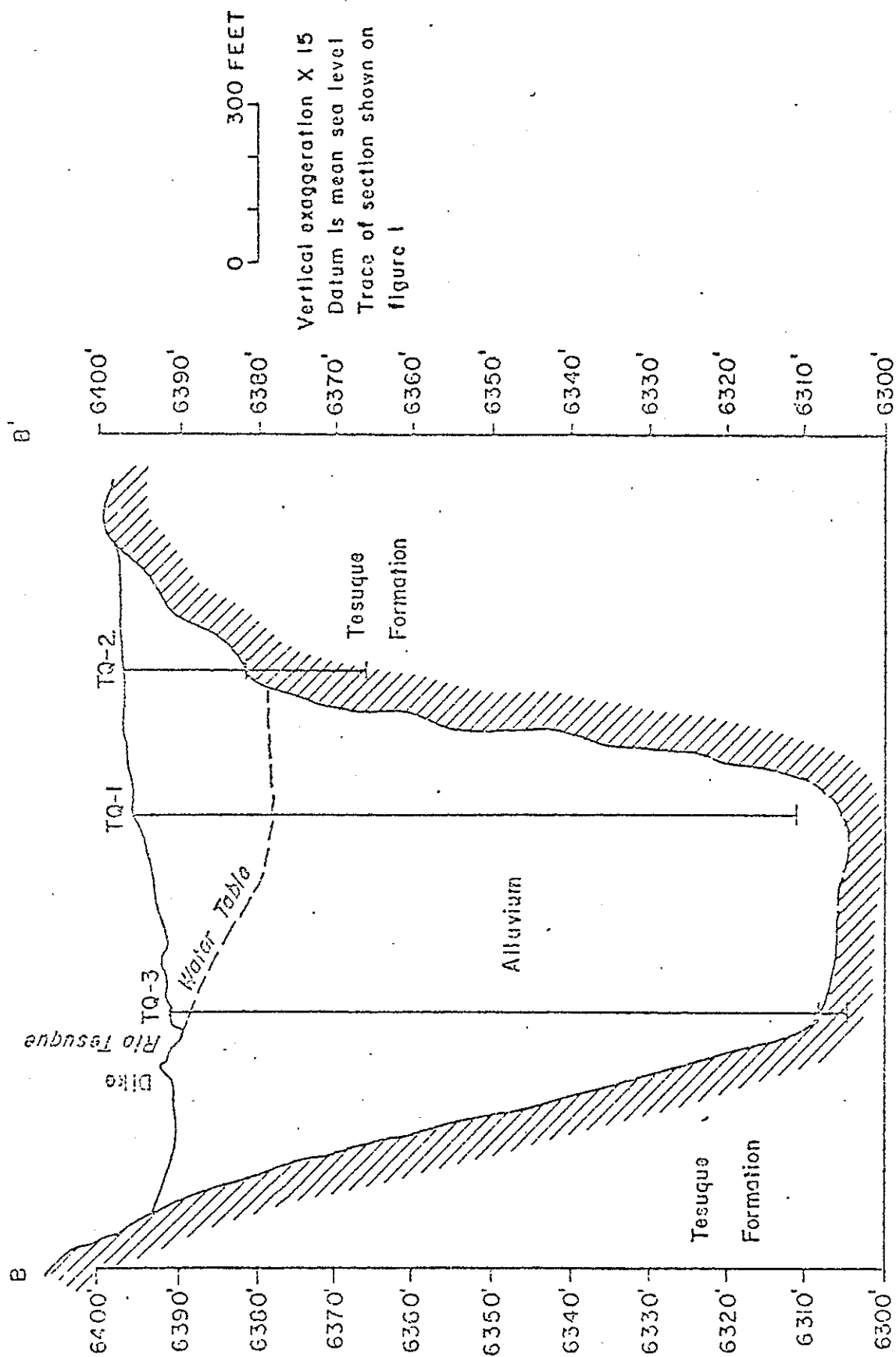


Figure 3.--Geologic section across the Rio Tesuque, Tesuque Pueblo.

(19) Estimated Groundwater Flow, Volume of Water in Storage, and Potential Yield of Wells in the Pojoaque River Drainage Basin, Santa Fe County, New Mexico, p. 6.

was estimated to be only 290 acre feet per year (49). This formation is intimately connected to the surface waters of the area, and as a result, any heavy pumping of the water stored in the alluvium will have an immediate effect on the Tesuque Creek and the Pojoaque River. The small average flow rate and the direct hydraulic connection between the surface waters in the area severely limit the development of the alluvium for irrigation purposes.

