Ground-Water Conditions in the Rincon and Mesilla Valleys and Adjacent Areas in New Mexico

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GROUND-WATER CONDITIONS IN THE RINCON AND MESILLA VALLEYS AND ADJACENT AREAS IN NEW MEXICO

By C. S. Conover

ABSTRACT

The Rio Grande in New Mexico winds through a succession of basins lying between isolated northward-trending mountain ranges constituting part of the Basin and Range physiographic province. The flood plain of the Rio Grande, in general, consists of wide and narrow sections corresponding to alternately soft and hard rocks traversed by the river. The Rincon and Mesilla Valleys are the two southernmost expanded flood plains of the Rio Grande in New Mexico and are parts of the Rio Grande project of the U. S. Bureau of Reclamation. Water for the project is stored at Elephant Butte Reservoir, which was constructed to equalize the flow of the river to the Rio Grande project because large variations occur in the natural flow. Caballo Dam, about 20 miles south of Elephant Butte Dam, permits control of irrigation water to the project after its use for generating electric power at Elephant Butte Dam.

After the heavy precipitation of 1941, Elephant Butte Reservoir filled to capacity, 2,197,600 acre-feet, but drought conditions followed, and by early 1946 the reservoir contained less than a year's normal supply of water for the project. The Elephant Butte Irrigation District, the administrative control agency for the New Mexico part of the project desired to know whether it would be advisable to try to develop a supplemental ground-water supply for the district. The District and the U. S. Geological Survey signed a cooperative agreement whereby the Ground Water Branch of the Survey would make a ground-water study of the area to determine the feasibility of using ground water to supplement the present supply of surface water for irrigation in the district.

Below Elephant Butte Dam the Rio Grande flows westward for about 6 miles across the northern end of the Caballo Mountains, a fault-block mountain of pre-Cambrian, Paleozoic, and Cretaceous rocks dipping to the east. The river then turns south, following the western base of the mountains. The land rises gently west of the river in a series of pediment slopes toward the Black Range, which forms the Continental Divide. At the south end of the Caballo Mountains the river swings southeastward and crosses the northward-trending Jornada del Muerto, an intermountain basin, and its southern extension, La Mesa, the river being bounded on the east by the Dona Ana, Organ, and Franklin Mountains. These mountains consist largely of tilted Paleozoic sedimentary rocks on a basement of pre-Cambrian rocks, but they also contain Tertiary volcanic rocks. The bolsonlike troughs between the mountains east and west of the river are filled with Tertiary and Quaternary sands, silts, clays, and gravels, constituting a valley fill that belongs largely to the Santa Fe formation of Miocene and Pliocene age. Overlying this material and terrace gravels, basalt lava flows, and the flood-plain deposits of the Rio Grande, the latter forming the smooth valley floor, generally bordered by steep bluffs, which may exceed 100 feet in height

Ground water occurs beneath the plains of La Mesa and Jornada del Muerto. Generally the water is unconfined—that is, water-table conditions exist. The map showing contours of the water table indicates that the ground water flows from La Mesa toward the valley rather than following a possible former course of the Rio Grande toward Mexico. The hydraulic gradient of the water table ranges from as little as 1.2 feet to the mile in the central part of La Mesa, where the aquifer is thick, to more than 100 feet to the mile on the steep slopes along the mountains, where the aquifer is relatively thin and the water is apparently upheld by the buried impermeable rocks of the mountains. The depth to water is generally greatest (more than 400 feet) in the central parts of the

plains, and least (less than 100 feet) toward the edges of the plains, near the mountains, and along the valleys. The ground water beneath the plains is recharged from precipitation upon the upland and mountainous areas. In the La Mesa area, the recharge is estimated to be about 0.02 inch of water per year. The average annual precipitation is a little less than 10 inches. The ground water from beneath the plains is discharged to the Rio Grande at a rate estimated to be less than 1 cubic foot a second per mile of valley, with that part in the Mesilla Valley approximating 40,000 acre-feet a year.

Water of the Rio Grande which generates hydroelectric power at Elephant Butte Dam is stored in Caballo Reservoir for irrigation use. Diversions from the Rio Grande to the irrigated lands of the district are made at Percha Dam in the Rincon Valley and at Leasburg and Mesilla Dams in the Mesilla Valley. A drainage system, consisting of 42 miles of open drains in the Rincon Valley and 226 miles in the Mesilla Valley, discharges return irrigation seepage to the Rio Grande.

The depth to the water table in the valley fill along the flood plain in the Rincon and Mesilla Valleys is generally less than 10 feet. The ground-water level rises during the irrigation season to a high level in late August and declines during the nonirrigation season to its lowest level in February or March. The water table, in general, slopes down the valley at a rate of about 4.5 feet to the mile, which is essentially the same as that of the valley floor. The ground water in the valley fill of the flood plain is recharged by infiltration of water applied to the land for irrigation, seepage from canals, seepage from certain stretches of the river, precipitation upon the flood plain, and ground-water flow from the mesas and other elevated areas. Recharge by direct infiltration of precipitation is, on the average, small.

Discharge of ground water in the valleys is essentially by seepage to the drains and parts of the river and by transpiration by plants in areas of high water table. Discharge of ground water in the project, as represented by the water returned to the river by the drains, is 249,400 acre-feet a year when a normal supply of surface water is available for irrigation. A quantity of ground water, which has not been exactly determined, is discharged directly to the river in certain stretches.

The coefficient of transmissibility of the alluvial deposits in the Rincon and Mesilla Valleys averages 75,000 gallons a day per foot, as determined from pumping tests on 7 wells and from the relation between the accretion to 7 drains and the slope of the water table perpendicular to them.

Ground water obtained by pumping in the Rincon and Mesilla Valleys does not represent an additional supply or new source of water to the project, but rather a change in method, time, and place of diversion of the supplies already available.

Sufficient water for irrigation can be obtained from wells throughout the major part of the Rincon and Mesilla Valleys. Wells will "sand up" and special well construction may be necessary to control it. Water for irrigation, generally in small amounts, can be obtained by drilling wells on the low bench lands that border the valley floor and in the arroyos cut in them. Some wells in these areas will have only small yields.

In 1946 the anticipated shortage of surface water gave impetus to the drilling of wells for irrigation water in the Mesilla and Rincon Valleys. The number of irrigation wells increased from 11 at the end of 1946 to about 56 at the end of 1947. By February 1948, 14 additional wells had been constructed or were under construction.

Some of the lands now irrigated from wells do not have water rights under the Rio Grande project. There are about 15,000 acres of such lands on the flood plain and bordering higher land which could be irrigated by ground water. These lands, if developed, would ultimately utilize about 38,000 acre-feet of water annually on a basis of 2.5 acre-feet per acre.

The writer concludes that in a hypothetical year having only 50 percent of a normal supply of surface water available for diversions, the project lands would require an additional acre-foot per acre of water from wells to assure successful irrigation of the crops. However, because of the reduction in flow of the drains caused by pumping and because of losses in distribution, the use of water from wells to supply this deficit would require pumping 2.42 acre-feet per acre, or 213,000 acre-feet a year for the 88,000 acres of water-right land in New Mexico. Of the amount pumped, it is calculated that all but 63,000 acre-feet would be diverted from surface-water flow. If supplemental pumping were resorted to for 5 successive dry years, continued pumping would be necessary for 3 to 4 years after a return to normal surface supply so as to permit bypassing of the required share of water to the El Paso district, awaiting the restoration of ground-water storage by recharge from surface water.

The total cost of pumping equipment and pumping of this supplemental water for a period of 5 years with about 50 percent of normal surface supply, such as has been recorded in the past at San Marcial gage above Elephant Butte Reservoir, would be approximately one-fifth of the resulting additional gross crop returns, on the basis of the average gross return per acre from 1937 to 1946.

Substitution of pumping of ground water for the usual winter releases of surface water for irrigation of a small percentage of the lands would result in a saving to the project of possibly 34,000 acre-feet of water annually if no water were allowed to bypass the project in the winter.

The chemical quality of the shallow ground water in the alluvium of the Rincon and Mesilla Valleys is slightly poorer than that of drain water but is satisfactory for most irrigation requirements. Comparatively good water is obtained on the surrounding high lands and in the arroyo beds.

As water pumped from wells in the Rincon and Mesilla Valleys is not an additional or new supply but rather water that is normally intercepted by the project, continuing records should be kept of the amount of water pumped, of water-level measurements, and of the location and performance of the irrigation wells. Measurements of the flow of the drains should be made periodically and at enough points to determine the magnitude of the effect of pumping upon the flow of the drains.

casing when the well is pumped, resulting in reduced yield. Many of the domestic wells are equipped with small automatic pressure pumps.

IRRIGATION SUPPLIES

Development of irrigation wells was quite rapid in 1947 and 1948 as a result of the anticipated shortage of surface water. At the end of 1946 about 11 irrigation wells were in operation in the Rincon and Mesilla Valleys, 5 of which had been in operation for a number of years. By the end of 1947 about 45 additional wells has been drilled for irrigation and other wells were in the process of being drilled. However, not all the new wells were equipped with pumps and a few, undoubtedly, will prove unsuccessful. About 70 wells drilled in the Mesilla and Rincon Valleys by February 1948 apparently had or would have sufficient water for irrigation.

Twelve of the irrigation wells drilled and equipped with pumps by the end of 1947 are on the side slopes of the valleys, above the level of the valley floor and present canal system. Eleven of these wells of which 9 were drilled in 1946 and 1947, are in the Rincon Valley, and the other 2 are in Mesilla Valley.

Owing to the anticipated shortage of surface water in 1948, normal winter releases of surface water were suspended from the end of the growing season in 1947 to the beginning of the growing season in 1948. No surface water was to be delivered in 1948 to lands classified as suspended, and only 2 acre-feet per acre was to be allowed initially on the classified lands. Because of these water-conservation measures, many irrigation wells were drilled to serve tracts of land devoted to truck crops that require winter irrigation and to tracts classified as suspended. However, irrigation wells have been drilled also on SCC classified lands (p. 18) as a crop-insurance measure in the event of a shortage of surface water.

PERFORMANCE OF EXISTING WELLS

The discharge of a well, other things being equal, is dependent upon the size and condition of the pump and its speed, which in turn is dependent upon the amount of power available. A pump discharging only a few gallons a minute does not in itself indicate whether the well is a poor well or a good well. In order to make a comparison between wells the specific capacities are usually given, expressed in gallons a minute per foot of drawdown. For a particular well this value is generally regarded as nearly constant for reasonable values of drawdown. For cased wells the specific

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capacity depends to some extent upon the perforations in the casing. If they become plugged or are insufficient in total area a low specific capacity may be indicated even though the aquifer is highly permeable.

The ultimate yield of and drawdown of water level in most of the wells can be inferred from the hydrologic characteristics of the aquifer, the coefficient of transmissibility, and the specific yield. Based on results of pumping tests and correlation of drain flow with ground-water gradients, the average coefficient of transmissibility for the Rincon and Mesilla Valleys is estimated to be 75,000 gpd per foot. In other areas of New Mexico where irrigation from wells is done successfully the average coefficient of transmissibility ranges from about 50,000 to about 100,000. In addition to the favorable coefficient of transmissibility, the water is quite shallow under the valley floor of the Rincon and Mesilla Valleys as compared with depths to water of 30 to more than 100 feet in other areas in New Mexico where ground water is pumped.

Reliable information on some of the present irrigation wells in the Rincon and Mesilla Valleys is lacking, particularly of those that had not been equipped with pumps by the time field work on this investigation had ended. Of 9 wells in the Rincon Valley floor equipped with pumps, the discharges, either measured or reported, range from 250 to 1,000 gpm. The specific capacities of 5 of the wells range from 57 to 96 and average about 70 gpm per foot of drawdown, values which indicate good irrigation wells.

In addition to the irrigation wells in the valley floor in the Rincon Valley, about 15 wells have been drilled on the alluvial fans of the arroyos west of the valley, 12 of which are equipped with pumps. The discharges of 11 of these wells, either measured or reported, range from 250 to 850 gpm and the specific capacities of 10 of them range from 11 to 100 and average about 50 gpm per foot of drawdown.

Two wells above the valley floor in the Rincon Valley, drilled by Mr. Osborn for irrigation, were unsuccessful. Well 16.5.25.341, in the alluvial fan of Percha Creek, produced only about 125 gpm with a drawdown almost to the bottom of the well. Well 17.5.10.442, on top of the bluff of the Santa Fe formation overlooking Montoya Arroyo, obtained only a small quantity of water, which was under sufficient pressure to rise to about 30 feet above the adjacent arroyo bed.

In the Mesilla Valley, by the end of 1947, there were about 24 irrigation wells on the valley floor and 2 on the alluvial slopes above the valley floor that were equipped with pumps. Also completed were 4 wells on the valley floor and 3 above the valley

floor that were drilled for irrigation but not equipped with pumps. In addition, there were other wells in the process of being drilled. Only 4 of these 33 wells were in existence prior to 1947, and 1 of the new wells, on the horticultural farm of the State College, is a replacement of a previous irrigation well.

As most of the irrigation wells in the Mesilla Valley are quite recent, their performance characteristics are not generally known. This is especially true of the drawdown of the water level when the wells are being pumped. The reported discharge from 16 of the wells on the valley floor range from about 600 to more than 2,000 gpm, with reported specific capacities for 8 of the wells ranging from less than 20 to about 60 gpm per foot of drawdown. The discharge measured for 2 wells were 1,100 and 1,270 gpm, with specific capacities of about 25 and 97.

As tractors furnish power for many of the wells at the present time, it is probable that the pumps are not being operated at capacity. Continued use of the wells generally results in an increased capacity as the fine sand from the formation around the well is removed. Running sand tends to fill the wells and causes the ground surface to cave. In order to keep the sand from filling the wells, constant pumping of the wells during development should be continued as long as the water contains sand. In addition to this trouble with sand, the inadequate perforations in some wells become plugged with fine gravel and sand.

The T. L. Simpson irrigation well furnishes an example of the effect of sand running into a well and of inadequate or clogged perforations. The well was drilled to a depth of 80 feet and the lower 20 feet of the casing was perforated with a Mill's knife. Large gravel was penetrated from 55 to 80 feet. Initially the pump discharged a maximum of about 800 gpm when the water level was drawn to the bottom of the pump suction pipe at about 60 feet. After cleaning out 10 feet of sand and gravel that had come into the well and reperforating the casing, the discharge of the pump was increased to 1,200 gpm with a smaller drawdown.

In order to reduce caving of the ground surface around the well, many wells are not drilled larger in diameter than the casing. The annular space between the hole and the casing is then filled with gravel, which fills the cavity that is formed by removal of the sand when the well is pumped. So far as the long-term yield of the well is concerned, gravel packing does not increase the discharge of the well. The ultimate production of a well is dependent upon the permeability of the formation surrounding the well at a distance and cannot be changed by the addition of the gravel.

Packing together of the gravel and sand and filling of the perforations by the mixed gravel and sand may cause the permeability around the well to be lower than that of the sand alone and may actually decrease the discharge of the well at a given drawdown. Wells that can be developed by removal of the sand without caving of the ground surface and without the gravel will be as productive, if not more so, than if gravel is used. If a large amount of gravel is used, if the perforations of the casing remain open, and if the porosity of the gravel is not reduced by the sand, the gravel serves to enlarge the effective diameter of the well, decreasing friction and consequently increasing its specific capacity. Gravel of a single size has a high porosity and is to be preferred to gravel of mixed sizes, which packs tighter and results in a lower porosity.

Performances of the present irrigation wells indicate that successful wells can be obtained nearly everywhere on the valley floor of the Rincon and Mesilla Valleys, provided that proper drilling and development methods are used to care for the large amounts of fine running sand. Reports of drillers suggest that more fine sand may be found in the lower part of the Mesilla Valley than in the remainder of the valley. Wells in the Selden Canyon area of the Rincon Valley and in the extreme upper part of the Mesilla Valley will be near mountain masses which delimit the sediments supplying water to the wells and result in comparatively large drawdowns after a period of time.

Irrigation wells on the alluvial slopes above the valley floor generally will be successful, although the capacity of most such wells will be smaller than that of wells in the Quaternary alluvial fill of the valley. Some attempts to obtain wells on the alluvial slopes will fail because of the local predominance of clay and fine sand mixed. Some difference is to be expected in the permeability of the undisturbed Santa Fe formation that forms the bluff along the valley and of the alluvial fans, slopes, and arroyo deposits formed from the erosion of the Santa Fe formation. However, no definite difference in the yield of wells drilled in these deposits has been noticed, good and poor wells having been completed in both the undisturbed and the reworked deposits.

FUTURE DEVELOPMENT

The extent to which irrigation from wells will be practiced in the future is dependent in large measure on whether surface-water supplies for the project lands continue to be insufficient. It is also dependent on whether farm prices conductive to development of new lands continue in effect. The present average farm cash return is at an all-time high, with indications that favorable conditions will continue for some time.

Even if sufficient surface water becomes available for the project lands, including those classified as suspended, the incentive for development of irrigation wells on high lands bordering the valley will remain. The initial cost of such land is comparatively small and its economic development probably can compete favorably with that of the project lands.

The acreage of land that can be irrigated by surface water in the Rincon and Mesilla Valleys has reached the maximum possible, being limited primarily by the amount of water available. In general less than one-third of the suspended land has been given water each year. It is supposed that in a dry year this part of the suspended land, about 4,600 acres in 1946, would not be allowed to have water. Therefore in such a dry year, when even land having a full water right might not have a full supply of water, there would be a tendency for farmers who have large tracts of suspended land to install pumps. This might also occur where an acreage of suspended land is being farmed in conjunction with land having a water right. A small tract of suspended land probably would not be irrigated in a dry year as in general it would not be economically feasible to install an irrigation well and pump on a tract of less than 20 acres. If there happened to be a few such small tracts adjoining each other it is possible that the owners might put down a cooperative well.

In 1946 there were 135 tracts of 20 acres or more of suspended land of all classifications in the Rincon and Mesilla Valleys, including the Texas portion of Mesilla Valley, with a total area of 5,822 acres, as given in the following table. This might be an indication of the maximum area of suspended land upon which wells would be drilled for irrigation. This area of 5,822 acres is slightly more than the 4,606 acres of suspended land reportedly irrigated with surface water in 1946, although not necessarily comprising the same tracts of land. The suspended land irrigated in 1946 was mainly land classified as seeped (waterlogged).

In addition to suspended land in the valleys that might be irrigated with ground water, a large part of which is now irrigated by surface water, new land susceptible to ground-water irrigation is available that is not now being farmed. This additional land is not now being farmed. This additional land is not within the area served by canals and some of it is located outside the boundaries of the Elephant Butte Irrigation District. The results of a reconnaissance survey by G. R. Chenot include the estimated maximum acreages of land that might be susceptible to irrigation by water from wells.

sloping line determined by the intersection of a horizontal line at the distance of the well from the stream or a drain and a vertical line at the time since pumping started. The residual effect of a pumped well after pumping stops can be determined by the difference in effect caused by a well pumping continuously from the time of start to the time in question and a recharge well pumping from the time of actual stop to the time in question.

This diagram shows that if a well in the Rincon or Mesilla Valleys were located a quarter of a mile from a drain the flow of the drain would be reduced after 3 months of continuous pumping by 63 percent of the pumping rate, after 6 months by 73 percent of the pumping rate, and after 1 year by 81 percent of the pumping rate. After 6 months of continuous pumping the flow of a drain would be reduced by 88 percent of the pumping rate for a well located an eighth of a mile from the drain, 73 percent for a well located a quarter of a mile from the drain, 50 percent by a well located half a mile from a drain, and 18 percent by a well located 1 mile from a drain. Within 12 days 50 percent of the water pumped by a well located an eighth of a mile from a drain would be diverted from the drain, but it would take about 2 years for a well located 1 mile from a drain to have the same effect. If a well located a quarter of a mile from a drain were pumped for 6 months and then stopped, the drain would still be losing water 1 year after the start of pumping, or its accretion would be reduced, at 8 percent of the pumping rate.

As evident from the formula and the graph, if the distance from the well to a drain is doubled the time necessary for the same effect upon the drain is four times as long; that is, for the same effect, the time varies as the square of the distance.

The effect of pumping upon the flow of a stream or a drain, in which the water is in free communication with the ground water, will be evidenced initially either by a decrease in the accretion of ground water by a gaining stream or drain, or by an increase in the rate of loss of water from a losing stream or drain. With continued pumping, in the case of a gaining drain or stream, the gradient of the water table would be reversed and the drain or stream would lose water in the section affected and finally in either case, if the pumping rate were great enough, the stream or drain would be dried in that section.

In order to dry the drains, the pumping effect per mile of drain must be at least equal to the accretion of the drain per mile. The average drainflow accretion under the present conditions of an average surface supply of water is about 0.8 cfs per mile in the late winter months, increasing to almost 2 cfs per mile in the late summer, with a maximum range from about 0.5 to 2.5 cfs per

mile based upon the total lengths of the drains. Certain stretches will probably show greater or less accretion than this. Wells placed a quarter of a mile from a drain at 1-mile intervals, each pumping continuously at the rate of 3 cfs, theoretically would dry a drain in the summer under the present conditions of drain flow after about 4 months of pumping. In a year with less than the average supply of surface water, the flow of the drains would be less than normal and the amount of pumping required to dry the drains would be less.

The theoretical effect of the pumping of a well upon the flow of a drain is possibly somewhat greater than would actually occur at any particular time because of clay layers that extend under the drains, which might introduce a lag in the effects of pumping from wells that extend below the clay layers.

If a well were located between drains or between a drain and the river, the total depletion of their flow after any given period of pumping from the well would be greater than if only one drain were involved. As the ultimate effect is the same, locating a well between drains only speeds up the effect of the pumping. This accelerated effect of the pumping probably would offset the possible lag caused by the stratification of the aquifer.

The maximum practical distance that a well can be located from a drain or the river in the Rincon and Mesilla Valleys is about a mile because of the narrowness of the valleys and the numerous drains. At the northern end of the Rincon Valley in the vicinity of Arrey, where there are no drains, a well on the valley floor could be as far as a mile from the river. Also, near Salem the maximum distance from a drain that a well on the valley floor could be located is about a mile. In the remainder of the Rincon Valley the maximum distance from either the river or a drain is less than a mile, in general being closer to half a mile, and for a large number of wells the average distance probably would be between a quarter and half a mile. In some areas it would be necessary to locate a well near a canal in order to be at a maximum distance from the river or a drain.