The other water-bearing formation beneath the pueblo is the Tesuque formation. This is a widely spread formation that occurs in most of the upper Rio Grande region. The composition of this formation varies to some extent from region to region, but it usually consists of salmon-colored, slightly consolidated sedimentary deposits (50). This formation is thought to have a thickness of 3500 feet in the vicinity of Tesuque Pueblo. The transmissibility of this formation has been determined to be approximately $670 \text{ ft}^3/\text{day ft}$ for a number of wells penetrating 1000 feet located in Los Alamos County across the Rio Grande River from the Pojoaque Drainage Basin (49). There is also data from a well located close to the San Ildefonso Pueblo, a pueblo located on the Rio Grande, that taps the Tesuque formation. This well only draws water from 100 feet of the aquifer and the United

States Geological Survey determined its transmissibility to be $160 \text{ ft}^3/\text{day ft}$ (49). Converting the $670 \text{ ft}^3/\text{day ft}$ for 1000 feet of aquifer and $160 \text{ ft}^3/\text{day/ft}$ for a 100 feet of aquifer to permeability (permeability = transmissibility/thickness) gives respective permeabilities of $.67 \text{ ft}^3/\text{day ft}^2$ and $1.6 \text{ ft}^3/\text{day ft}^2$.

In their report, the US Geological Survey assumed the well near San Ildefonso Pueblo was in an unusually permeable geological region and used the permeability determined from the Los Alamos County wells. Still, the large variance between the two permeabilities and the distance of the test wells from Tesuque Pueblo leads to many questions of the validity of any predictions based on this data. Also, in this report, the storage coefficient was unknown and they assumed a value of 0.2. An additional complication in the Tesuque formation is the clay beds that result in the horizontal permeability being considerably greater than the vertical permeability. It is estimated that the horizontal permeability is 25 times greater than the average vertical permeability (49).

Additional information used in this report was the rather steep gradient of the land of a 100-foot drop for every mile traveled down the drainage basin toward the Rio Grande River. Using a head of 100 feet per mile, a depth of 3500 feet for the aquifer, and the transmissibility

value of the Los Alamos wells, the US Geological Survey determined the groundwater flow rate at Tesuque Pueblo to be 1,970 acre feet per year for every mile cutting across the groundwater flow (49). The equation used was:

$$Q = TIL$$

T = transmissibility of 1000 ft well

I = head gradient of 100 ft per mile

L = length at right angles to flow

$$Q = (3.5) \times (670 \text{ ft}^3/\text{day ft}) \times \left(\frac{100 \text{ ft}}{5280 \text{ ft}}\right) \times (5280 \text{ ft})$$

$$Q = 2.35 \times 10^5 \text{ ft}^3/\text{day} \text{ or } 1,970 \text{ acre ft per yr per mile}$$

Still, the majority of this groundwater flow will not be captured since only a portion of the 3500 feet of aquifer will be utilized, depending on the depth of the wells used. Assuming the wells drilled will utilize 500 feet of the aquifer, then the groundwater flow intercepted would be:

$$Q = TIL$$

$$Q = (.5) \times (670 \text{ ft}^3/\text{day ft}) \times \left(\frac{100 \text{ ft}}{5280 \text{ ft}}\right) \times (5280 \text{ ft})$$

$$Q = 3.35 \times 10^4 \text{ ft}^3/\text{day} \text{ or } 280 \text{ acre ft per yr per mile}$$

The length of the reservation that would intersect the groundwater flow is approximately 8 miles; therefore, the flow passing beneath the reservation that would be captured would be (8 miles) x (280 acre ft/mile) or 2240 acre feet (see map sheet). Naturally, there would be recharge to the reservation from all directions, but most of this recharge flow will occur from the uphill side of the

drainage basin, due to the steep gradient of 100 feet per mile. Assuming these calculations are correct -- which is debatable considering the available data -- then pumping 5,685 acre feet of water per year would lead to the condition of groundwater mining. This would mean that the groundwater table underneath the reservation would start falling and never reach a steady-state condition, since withdrawal of groundwater would exceed recharge flow.

The calculation of drawdown for the individual wells and the effect of these wells on non-Indian neighbors is virtually impossible, given the uncertainty in the transmissibility of the aquifer, the problem of an unknown storage coefficient and the anisotropic condition due to the claybeds in the formation. Any predictions based on this data could easily vary from the actual hydrological effect by a factor of two or three. In other words, even using the most sophisticated methods of analysis, the available data is inadequate to accurately analyze the situation.

In order to assess the effect of pumping 5,685 acre-feet of water per year from beneath Tesuque Pueblo, it would be necessary to conduct aquifer response tests on the pueblo itself using wells that tap the Tesuque formation. The tests should be run on a relatively shallow well (penetration of 100 feet of aquifer) and a

deep well (penetration of 400-500 feet of aquifer). Small observation wells should be drilled in the vicinity of the pumping wells to observe the effect of pumping on the water table. Ideally, more than two wells should be used, but cost limitations would probably restrict the number of wells drilled. Assuming the other pueblos involved in the suit also undergo aquifer response tests, then the data from these tests could be used as a rough check on each other.