In the Mesilla Valley, where drains are more numerous than in the Rincon Valley, practically the only area where wells on the valley floor could be more than a mile from the river or a drain is in Las Cruces. The maze of drains in the rest of the valley precludes locating a well much more than half a mile from the river or a drain and then the well might be near a canal. Also, in most of the valley a well would be situated between two drains or a drain and the river, which would increase the total effect of pumping at

any particular time over that upon one drain. For a number of wells the average distance to the river or a drain probably would be between a quarter and half a mile, and many of the wells would be between two drains or between a drain and the river.

As the flow of the drains is derived principally from return seepage from irrigated lands and from canals and as interception of this seepage by a well results in a decrease in flow of the drains such interception does not reduce the ultimate effect of the pumping upon the flow of the drain.

SUPPLEMENTAL PUMPING OF GROUND WATER IN A DROUGHT PERIOD

Under the present conditions in the Rincon and Mesilla Valleys the surface and ground waters are in approximate equilibrium. The surface water is diverted throughout the year to the canals and irrigated land and a certain percentage that is not lost by evaporation and transpiration seeps underground and returns to the river directly or by drain flow for reuse in the next lower irrigation division. The drain flow, as stated before, is composed almost entirely of return diversions and seepage of river water but it contains a small amount of ground-water flow from the side mesas. The drain flow is not waste water insofar as the next lower irrigation unit is concerned but instead is counted upon as a part of the water supply of the project. Thus, no water is wasted in the project except by transpiration and evaporation—the total amount of which is increased if water is used carelessly—and for the small quantity that bypasses the lower unit, especially during the winter.

Pumping of ground water for supplemental use does not represent an additional supply or new source of water but rather a change in in method, time and place of diversion of available supplies.

The pumping effect of one well upon a drain has been discussed in another paragraph. The remaining water pumped that is not diverted from the drains or the river or saved from evapotranspiration at any particular time is taken from storage. As seen from the graph, figure 15, the percentage of water taken from storage in the case of a single well pumping for 6 months at a distance of a quarter of a mile from a drain is only about 27 percent. Thus on a short-term basis of 1 year, only about a quarter of the water pumped is taken from storage and represents water not otherwise available during that year.

Thus, on a year-to-year basis, the net gain of water to the district is that quantity of water pumped in excess of the decrease in normal drain flow caused by the pumping. This net gain of water

is water taken mainly from storage, that is, borrowed from the ground-water supply. This borrowed water must be replaced in future years if the flow of the drains is to return to normal.

If in future years no excess surface water is available to the project to raise the ground-water level to the nonpumping stage, then pumping must be continued, even in a year of normal water supply, unless the pumped water is used more efficiently than surface water, in which case the total amount needed would be less and the debt to ground-water storage could gradually be reduced.

The economy of a supplemental pumping project in the Elephant Butte Irrigation District depends upon the quantity of water that must be pumped. This in turn depends upon how the gravity water in the Rio Grande project is distributed to the various valleys, what economies could be effected in its distribution, and what salvage of water would occur by reason of the lowered water table in a dry year. The distribution of surface water might be in proportion to the average diversions, or to the average river depletions. It might be assumed that pumping would be done in the El Paso district also, which would save some water that would otherwise drain from the land, and thus provide more water for the project; or it might be assumed that the El Paso district would not install pumps also, in which case the Elephant Butte district might be regarded as having an obligation not to interfere with the deliveries of water to the lower district. Some water would be saved from evaporation by drying of the drains and by lowering of the water table in waterlogged areas.

For the purpose of this study it is assumed that direct canal waste would be largely eliminated throughout the project and that the Elephant Butte district has no obligation to the lower district to continue this direct loss. It is assumed also that an obligation does exist to continue to deliver the average proportionate drain flow, which is taken to be 40 percent of the gross diversions.

As stated on page 52, in a hypothetical year in which the surface supply of water available for diversions is only half the average, it is believed that 2.28 feet of water could be delivered to the farms, or about 1 foot less than that needed for successful irrigation of the crops. If the additional foot of water were supplied by pumping ground water into the canals, some loss of the pumped water would occur, owing to waste and to seepage from the canals. Owing to closer control of the pumps and to the shorter distance that the pumped water would travel in the canals as compared with surface water, a wastage of 3 percent and a seepage loss of 17 percent of the pumped water may be assumed. This combined

loss of about 20 percent is compared with a probable minimum of 30 percent for gravity water. Every additional acre-foot of pumped water delivered to the farms, therefore, would necessitate pumping about 1.25 acre-feet.

However, pumping of wells would diminish the drain flow. This decrease in drain flow presumably would necessitate a corresponding decrease in the allowable diversions for the Elephant Butte Irrigation District.

The narrowness of the valleys and the large number of drains preclude locating pumps very far from either the drains or the river. If a large number of pumps were installed, as would be necessary for a district pumping system, the average distance from a drain would be about a quarter of a mile, and it is expected that the drains would be dried during the first summer of pumping if only a small gravity water supply were available. The amount of the drain flow in an average year is about 42 percent of the gross diversions. In a dry year, with less excess water applied to the lands, the drain flow is expected to be less, probably about 40 percent of the diversions. In an assumed dry year when only 50 percent of a normal gravity-water supply were available, 3.25 acre-feet per acre would be diverted in the Rincon and Mesilla Valleys, of which 40 percent would be returned to the system as drain flow, leaving a total diversion used within these valleys of 1.95 feet. If a pumping system were installed and the drains were dried, presumably 1.95 feet would be the justifiable diversion to these valleys. It has been assumed that, in a dry year, 3.3 acre-feet of water per acre is needed for a full crop, that 30 percent of the surface water diverted would be lost, largely by seepage from the canals, and that about 20 percent of the pumped water would be lost by seepage and waste from the canals. Therefore,

$$3.3 = 1.95 \times 0.7 + \text{pumped water} \times 0.8;$$

therefore,

$$\text{pumped water} = 2.42 \text{ acre-feet per acre.}$$

Thus, in order to make up the deficiency of 1 acre-foot per acre that would result from gravity irrigation alone in the assumed dry year, it would be necessary to pump about 2.42 acre-feet per acre. This is the minimum amount with judicious use of water. If canal wastage were higher and the water were inefficiently used on the land this amount would not be sufficient.

As there are water rights for about 88,000 acres of land in the New Mexico part of the project, the total pumpage of water would be about 213,000 acre-feet and the total surface water diverted about 172,000 acre-feet.

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The amount of water pumped from storage in the ground would be the difference between the amount actually used by the crops, assumed to be 2.5 acre-feet per acre, and the amount diverted from the river, 1.95 acre-feet per acre, plus evaporation and waste from the canal. The latter has been estimated as 3 percent of the pumped water or 0.07 acre-foot per acre and 5 percent of the gravity water or 0.10 acre-foot per acre, making the water pumped from storage 0.72 acre-foot per acre per year.

Viewed in another way, the amount of water pumped from storage would equal the difference between the total water pumped and that part of the pumped and surface water that would return to the water table. This amount from storage, all quantities being given in acre-feet per acre, would be: the total amount pumped, 2.42, less the pumped water lost by seepage from the canals, 17 percent (see p. 122) or 0.41, less the gravity water lost by seepage from the canals, 25 percent (see p. 52) of that diverted, 0.49, less the difference between the water applied to the land, 3.3, and the consumptive use 2.5, or 0.8. The amount of water pumped from storage in 1 year would therefore be 0.72 acre-foot per acre irrigated, or 63,360 acre-feet for the 88,000 acres in the Elephant Butte Irrigation District. The amount of water returned underground by seepage from the canals and from the irrigated lands would be 1.70 acre-feet per acre or 39 percent of the total diversions and pumpage of about 4.4 acre-feet per acre.

The period of drought during which supplemental pumped water might be needed is, of course, a matter of conjecture. A short period of pumping would be relatively costly. The flow of the Rio Grande at San Marcial above Elephant Butte Dam, at the head of the Rio Grande project, averaged only 697 cfs in the 5-year period 1898 to 1902, inclusive, 46 percent of the 52-year average of 1,530 cfs (International Boundary and Water Commission, 1946, p. 4). During a period of drought the lake level at Elephant Butte and Caballo Dams would be low and there would be less evaporation loss than under average conditions. This reduced evaporation loss, plus what water there was in storage at the beginning of the drought, would temper the actual decrease in flow of the Rio Grande. Without extensive study it appears, therefore, that a 5-year drought period in which only half the normal supply of water would be available for diversions is about the longest that could reasonably be expected.

If pumping were done for 5 such dry years the total pumpage from storage would be about 316,800 acre-feet, neglecting water saved from evaporation or transpiration, in waterlogged areas. This amount of ground water would have to be replaced before the flow of the drains would return to normal.

As the drains would have been dried by the pumping, the diversions to the district in a year of average surface-water supply following a period of 5 years of pumping possibly would be reduced by the amount that the drains would normally flow, or 42 percent of the diversions. The actual diversion would then be 6.5 - (0.42 x 6.5) = 3.77 feet. This amount would make 2.64 feet available for delivery to the farms, thus requiring additional pumping of ground water to make up the difference to the 3.3 feet believed necessary for delivery to the farms. The amount of ground water that would have to be pumped would be

$$3.30 = 3.77 \times 0.7 + \text{pumped water} \times 0.8;$$

therefore,

pumped water = 0.83 acre-feet per acre.

The amount of water that would seep to the water table in this year would equal the seepage losses of pumped and surface water from the canals plus the seepage return of excess water above the consumptive use delivered to the farms, and would be

$$(0.83 \times 0.17) + (3.77 \times 0.25) + (3.30 - 2.50) = 1.88 \text{ acre-feet per acre.}$$

The payment or reduction of the ground-water debt would be the return seepage in excess of the pumpage, or 1.05 feet. The number of years required, while pumping 0.83 acre-foot per acre, to pay off the debt would be $5 \times 0.72/1.05 = 3.4$ years.

The available surface-water diversions without pumping in the fourth year of average surface supply, following the assumed 5 years of pumping, would be less than the average by the amount of water that would have to be bypassed to the lower district to make up for the reduction in average drain flow resulting from the remaining effects of the pumping. The amount of bypassed water, x, plus the actual drain flow, y, must be equal to the average drain return flow of 2.73 feet (0.42 x 6.5) in a year of average diversions. The actual drain return flow would be equal to 42 percent of the actual diversions reduced by the remaining ground-water debt. The remaining debt would be (5 x 0.72) - (3 x 1.05) = 0.45 foot. Therefore:

$$x + y = 2.73$$

$$\text{and } y = (6.50 - x)\, 0.42 - 0.45;$$

therefore: $x = 0.78$

and the actual diversion would be:

$$6.50 - 0.78 = 5.72 \text{ feet.}$$

The water schedule for the 5 years of about 50-percent average surface supply followed by 5 years of average surface-water supply is given in the following table:

Comparison of irrigation water available as diversions to the canals of the Elephant Butte Irrigation District, for 5 years of 50-percent average surface supply followed by a period of average surface supply

[Acre-feet per acre]

Year of irrigation	With supplemental pumping		Without supplemental pumping
	Pumped water	Surface water	Surface water
1	2.42	1.95	3.25
2	2.42	1.95	3.25
3	2.42	1.95	3.25
4	2.42	1.95	3.25
5	2.42	1.95	3.25
6	.83	3.77	6.50
7	.83	3.77	6.50
8	.83	3.77	6.50
9	.00	5.72	6.50
10	.00	6.50	6.50
Total	14.59	33.28	48.75

Little net water can be gained to the Rio Grande project as a whole by pumping ground water in the Elephant Butte district, and the total amount of water received by the Elephant Butte district under a pumping system is practically no more than would be obtained from surface supplies, if the customary interest of the El Paso district is preserved. The reason for this is, of course, that the drain water is used again in the project and the district has been assumed to be responsible for any decrease of the flow of the drains resulting from pumping.

The ground-water debt could be repaid by efficient use of water in 4 years of average water supply. If water were wasted, it would not be possible to repay the ground-water debt and pumping probably would have to be continued for years.

As indicated previously (p. 44), Rincon and Mesilla Valleys customarily use about 46 percent of the total reservoir releases in a year of average surface supply. In the assumed drought period of 5 years the surface water available for diversions was considered as 50 percent of the average. The average diversion to the El Paso division has been 395,400 acre-feet, and therefore in such a dry year presumably 197,700 acre-feet should be available for diversion to the El Paso Valley. The reservoir releases in a year should be equal to the sum of all diversions minus the return drain flow, disregarding any nonbeneficial evaporation and transpiration losses and any undiverted water that might bypass the El Paso Valley. As the return drain flow from the Rincon and Mesilla Valleys would be zero if extensive pumping were done, the reservoir releases would be 88,000 x 1.95 + 197,700 = 369,000 acre-feet. The depletion of reservoir releases by the Elephant Butte Irrigation District

for any of the first 5 years of pumping is then 46 percent, which, disregarding canal wastes, is the same reservoir depletion as in an average year. In the sixth, seventh, and eighth years, the drains still being dry, the depletion of reservoir releases would be about 45 percent. This shows that the Rincon and Mesilla Valleys would be getting their usual share of the reservoir releases.

In the analysis it was assumed that the drains would be dry during all the first year, whereas actually they would not be dry until near the end of the first pumping season and a small amount of water might flow during the first winter. Therefore, during the first summer it is probable that a smaller amount of water would need to be pumped. Also, it has been assumed that all the ground water taken from storage would be derived from the lowering of the water table under only the irrigated area of the valley. Actually, the effects of pumping would be somewhat smaller in the valley area, as the cone of depression would extend away from the valley, under the mesas. As the irrigation water is applied to lands near the drains, it is possible that water in the drains would begin to flow in the eighth year, or earlier, even though all the ground-water debt had not been repaid. The district would benefit by this lag, which would spread the repayment of the ground-water debt over a longer period of time than was assumed. A small amount of the pumped water probably would not be taken from storage but would be salvaged from areas of transpiration by the lowering of the water level. This salvaged water would be a net gain of usable water and would reduce the calculated pumpage from storage.

Pumping of ground water in the valley by individual farmers would, of course, have the same effect upon the flow of the drains as would pumping by the Elephant Butte Irrigation District. And water pumped onto the land from ground-water storage that does not return to the ground-water body would be water lost to the project, even though a gain of water might accrue to an individual farm. It is probable that in a dry year enough farmers would install wells and pumps so that the flow of the drains would be reduced markedly or, in some sections, even be stopped entirely. If in a dry year such a reduction of normal drain flow occurred through installation of individual pumps, and if the El Paso division received its accustomed share of the reservoir water, diversions to the Elephant Butte Irrigation District would have to be reduced by a like amount. Any such reduction in diversions would work a hardship on the farmers who had not installed pumps, provided that the available surface water was distributed equally. If it were desired to maintain the delivery of the same amount of water to the farms not having pumps as they would have received had there been no pumping, then it would be necessary to reduce the delivery of water to the farms having pumps. This would be the condition during years of a shortage of surface water. Pumping by individuals during years of a normal supply is discussed in the following pages.

PUMPING OF GROUND WATER WITH A NORMAL SUPPLY OF SURFACE WATER

Pumping of ground water in a year of normal supply of surface water might be practiced by individuals upon project lands for various reasons. A farmer who has a pump would have water available at times convenient to himself. And, in years when water was rationed, even though an adequate amount would be available, he would be able to pump additional water to satisfy his requirements. However, as pumped water would be an additional cost for water, it is not expected that pumping would be prevalent on project lands in years of normal supply of gravity water.

As the production of crops requires a certain amount of water and as there would be adequate surface water available for all crops in a normal year, the use of ground water for supplemental purposes on project lands in such a year would not deplete the project water supply any more than the use of gravity water, unless excessive irrigation by ground water caused an excessive consumptive use by the crops and excessive transpiration and evaporation losses.

Pumping of ground water in a year of normal surface supply could result in some saving of water to the project if pumps were located in areas of native vegetation where a lowering of water level would reduce nonbeneficial transpiration losses.

Also, use of ground water instead of surface water for winter irrigation would result in some water savings to the project, especially if drain water were pumped. Approximately 50,000 acre-feet of water is released from storage annually from October through February for winter irrigation of a widely distributed acreage planted principally to truck crops. This acreage constitutes a small percentage of the total irrigated acreage. An unusually large part of this winter release is lost through waste, seepage, and unnecessary evaporation and transpiration, the losses per acre served being proportionately much higher than those involved in irrigation in the summer.

The pumping of drain water during the winter would utilize some water that is now allowed to bypass the project. W. F. Resch, project manager of the Bureau of Reclamation, El Paso, Tex., estimates roughly that, of the drain flow passing the end of Mesilla Valley, 40 percent of that in October, 50 percent of that in November and December, 100 percent of that in January, and 40 percent of that in February is not used in the lower El Paso Valley. These percentage estimates, combined with the drain flow given in table 5, pages 141, 142, show that possibly 34,000 acre-feet of the winter drain flow is allowed to bypass the project. However, as part of the winter drain flow is a result of the large losses from the winter releases, it is not expected that this quantity would be available

for pumping from the drains. Some pumping from ground-water storage would be necessary. The quantity of water saved in winter irrigation by substituting pumping, especially from drains, for reservoir releases therefore presumably would be about 34,000 acre-feet anually, if all water bypassing the project in the winter could be stopped, plus some small saving in losses from evaporation and transpiration. As drain flow removes undesirable salts from the lands and is as necessary as removal of sewage from a city, it is presumed that not all drain flow bypassing the project throughout the year should be stopped in order to save water, but that the drain flow seemingly could be profitably stopped in the winter.

COST OF PUMPING SUPPLEMENTAL GROUND WATER

The minimum number of pumps required to deliver the 213,000 acre-feet of pumped water believed necessary for the Elephant Butte Irrigation District in a dry year is estimated to be about 148, on the assumption that each pump would discharge 1,800 gpm continuously for 6 months. Allowance should be made for periods of high demand; otherwise, with the pumps running continuously at full capacity, the farmers would have to take water on a strict rotating schedule and any breakdown in pumping equipment would result in a shortage of water. Also, it is unlikely that every well drilled would be capable of discharging 1,800 gpm. Therefore, allowing a 15-percent operational variance and 10 percent for breakdowns, and assuming a lower average discharge per well of perhaps 1,500 gpm, the number of pumps necessary is estimated to be about 220.

Rough estimates made in 1948 of the costs of installation of a well, pump, and motor; fuel and lubrication; labor and transportation; total depreciation in 5 years; interest on investment; and taxes indicate a total charge of $2,900 per pump per year during the first 5 years of operation. The charge for 220 pumps would be $638,000 a year, or $3,190,000 for the 5-year period. This is equivalent to $7.25 per acre per year for 88,000 acres or $3.00 per acre-foot of water on the basis of 2.42 acre-feet per acre per year.

Under the assumptions given previously, only 73,000 acre-feet of water per year would need to be pumped in the sixth, seventh, and eighth years. This would require 75 pumps, on the basis that 220 pumps would be needed for pumping 213,000 acre-feet per year. Assuming the pumps to be fully depreciated at the end of the first 5 years, the unit cost per pump in the sixth, seventh, and eighth years is estimated at about $1,540 per year or $346,860 for 75 pumps for 3 years. The total cost for 8 years thus would be $3,536,900.

As stated previously, a 50-percent gravity supply would suffice, with extremely careful use, to irrigate about 70 percent of the acreage. The pumping of irrigation water would result in saving all the crops on the remaining 30 percent; thus the pumping costs should be justified by that acreage. The average gross return per acre for the Rio Grande project was about $140 in 1945 and about $252 in 1946, the record year up to that time. However, the average crop return on the project from 1914 to 1946 was about $84 per acre and from 1937 to 1946 was about $120 per acre[12]. The additional gross return through ground-water irrigation in 5 dry years, on the basis of 1937-46 average crop returns, would be $15,800,000. The total cost of pumping and pumping equipment is thus approximately one-fifth of the increase in average gross crop returns and probably less than the normal net profit. The average cost per acre for 88,000 acres during the initial 5 years would be about $7.25 a year.

Intermittent operation and the probable smaller capacity of a pump on an individual farm would result in a somewhat higher unit cost of pumping than would continuous operation of large-capacity pumps by a district pumping system.

The favorable factor of cost of pumping is offset somewhat by the unfavorable factor of little net gain of water and the problem of installation and operation. Installation of 220 wells, pumps, and motors would consume some time, but possibly less than the period of shortage of surface water supply. Among the operational problems would be the distribution of the pumped water to the New Mexico lands only. About 11,000 acres of irrigated land in the Mesilla Valley is in Texas and is served by the same canal system. Also, very strict operating and irrigating schedules would have to be maintained, as only a 3-percent wastage was assumed in the estimates.

RECOMMENDED LOCATION OF WELLS

Wells producing sufficient water for irrigation can be located nearly everywhere on the floor of the Rincon and Mesilla Valleys. As a result of the variable nature of the alluvial sediments that have been deposited by the meandering Rio Grande, there will be a variation in the performance of the wells. Many wells will be filled with running sand and the perforations of some well casings will be clogged by gravel and sand. It does not appear possible to predict the location of gravel stringers in which presumably better wells would be obtained than in sand alone. The meager information available indicates that sand predominates in the lower end of the Mesilla Valley.

[12]U. S. Bureau of Reclamation, 1946, Project history: unpublished report, El Paso, Tex.

With respect to the chemical quality of the water, generally better water is obtained with depth; an exception is the lower end of the Mesilla Valley, where apparently very poor water is obtained at depth. Some shallow wells in the Selden Canyon area obtain so-called salt water, which may occur also at greater depths. As the shallow water is generally satisfactory for irrigation, however, the drilling of irrigation wells deeper than 100 feet for the better water is not justified. Many domestic wells in the Mesilla Valley obtain their comparatively good water from depths in excess of 100 feet. Deep irrigation wells would possibly disturb this availability of better water with depth by drawing in poorer water from the upper strata to the lower.

As water of comparatively good chemical quality enters the valleys as underflow from adjacent arroyos, wells located on the valley floor in line with or a short distance downstream from these arroyos may obtain better-than-average water from the valley fill.

The alluvial fill in the Selden Canyon area and in the northern end of the Mesilla Valley, near Leasburg Dam, is thin and narrow. If a large number of irrigation wells were drilled in these areas and used continuously, comparatively large drawdowns of water level would result and wells drilled near the impermeable rocks at the edges of the valleys would be relatively unproductive.