Considering the effect of the claybeds in the formation, it would be necessary to pump the wells for a fairly lengthy period of time to determine the effect of this pumping on the groundwater table. Also, it would be important to continue monitoring the observation wells after the pumping had been stopped to record any additional water table drops due to the delaying action of the claybeds. The data that needs to be obtained is the transmissibility of the aquifer, the specific storage coefficient, and the effect of pumping on the groundwater table in the vicinity of the test wells. Using this information it would then be possible to determine a "safe" withdrawal rate of groundwater so as to not cause major adverse effects on the water appropriators within the Pojoaque Drainage Basin.

Chapter 6

CONCLUSION

The dispute over the water rights of the Pueblo Indians in the Pojoaque Drainage Basin is at a fairly advanced stage legally, but is underdeveloped from the technical standpoint. Reviewing the evidence presented in the court trials to date shows a significant lack of information concerning the hydrological system of the basin.

The reason for this lack of information is due to the fairly high cost of conducting groundwater hydrological surveys. Still, considering the value of the water rights in question and the possible adverse effects of utilization of these water rights on non-Indian appropriators, these groundwater surveys must be undertaken. Sufficient information needs to be obtained to determine the depth to the groundwater table and to determine the characteristics of the aquifer beneath the pueblos. Some of the cost of these groundwater surveys may be offset by using the test wells for supplemental irrigation of lands presently being cultivated on the pueblos. A number of wells need to be tested in these surveys, since relying on only one well could lead to misleading data, especially

if the well site was selected by a geologist with the intent of obtaining data showing the "best" or the "worst" characteristics of the aquifer. Ideally, at least two wells, one shallow and one fairly deep, should be tested on each pueblo.

Using the water contour maps and the aquifer characteristics obtained from the groundwater surveys, it would be possible to determine the practicably irrigable lands present on each pueblo. Also, it would be possible to determine the "safe" withdrawal rate for groundwater so as to not cause major adverse effects on the hydrological system. As to whether the limiting factor will be practicably irrigable lands or the natural limits of the aquifer is not clear at the present time.

The water rights of the pueblos will be determined on an agricultural basis, but they are not restricted to agricultural usage of the water once the water right has been determined. Different uses of these water rights will have an effect on how much of this water will be returned to the hydrological system of the basin. If the water allocated to the Indians is used for agricultural purposes, then 25 to 40 percent of the water, depending on the porosity of the soil, will be returned to the hydrological system by deep percolation losses from irrigation. If the Indians lease their water rights to

land developers within the basin, then 60 to 70 percent of the water will be returned to the system by either septic tanks or treatment of the water and subsequent release to surface waters of the basin. Another possibility is that the Indians may lease their water rights to municipalities such as Santa Fe or Espanola, since the State Engineer's Office is now requiring all major water-users to purchase or lease water rights to offset the effect of their appropriation on the surface waters within the Rio Grande Drainage Basin. Under these circumstances, the Pojoaque Drainage Basin would not undergo development but the source of water supplying the municipality would be exploited to a greater extent.

What the Indians do with their water rights will depend on a number of factors. One of the most important factors will be whether the Indians want to have maximum cash flow within the pueblos or have maximum profits. For instance, utilization of their water rights for large commercial farming units on pueblo lands would lead to large cash flows within the pueblos, but would probably not lead to maximum profits.

The large groundwater rights of the pueblos will cause a decrease in the quantity of surface water within the Pojoaque Drainage Basin and eventually will affect both the surface and groundwaters of the Rio Grande. In

other words, awarding groundwater rights to the Pueblo Indians will solve the immediate problem, but will lead to future problems as these groundwater rights infringe on surface water rights of other appropriators.

The Pueblo Indians must receive sufficient water rights to grow and prosper as viable communities, while at the same time care must be taken to insure there are no major adverse effects on other water appropriators. This extremely difficult -- if not impossible -- task is presently being considered by the courts. The solution to this problem will have a major effect on New Mexico, especially considering that it has been estimated that the Upper Rio Grande Valley will be the shortest of water in relation to projected demand, in 1980, than any other basin in the continental United States.

Chapter 7

RECOMMENDATIONS

Prior to the final court settlement, aquifer response tests must be done on the aquifer beneath the Pojoaque Basin in order to provide the necessary technical information to resolve this problem from a rational point of view. The data that needs to be obtained is the transmissability of the aquifer, the specific storage coefficient, the effect of pumping on the groundwater table, and the effect of groundwater utilization on the surface waters in the area.

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