In order to draw a greater percentage of the pumped water from storage, the wells should be located as far as possible from the drains and the river. Canals that leak excessively are paralleled with drains, and the water level in the canals is without doubt above the water table. The water level in sections of canals that have only a small leakage is also above the water table. Wells drilled near canals whose water is not in direct contact with the ground water will not appreciably increase the leakage from the canals, but will divert to the pumps water that would normally be picked up by drains.

Locating irrigation wells in areas of native vegetation will lower the water table in these areas and will reduce transpiration losses and save some water for the project.

Therefore, for least effect upon the project supply and for maximum well production, it is recommended that irrigation wells on the valley floors should be located as far as possible from the drains and the river; be drilled as far as practicable from the mountain masses in Selden Canyon and the northern end of Mesilla Valley; be drilled near arroyo mouths where possible; be drilled no deeper than necessary to secure an adequate supply of water; and not be drilled in the lower end of Mesilla Valley.

RECOMMENDATIONS FOR FUTURE STUDIES

As brought out previously, water pumped by wells in the Rincon and Mesilla Valleys is not an additional or new supply but, instead, is water that would normally flow to the drains and be diverted for use in a lower part of the project. Pumping of ground water, therefore, is essentially a change in point of diversion of an existing supply. In times of normal or adequate supply of surface water to the project, pumping obtains water that would otherwise be available by gravity. In a year of surface-water shortage, pumping results in an adequate supply of water to those farmers having pumps but may reduce the amount of surface water available for diversion in the lower part of the district or project. Pumping water from wells upon new lands, either in or bordering the valleys, will result in reducing to some extent the supply of water to the project.

Because of these effects of pumping upon the water supply of the project, continuing records should be kept of the amount pumped and the location of the irrigation wells.

The initial effect of the pumping, especially in a year of inadequate surface supply, will be a decrease in the drain flow. This decrease may not be readily apparent for a small number of pumps unless accurate and frequent measurements of the drain flow are made. If 75 pumps are in operation, the decrease in drain flow may amount to approximately 10,000 acre-feet a year. If measurements of the drain flow approach an accuracy of 5 percent, the error in measurements in a year of average drain flow may amount to about 12,500 acre-feet. Thus, unless accurate and frequent measurements of drain flow are made, any decreases noted could not be definitely attributed to the effects of pumping. At present, the drainage return flow is measured only at the outlets to the river. Measurements should be made at additional points along the drains in order that any decrease in flow caused by pumping can be localized within sections of the drains.

The ground-water levels will decline as a result of pumping. However, the decline will be small so long as water continues to flow in the drains, the drains acting as sources of recharge to the cones of depression caused by the pumps. An effort should be made to continue measurements in the fifty-odd auger holes in the Mesilla Valley that have been measured for a number of years by the Bureau of Reclamation. Auger holes should be installed in the Rincon Valley at pertinent locations in order to permit observation of any effects of pumping upon the water level there. Also, measurements of water level should be made in the irrigation wells at least once a year, preferably in January or early February when the effects from the previous irrigation season are at a minimum.

Records as to the performance of each well and logs of formations penetrated would aid in interpretation of the effects of pumping.

In summary, in order to have reliable data for a future re-evaluation of the effects of pumping, if such becomes desirable, the following records should be kept: information on the irrigation wells such as, location, performance, and pumpage; measurements of water level in the irrigation wells annually and in the auger wells seasonally; and additional measurements of drain flow.

SUMMARY

1. The ground water in the valley fill originates mainly from surface water, that is, from seepage of the canals and the river, and from excess water applied to irrigated lands, but partly from ground water from the adjoining high lands, and, occasionally, from precipitation upon the valley floor.

2. The quality of the shallow ground water in the alluvium of the Rincon and Mesilla Valleys is slightly poorer than drain water but satisfactory for most irrigation requirements. The dissolved solids generally decrease with increased depth of wells except in a few areas, especially in the lower end of the Mesilla Valley and in the Selden Canyon. Comparatively good water is obtained in surrounding high lands and in arroyo beds.

3. Wells yielding sufficient water for irrigation can be developed over the major part of the valley floors of the Rincon and Mesilla Valleys, with the probable exceptions of the Selden Canyon area and the southern end of the Mesilla Valley. Sanding of wells has occurred and may occur in wells that may be drilled, and special well construction may be necessary to prevent it.

4. Irrigation wells, generally of small capacity, can be developed on the arroyos and on the low benchlands. However, many wells in these areas may not obtain sufficient quantities for irrigation.

5. Pumping of ground water will divert water from the drains and the river. The drains may practically stop flowing by the end of the first summer in a dry year if enough pumps are installed to furnish an adequate water supply for all lands.

6. If an increased portion of releases from the reservoir were made up to the lower district as compensation for the reduction in flow of the drains, caused by pumping in the Rincon and Mesilla Valleys, a corresponding reduction in the diversions to the Elephant Butte Irrigation District would be necessary.

7. As no unused ground-water recharge escapes from the project, and there is very little unused ground-water discharge, only a small amount of water can be salvaged to the Rio Grande project as a whole over a period of years by pumping in the Elephant Butte district.

8. Assuming that the El Paso division continues to get diversions in the same proportion of reservoir releases as in the past, pumping of ground water will not result in any additional water for the Elephant Butte Irrigation District on a year-to-year basis unless the amount of pumping exceeds the amount of the diverted drain flow, when this excess will come from storage.

9. On a long-term basis nearly all water removed from storage must be replaced before the flow of the drains returns to normal.

10. With a gravity water supply available for diversions of 50 percent of average, about 70 percent of the land in the Elephant Butte Irrigation District probably could be irrigated by careful use and control of gravity water alone.

11. During a year in which the normal supply of surface water is deficient by 50 percent, an additional acre-foot per acre would be needed to successfully irrigate the water-right land in New Mexico. To supply this deficit for 88,000 acres by pumping from wells would, because of distribution losses and reduction in flow of the drains caused by pumping, require pumping 213,000 acre-feet per year, assuming that the El Paso division receives its accustomed share of the reservoir water.

12. As supplemental pumpage would in effect save the crops on 30 percent of the land that could not be irrigated by surface water in a year of 50-percent gravity supply, the additional gross crop return resulting from pumping would be $15,800,000 for a 5-year period on the basis of the average annual gross crop return from 1937-46 of $120 an acre.

13. The total number of wells and pumps required in a year of 50-percent gravity supply is estimated to be about 220 and the total cost about $3,190,000 on the basis of a 5-year period and $3,536,900 for 8 years, including all charges, or approximately one-fifth of the average gross dollar benefits from crops grown.

14. Total cost per acre-foot of water pumped would be about $3.00, equal to about $7.25 per irrigated acre per year for the district.

15. Pumping of ground water on individual farms in years of deficient gravity water supply would ultimately reduce the water

supply of the Rio Grande project. If such a reduction were borne by the Elephant Butte Irrigation District, it would be necessary to reduce deliveries of surface water to farms with pumps in order to maintain the expected deliveries to farms without pumps.

16. Pumping of ground water for winter irrigation in the project could effect savings in water, as losses of winter releases are disproportionately large for the acreage irrigated.

17. About 15,000 acres of now undeveloped land and suspended land could be irrigated by ground water. Water pumped on these lands will, in a few years, reduce the water available to the existing irrigated lands by an amount equal to the consumptive use by the lands and crops irrigated.

18. As the water pumped will affect the water supply of the project, especially in years of deficient surface supply, continuing records should be kept of the amount of water pumped, of water-level measurements, and of the location and performance of irrigation wells.

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Water Appropriations.
Rio Grande Project.

DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY
Reclamation Service.

Carlsbad, New Mexico. Jan. 23, 1906.

Mr. David L. White,
Territorial Irrigation Engineer,
Santa Fe, New Mexico.

Dear Sir:

The United States Reclamation Service, acting under authority of an Act of Congress known as the Reclamation Act, approved June 17, 1902 (32 Stat., 388), proposes to construct within the Territory of New Mexico certain irrigation works in connection with the so-called Rio Grande project. The operation of the works in question contemplates the diversion of water from the Rio Grande River.

Section 22 of Chapter 102 of the laws enacted in 1905 by the 36th Legislative Assembly of the Territory of New Mexico - an Act entitled, "An Act Creating the Office of Territorial Irrigation Engineer, to Promote Irrigation Development and Conserve the Waters of New Mexico for the Irrigation of Lands and for other Purposes," approved March 16, 1905 - reads as follows:

"Whenever the proper officers of the United States authorized by law to construct irrigation works, shall notify the territorial irrigation engineer that the United States intends to utilize certain specified waters, the waters so described, and unappropriated at the date of such notice, shall not be subject to further appropriations under the laws of New Mexico, and no adverse claims to the use of such waters, initiated subsequent to the date of such notice, shall be recognized under the laws of the territory, except as to such amount of the water described in such notice as may be formally re-leased in writing by an officer of the United States thereunto duly authorized".

In pursuance of the above statute of the Territory you are hereby notifed that the United States intends to utilize the following described waters, to-wit:

A volume of water equivalent to 730,000 acre-feet per year requiring a maximum diversion or storage of 2,300,000 miner's inches said water to be diverted or stored from the Rio Grande River at a point described as follows:

Storage dam about 9 miles west of Engle, New Mexico, with capacity for 2,000,000 acre-feet, and diversion dams below in Palomas, Rincon, Mesilla, and El Paso Valleys in New Mexico and Texas.

It is, therefore, requested that the waters above described be withheld from further appropriation and that the rights and interests of the United States in the premises be otherwise protected as contemplated by the statute above cited.

Very truly yours,

(Signed) B. M. Hall

Supervising Engineer.

Supplemental notice of the intention of the United States to use the waters of the Rio Grande for irrigation purposes on the Rio Grande Project.

Phoenix, Arizona, April , 1908.

Mr. Vernon L. Sullivan,
Territorial Engineer,
Santa Fe, New Mexico.

Dear Sir:-

Claiming and reserving all rights under our former notice of January 23, 1906, addressed to David L. White, Territorial Irrigation Engineer of New Mexico, which said notice advised him of the intention of the United States to use the waters of the Rio Grande for the purpose of irrigation, and is now filed in your office, I do now hereby give you the following notice in addition to said former notice and supplemental thereto.

The United States acting under authority of an Act of Congress, known as the Reclamation Act, approved June 17, 1902, (32 Stat. 388), proposes to construct within the Territory of New Mexico certain irrigation works in connection with the so-called Rio Grande Project. The operation of the works in question contemplates the diversion of the water of the Rio Grande River.

Section 40 of Chapter 49 of the laws enacted in 1907 by the 37th Legislative Assembly of the Territory of New Mexico, an Act entitled, "An Act to conserve and regulate the use and distribution of the waters of New Mexico; to create the office of Territorial Engineer; to create a Board of Water Commissioners, and for other purposes", approved March 19, 1907, reads as follows:

Whenever the proper officers of the United States authorized by law to construct works for the utilization of waters within the Territory, shall notify the Territorial Engineer that the United States intends to utilize certain specified waters, the waters so described and unappropriated, and not covered by applications of affidavits duly filed or permits as required by law, at the date of such notice, shall not be subject to a further appropriation under the laws of the Territory for a period of three years from the date

of said notice, within which time the proper officers of the United States shall file plans for the proposed work in the office of the Territorial Engineer for his information, and no adverse claim to the use of the water required in connection with such plans, initiated subsequent to the date of such notice, shall be recognized under the laws of the Territory, except as to such amount of water described in such notice as may be formally released in writing by an officer of the United States thereunto duly authorized; Provided, that in case of failure to file plans of the proposed work within three years, as herein required, the waters specified in the notice given by the United States to the Territorial Engineer shall become public water, subject to general appropriations.

In pursuance of the above statute of the Territory you are hereby notified that the United States intends to utilize the following described waters, to-wit:

All the unappropriated water of the Rio Grande and its tributaries, said water to be diverted or stored from the Rio Grande River at a point described as follows:

Storage dam about nine miles west of Engle, New Mexico, with capacity for two million (2,000,000) acre feet, and diversion dams below in Palomas, Rincon, Mesilla and El Paso Valleys in New Mexico and Texas.

It is therefore requested that the waters above described be withheld from further appropriation and that the rights and interests of the United States in the premises be otherwise protected as contemplated by the statue above cited.

Very truly yours,

(Signed) Louis C. Hill

Supervising Engineer.

6 copys

TREATY SERIES, No. 455

CONVENTION

BETWEEN THE

UNITED STATES AND MEXICO

Equitable Distribution of the Waters of the Rio Grande

SIGNED AT WASHINGTON, MAY 21, 1906
RATIFICATION ADVISED BY THE SENATE, JUNE 26, 1906
RATIFIED BY THE PRESIDENT, DECEMBER 26, 1906
RATIFIED BY MEXICO, JANUARY 5, 1907
RATIFICATIONS EXCHANGED AT WASHINGTON, JANUARY 16, 1907
PROCLAIMED, JANUARY 16, 1907

WASHINGTON
GOVERNMENT PRINTING OFFICE
1919

By the President of the United States of America.

A PROCLAMATION.

Whereas a Convention between the United States of America and the United States of Mexico, providing for the equitable distribution of the waters of the Rio Grande for irrigation purposes, and to remove all causes of controversy between them in respect thereto, was concluded and signed by their respective Plenipotentiaries at Washington on the twenty-first day of May, one thousand nine hundred and six, the original of which Convention, being in the English and Spanish languages, is word for word as follows:

The United States of America and the United States of Mexico being desirous to provide for the equitable distribution of the waters of the Rio Grande for irrigation purposes, and to remove all causes of controversy between them in respect thereto, and being moved by considerations of international comity, have resolved to conclude a Convention for these purposes and have named as their Plenipotentiaries:

The President of the United States of America, Elihu Root, Secretary of State of the United States; and

The President of the United States of Mexico, His Excellency Señor Don Joaquín D. Casasús, Ambassador Extraordinary and Plenipotentiary of the United States of Mexico at Washington; who, after having exhibited their respective full powers, which were found to be in good and due form, have agreed upon the following articles:

Los Estados Unidos de América y los Estados Unidos Mexicanos deseosos de ponerse de acuerdo en la equitativa distribución de las aguas del Río Grande para fines de irrigación, y de alejar todas las causas de discusión entre ellos á ese respecto, y obrando por consideraciones de cortesía internacional, han resuelto celebrar una Convención con este propósito y han nombrado sus Plenipotenciarios, á saber:

El Presidente de los Estados Unidos de América, al Señor Elihu Root, Secretario de Estado de los Estados Unidos; y

El Presidente de los Estados Unidos Mexicanos, á Su Excelencia el Señor Don Joaquín D. Casasús, Embajador Extraordinario y Plenipotenciario de los Estados Unidos Mexicanos en Washington; quienes, despues de presentar sus plenos poderes respectivos, que se encontraron en buena y debida forma, han convenido en los artículos siguientes:

Article I.

After the completion of the proposed storage dam near Engle, New Mexico, and the distributing system auxiliary thereto, and as soon as water shall be available in said system for the purpose, the United States shall deliver to Mexico a total of 60,000 acre-feet of water annually, in the bed of the Rio Grande at the point where the head works of the Acequia Madre, known as the Old Mexican Canal, now exist above the city of Juarez, Mexico.

Artículo I.

Una vez que se hayan terminado la proyectada presa cerca de Engle, Nueva México, y el sistema auxiliar de distribución al efecto, y tan luego como haya agua disponible para el objeto en dicho sistema, los Estados Unidos entregarán á México un total de 60,000 acres pies de agua anualmente, en el lecho del Río Grande y en el punto en donde se encuentran ahora las obras principales de la Acequia Madre, conocida con el nombre de viejo canal mexicano, arriba de Ciudad Juarez, Mexico.

Article II.

The delivery of the said amount of water shall be assured by the United States and shall be distributed through the year in the same proportions as the water supply proposed to be furnished from the said irrigation system to lands in the United States in the vicinity of El Paso, Texas, according to the following schedule, as nearly as may be possible:

	Acre feet per month.	Corresponding cubic feet of water.
January	0	0
February	1,090	47,480,400
March	5,460	237,837,600
April	12,000	522,720,000
May	12,000	522,720,000
June	12,000	522,720,000
July	8,180	356,320,800
August	4,370	190,357,200
September	3,270	142,441,200
October	1,090	47,480,400
November	540	23,522,400
December	0	0
Total for the year	60,000 acre-feet	2,613,600,000 cubic feet

Artículo II.

Los Estados Unidos asegurarán la entrega de dicha cantidad de agua y la distribuirán durante el año en las mismas proporciones que la cantidad de agua que se proyecta proporcionar del expresado sistema de irrigación á los terrenos de los Estados Unidos en las cercanías de El Paso, Texas, de conformidad, y tan aproximadamente como sea posible, con la siguiente lista:

	Acres pies por mes.	Pies cúbicos de agua correspondientes.
Enero	0	0
Febrero	1,090	47,480,400
Marzo	5,460	237,837,600
Abril	12,000	522,720,000
Mayo	12,000	522,720,000
Junio	12,000	522,720,000
Julio	8,180	356,320,800
Agosto	4,370	190,357,200
Setiembre	3,270	142,441,200
Octubre	1,090	47,480,400
Noviembre	540	23,522,400
Diciembre	0	0
Total en el año	60,000 acres pies	2,613,600,000 pies cúbicos

In case, however, of extraordinary drought or serious accident to the irrigation system in the United States, the amount delivered to the Mexican Canal shall be diminished in the same proportion as the water delivered to lands under said irrigation system in the United States.

Article III.

The said delivery shall be made without cost to Mexico, and the United States agrees to pay the whole cost of storing the said quantity of water to be delivered to Mexico, of conveying the same to the international line, of measuring the said water, and of delivering it in the river bed above the head of the Mexican Canal. It is understood that the United States assumes no obligation beyond the delivering of the water in the bed of the river above the head of the Mexican Canal.

Article IV.

The delivery of water as herein provided is not to be construed as a recognition by the United States of any claim on the part of Mexico to the said waters; and it is agreed that in consideration of such delivery of water, Mexico waives any and all claims to the waters of the Rio Grande for any purpose whatever between the head of the present Mexican Canal and Fort Quitman, Texas, and also declares fully settled and disposed of, and hereby waives, all claims heretofore asserted or existing, or that may hereafter arise, or be asserted, against the United States on account of any damages alleged to have been sustained by the owners of land in Mexico, by reason of the diversion by citizens of the United States of waters of the Rio Grande.

En caso, sin embargo, de extraordinaria sequía ó de serio accidente en el sistema de irrigación en los Estados Unidos, se disminuirá la cantidad de agua que deba entregarse al canal mexicano, en la misma proporción que la que se entregue á las tierras sujetas á dicho sistema de irrigación en los Estados Unidos.

Artículo III.

La expresada entrega se hará sin gasto alguno para México, y los Estados Unidos convienen en pagar el total costo del depósito de la mencionada cantidad de agua que debe darse á México, de la condución de la misma hasta la línea internacional, de la medición de dicha agua y de su entrega en el lecho del río, arriba de la boca del Canal Mexicano. Queda entendido que los Estados Unidos no asumen otra obligación que la de entregar el agua en el lecho del río, arriba de la boca del Canal Mexicano.

Artículo IV.

La entrega del agua, como aquí se establece, no se considerará como un reconocimiento por los Estados Unidos de ningún derecho por parte de México á dichas aguas; y se conviene que, en consideración á dicho abastecimiento de agua, México retira cualquiera y todas las reclamaciones, sea cual fuere su objeto, á las aguas del Río Grande entre la boca del actual Canal Mexicano y Fort Quitman, Texas, y declara también completamente arregladas y extinguidas todas las reclamaciones hasta hoy presentadas, existentes ó que puedan después suscitarse ó presentarse contra los Estados Unidos á causa de cualesquiera daños que los propietarios de tierras en México aleguen haber sufrido con motivo de las desviación de aguas del Río Grande efectuada por ciudadanos de los Estados Unidos.

Article V.

The United States, in entering into this treaty, does not thereby concede, expressly or by implication, any legal basis for any claims heretofore asserted or which may be hereafter asserted by reason of any losses incurred by the owners of land in Mexico due or alleged to be due to the diversion of the waters of the Rio Grande within the United States; nor does the United States in any way concede the establishment of any general principle or precedent by the concluding of this treaty. The understanding of both parties is that the arrangement contemplated by this treaty extends only to the portion of the Rio Grande which forms the international boundary, from the head of the Mexican Canal down to Fort Quitman, Texas, and in no other case.

Artículo V.

Los Estados Unidos, al celebrar este tratado, no otorgan con él, explícita ni implícitamente, ningún fundamento legal para reclamaciones que en lo futuro se aleguen, ó puedan alegarse, procedentes de cualesquiera pérdidas sufridas por los propietarios de tierras en México, ora se deba ó se alegue deberse, á la desviación de las aguas del Río Grande dentro de los Estados Unidos; ni convienen los Estados Unidos de ninguna manera en el establecimiento de ningún principio general ó precedente á causa de la celebración de este tratado. Quedan entendidas las dos Altas Partes Contratantes que el arreglo que se proyecta con este tratado sólo se extiende á la porción del Río Grande que forma el límite internacional, desde la boca del Canal Mexicano hasta Fort Quitman, Texas, y á ningún otro caso.

Article VI.

The present Convention shall be ratified by both contracting parties in accordance with their constitutional procedure, and the ratifications shall be exchanged at Washington as soon as possible.

In witness whereof, the respective Plenipotentiaries have signed the Convention both in the English and Spanish languages and have thereunto affixed their seals.

Done in duplicate at the City of Washington, this 21st day of May, one thousand nine hundred and six.

Artículo VI.

La presente Convención será ratificada por Ambas Partes Contratantes de acuerdo con las formalidades constitucionales de cada una de ellas, y se canjearán las ratificaciones en Wáshington tan luego como fuere posible.

En fe de lo cual, los respectivos Plenipotenciarios han firmado la presente Convención, tanto en inglés como en castellano, y han puesto en ella sus sellos.

Hecho en dos originales en la Ciudad de Washington, el 21 de Mayo, de mil novecientos seis.

ELIHU ROOT [SEAL.]
JOAQUIN D CASASUS [SEAL.]

And whereas the said Convention has been duly ratified on both parts, and the ratifications of the two governments were exchanged in the City of Washington, on the sixteenth day of January, one thousand nine hundred and seven;

Now, therefore, be it known that I, Theodore Roosevelt, President of the United States of America, have caused the said Convention to be made public, to the end that the same and every article and clause thereof may be observed and fulfilled with good faith by the United States and the citizens thereof.

In testimony whereof, I have hereunto set my hand and caused the seal of the United States of America to be affixed.

Done at the City of Washington, this sixteenth day of January, in the year of our Lord one thousand nine hundred and seven, [SEAL.] and of the Independence of the United States of America the one hundred and thirty-first.

THEODORE ROOSEVELT

By the President:
ELIHU ROOT
Secretary of State.

CONFIDENTIAL

EXHIBIT 2

10/9/80 CI

1906 Treaty Studies
Rio Grande Project

Historic Allotments and
Deliveries to United States Lands and Mexico

(1) Year	(2) Historical Allotment in Acre-feet/Acre	(3) Historical Allotment to Mexico in Acre-feet
1950	3.00	60,000
51	1.75	34,749
52	2.50	49,640
53	1.90	37,730
54	0.50	9,930
55	0.42	8,273
56	0.39	7,777
57	1.17	23,232
58	4.00	60,000
59	3.50	60,000
1960	3.25	60,000
61	2.45	48,608
62	3.25	60,000
63	2.00	39,681
64	0.33	6,614
65	1.85	36,705
66	2.50	49,602
67	1.50	29,761
68	2.00	39,681
69	3.00	60,000
1970	3.00	60,000
71	1.75	34,721
72	0.80	15,872
73	3.00	60,000
74	3.00	60,000
75	3.00	60,000
76	3.00	60,000
77	1.25	24,801
78	0.75	14,880
Average	2.10	40,423

Data in Columns (2) and (3) provided by WPRS each year when allotment of water is determined.

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EXHIBIT 3

AB:10/7/80

Re 1906 Treaty

Historic (1950 - 1978) Allotment and Deliveries

(1)	(2)	(3)
Year	Final Allocation Acre-feet/Acre	Deliveries To United States Farms Acre-feet/Acre
1950	3.00	3.08
51	1.75	1.83
52	2.50	2.09
53	1.90	1.94
54	0.50	0.72
55	0.42	0.56
56	0.39	0.53
57	1.17	1.27
58	4.00	2.85
59	3.50	2.87
1960	3.25	2.81
61	2.45	2.30
62	3.25	2.82
63	2.00	2.11
64	0.33	0.46
65	1.85	1.70
66	2.50	2.25
67	1.50	1.71
68	2.00	1.84
69	3.00	2.58
1970	3.00	2.75
71	1.75	1.94
72	0.80	0.92
73	3.00	2.45
74	3.00	2.54
75	3.00	2.51
76	3.00	2.73
77	1.25	1.42
78	0.75	0.86
Average	2.10	1.95

Column (2) the acre-feet/acre allotment data provided by WPRS each year when allotment of water is determined.

Column (3) deliveries to United States farms. Data provided by WPRS sent with letter dated December 19, 1978 by J. W. Kirby. The acre-feet/acre was computed by dividing deliveries by actual irrigated acreage.

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Exhibit 4

Allotment during Shortage Years Based upon 1) Quantity of Waters Available for Release from Project Storage, 2) 790,000 Acre-Feet Required for a Full Supply, and 3) Deliveries to U.S. Headgates As Well As Mexican Headgate, Applied to Years 1950 to 1978

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
				Estimated Delivery to Mexican Headgates				Difference	
Year	Water Available for Release Total Acre-Feet	Less Estimated 10% for Losses to Headgates Acre-Feet	For Full Delivery to Headgates U.S. & Mexico* .90(790,000) Acre-Feet	% (2)÷(3) x 100	in A.F. % x 60,000	Estimated Delivery to U.S. Headgates Acre-Feet	Historical Allotment to Mexico in A.F.	Proposed minus Historic Acre-Feet	%
1950	894,136*	711,000**	711,000	100	60,000	651,000	60,000	0	0
51	467,752	421,000	711,000	59.2	35,500	385,500	34,749	+ 751	+ 2.2
52	835,759*	711,000**	711,000	100	60,000	651,000	49,640	+ 10,360	+ 20.9
53	606,152	545,500	711,000	76.7	46,000	499,500	37,730	+ 8,270	+ 21.9
54	243,531	219,200	711,000	30.8	18,500	200,700	9,930	+ 8,570	+ 86.3
55	320,544	288,500	711,000	40.6	24,400	264,100	8,273	+ 16,127	+ 194.9
56	263,748	237,400	711,000	33.4	20,000	217,400	7,777	+ 12,223	+ 157.2
57	653,950	588,600	711,000	82.8	49,700	538,900	23,232	+ 26,468	+ 113.9
58	1,340,803*	711,000**	711,000	100	60,000	651,000	60,000	0	0
59	1,166,324*	711,000**	711,000	100	60,000	651,000	60,000	0	0
1960	1,062,641*	711,000**	711,000	100	60,000	651,000	60,000	0	0
61	729,912	656,900	711,000	92.4	55,400	601,500	48,608	+ 6,792	+ 14.0
62	831,204*	711,000**	711,000	100	60,000	651,000	60,000	0	0
63	581,416	523,300	711,000	73.6	44,200	479,100	39,681	+ 4,519	+ 11.4
64	232,536	209,300	711,000	29.4	17,600	191,700	6,614	+ 10,986	+ 166.1
65	715,075	643,600	711,000	90.5	54,300	589,300	36,705	+ 17,595	+ 47.9
66	865,184*	711,000**	711,000	100	60,000	651,000	49,602	+ 10,398	+ 21.0
67	561,245	505,100	711,000	71.0	42,600	462,500	29,761	+ 12,839	+ 43.1
68	665,486	598,900	711,000	84.2	50,500	548,400	39,681	+ 10,819	+ 27.3
69	839,289*	711,000**	711,000	100	60,000	651,000	60,000	0	0
1970	811,167*	711,000**	711,000	100	60,000	651,000	60,000	0	0
71	507,550	456,800	711,000	64.2	38,500	418,300	34,721	+ 3,779	+ 10.9
72	303,038	272,700	711,000	38.4	23,000	249,700	15,872	+ 7,128	+ 44.9
73	899,699*	711,000**	711,000	100	60,000	651,000	60,000	0	0
74	899,544*	711,000**	711,000	100	60,000	651,000	60,000	0	0
75	827,138	711,000**	711,000	100	60,000	651,000	60,000	0	0
76	742,975	668,700	711,000	94.1	56,500	612,200	60,000	- 3,500	- 5.8
77	439,561	395,600	711,000	55.6	33,400	362,200	24,801	+ 8,599	+ 34.7
78	389,703	350,700	711,000	49.3	29,600	321,100	14,880	+ 14,729	+ 98.9
Sum	19,697,062	16,113,800			1,359,700	14,754,100	1,172,257	+187,443	
Average	679,210	555,600			46,900	508,800	40,423	+ 6,464	+ 16.0

Column (1) Water in storage available for releases was determined jointly by Engineers D. Farias (WPRS) and C. Ito (IBWC), by adding the actual storages in Elephant Butte and Caballo Dam one day before the date of the last announcement published by the WPRS, plus the releases made from Caballo Dam from the beginning of the irrigation season through a day before the date of the announcement.

Column (2) Column (1) less 10% for losses

Column (6) Column (2) minus Column (5)

Column (7) WPRS Records

*Based upon irrigated area 159,650 acres

**Maximum release 790,000 acre-feet less 10% for losses
acre-feet

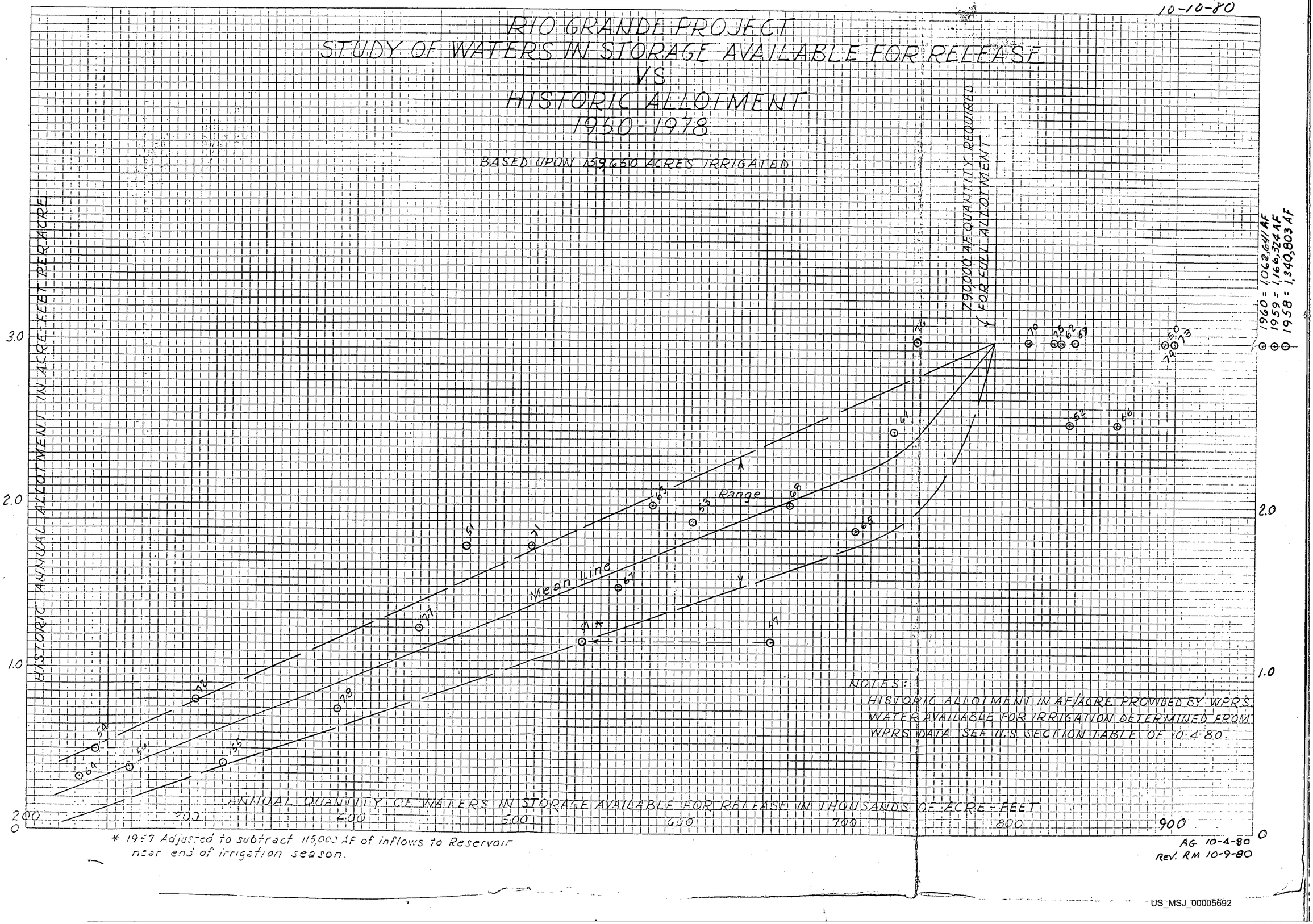
US_MSJ_00005691

US0168986

EXHIBIT 5
10-10-80

RIO GRANDE PROJECT
STUDY OF WATERS IN STORAGE AVAILABLE FOR RELEASE VS HISTORIC ALLOTMENT 1950-1978

BASED UPON 859,650 ACRES IRRIGATED



NOTES:
HISTORIC ALLOTMENT IN AF/ACRE PROVIDED BY WPRS.
WATER AVAILABLE FOR IRRIGATION DETERMINED FROM WPRS DATA SEE U.S. SECTION TABLE OF 10-4-80.

AG 10-4-80
REV. RM 10-9-80

47 0703

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Exhibit 6

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CI 10-8-80

1906 Treaty Studies - OPTION B

Allotment during Shortage Years Based upon 1) Quantity of Waters Available for Release from Project Storage, 2) 790,000 Acre-Feet Required for Full Supply, and 3) Historic Allotments, Applied to Years 1950 to 1978

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Waters Available for Release	Allocation to Mexico from Mean Curve by U.S. Section dtd 10-3-80			Historic Allotment to Mexico	Difference Proposed - Historic	
Year	Acre-Feet	AF/Acre**	%	A.F.	Acre-Feet	Acre-Feet	%
1950	894,136*	3.00	100	60,000	60,000	0	0
51	467,752	1.22	40.3	24,200	34,749	- 10,549	- 30
52	835,759*	3.00	100	60,000	49,640	+ 10,360	+ 21
53	606,152	1.80	59.5	35,700	37,730	- 2,030	- 5
54	243,531	0.32	10.6	6,400	9,930	- 3,530	- 35
55	320,544	0.64	21.2	12,700	8,273	+ 4,427	+ 54
56	263,748	0.41	13.6	8,200	7,777	+ 423	+ 5
57	653,950	1.98	65.5	39,300	23,232	+ 16,068	+ 69
58	1,340,803*	3.00	100	60,000	60,000	0	0
59	1,166,324*	3.00	100	60,000	60,000	0	0
1960	1,062,641*	3.00	100	60,000	60,000	0	0
61	729,912	2.31	76.4	45,800	48,608	- 2,808	- 6
62	831,204*	3.00	100	60,000	60,000	0	0
63	581,416	1.74	57.5	34,500	39,681	- 5,181	- 13
64	232,536	0.34	11.2	6,700	6,614	+ 86	+ 1
65	715,075	2.38	78.7	47,200	36,705	+ 10,495	+ 29
66	865,184*	3.00	100	60,000	49,602	+ 10,398	+ 21
67	561,245	1.75	57.9	34,700	29,761	+ 4,939	+ 17
68	665,486	2.19	72.4	43,400	39,681	+ 3,719	+ 9
69	839,289*	3.00	100	60,000	60,000	0	0
1970	811,167*	3.00	100	60,000	60,000	0	0
71	507,550	1.42	46.9	28,100	34,721	- 6,621	- 19
72	303,038	0.61	20.2	12,100	15,872	- 3,772	- 24
73	899,699*	3.00	100	60,000	60,000	0	0
74	899,544*	3.00	100	60,000	60,000	0	0
75	827,138	3.00	100	60,000	60,000	0	0
76	742,975	2.42	80.0	48,000	60,000	- 12,000	- 20
77	439,561	1.14	37.7	22,600	24,801	- 2,201	- 9
78	389,703	0.96	31.7	19,000	14,880	+ 4,120	+ 28
Sum	19,697,062			1,188,600	1,172,257	+ 16,343	
Average	679,210			41,000	40,423	+ 600	+ 1

Although total waters available exceeded 790,000 acre-feet, assumption made that the maximum release would not exceed 790,000 acre-feet to not cause artificial spill under Rio Grande Compact.

Water in storage available for releases was determined jointly by Engineers D. Farias (WPRS) and C. Ito (IBWC) by adding the actual storages in Elephant Butte and Caballo Dam one day before the date of the last announcement published by the WPRS, plus the releases made from Caballo Dam from the beginning of the irrigation season through a day before the date of the announcement.

Beginning in 1976, a minimum storage of 51,000 acre-feet was reserved in Elephant Butte.

Data in Column (5) provided by WPRS.

**Based upon 159,650 acres irrigated.

CONFIDENTIAL

EXHIBIT 7

CI:10/9/80

RIO GRANDE PROJECT, NEW MEXICO-TEXAS
Total Acreages Irrigated/Served
United States Lands**

Year	Agricultural Lands Irrigated	City of El Paso Lands	Total Acreages
1951	156,961	1,447.30	158,408.30
52	158,512	1,456.36	159,968.36
53	159,768	1,458.69	161,226.69
54	142,868	1,458.69	144,326.69
55	142,694	1,500.45	144,194.45
56	132,355	1,497.84	133,852.84
57	133,445	1,744.44	135,189.44
58	140,802	1,843.34	142,645.34
59	143,943	1,817.13	145,760.13
1960	143,390	1,820.89	145,210.89
61	141,654	1,833.19	143,487.19
62	145,648	1,837.37	147,485.37
63	147,452	1,855.42	149,307.42
64	141,999	2,075.75	144,074.75
65	138,127	1,756.68	139,883.68
66	134,155	2,350.18	136,505.18
67	131,814	2,422.83	134,236.83
68	138,863	2,617.21	141,480.21
69	140,937	2,683.23	143,620.23
1970	141,239	2,792.02	144,031.02
71	138,535	2,894.00	141,429.00
72	133,410	2,982.78	136,392.78
73	138,485	3,077.25	141,562.25
74	138,277	3,075.94	141,352.94
75	137,500	3,569.20	141,069.20
76	137,485	3,695.96	141,180.96
77	136,272	4,040.23	140,312.23
78	130,369	4,270.17	134,639.17
Average	140,963	2,352.66	143,315

NOTE: City of El Paso Lands represent lands with rights to use Project water that have been retired from agricultural production and the water therefrom diverted to municipal uses.

**Data from WPRS, with letter dated March 6, 1980.

CONFIDENTIAL

AB 10-8-80 Exhibit 8

1906 Treaty Studies - OPTION C

Allotment during Shortage Years Based upon 1) Quantity of Waters Available for Release from Project Storage, 2) 790,000 Acre-Feet Required for Full Supply, 3) Historic Allotments, and 4) Adjustment for Acres Irrigated, Applied to Years 1950 to 1978

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
		Allocation to Mexico from Mean Curve by U.S. Section dtd 10-3-80			Column 4 Adjusted for Actual Acreage	Historic Allotment to Mexico	Difference Proposed - Historic	
Year	Waters Available for Release Acre-Feet	AF/Acre a)	%	A.F.	Acre-Feet	Acre-Feet	Acre-Feet	%
1950	894,136*	3.00	100	60,000	60,000	60,000	0	0
51	467,752	1.22	40.3	24,200	24,400	34,749	- 10,349	- 30
52	835,759*	3.00	100	60,000	60,000	49,640	+ 10,360	+ 21
53	606,152	1.80	59.5	35,700	35,700	37,730	- 2,030	- 5
54	243,531	0.32	10.6	6,400	7,100	9,930	- 2,830	- 28
55	320,544	0.64	21.2	12,700	14,100	8,273	+ 5,827	+ 70
56	263,748	0.41	13.6	8,200	9,800	7,777	+ 2,023	+ 26
57	653,950	1.98	65.5	39,300	46,400	23,232	+ 23,168	+100
58	1,340,803*	3.00	100	60,000	60,000	60,000	0	0
59	1,166,324*	3.00	100	60,000	60,000	60,000	0	0
1960	1,062,641*	3.00	100	60,000	60,000	60,000	0	0
61	729,912	2.31	76.4	45,800	51,000	48,608	+ 2,392	+ 5
62	831,204*	3.00	100	60,000	60,000	60,000	0	0
63	581,416	1.74	57.5	34,500	36,900	39,681	- 2,781	- 7
64	232,536	0.34	11.2	6,700	7,400	6,614	+ 786	+ 12
65	715,075	2.38	78.7	47,200	53,900	36,705	+ 17,195	+ 47
66	865,184*	3.00	100	60,000	60,000	49,602	+ 10,398	+ 21
67	561,245	1.75	57.9	34,700	41,300	29,761	+ 11,539	+ 39
68	665,486	2.19	72.4	43,400	49,000	39,681	+ 9,319	+ 23
69	839,289*	3.00	100	60,000	60,000	60,000	0	0
1970	811,167*	3.00	100	60,000	60,000	60,000	0	0
71	507,550	1.42	46.9	28,100	31,700	34,721	- 3,021	- 9
72	303,038	0.61	20.2	12,100	14,200	15,872	- 1,672	- 11
73	899,699*	3.00	100	60,000	60,000	60,000	0	0
74	899,544*	3.00	100	60,000	60,000	60,000	0	0
75	827,138	3.00	100	60,000	60,000	60,000	0	0
76	742,975	2.42	80.0	48,000	54,300	60,000	- 5,700	- 10
77	439,561	1.14	37.7	22,600	25,700	24,801	+ 899	+ 4
78	389,703	0.96	31.7	19,000	22,500	14,880	+ 7,620	+ 51
Sum	19,697,062			1,188,600	1,245,400	1,172,257	+ 73,143	
Average	679,210			41,000	42,900	40,423	+ 2,500	+ 6

*Although total waters available did exceed 790,000 acre-feet, the maximum release that will be made will not exceed 790,000 acre-feet to comply with Rio Grande Compact agreements.

Water in storage available for releases was determined jointly by Engineers D. Farias (WPRS) and C. Ito (IBWC) by adding the actual storages in Elephant Butte and Caballo Dam one day before the date of the last announcement published by the WPRS, plus the releases made from Caballo Dam from the beginning of the irrigation season through a day before the date of the announcement.

Beginning in 1976, a minimum storage of 51,000 acre-feet was reserved in Elephant Butte.

Data in Column (5) obtained by multiplying Column (4) by 159,650 divided by actual acreage each year.

Data in Column (6) provided by WPRS.

a) Based upon 159,650 acres irrigated.

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SUMMARY TABLE

COMPARISON OF OPTIONS FOR DETERMINING ALLOTMENT TO MEXICO IN YEARS OF SHORTAGES UNDER 1906 TREATY

ASSUMING OPTION APPLIED TO PERIOD 1950 TO 1978

Description	Number of Years Of Full Allotment	Average Annual Allotment 29 Years In Acre Feet	Change from Average Annual Historical Allotment In Acre Feet
Historical Allotment	11	40,400	--
Option A - Based upon ratio of 1) quantity of waters in storage available for release, and 2) quantity required for full supply - 790,000 acre feet; and allotments based on deliveries to headgates on river for U.S. and Mexico.	12	46,900	+6,500
Option B - Based upon 1) quantity of waters in storage available for release, 2) 790,000 acre feet required for full supply, and 3) historical allotments	12	41,000	+ 600
Option C - Based upon 1) quantity of waters in storage available for release, 2) 790,000 acre feet required for full supply, 3) historic allotments, and 4) adjustment for acres irrigated.	12	42,900	+2,500

Exhibit 9

EP-431
WTR-4.10

31 OCT 1997

Mr. Ed Archuleta
Manager, Public Service Board
City of El Paso Water Utilities
1154 Hawkins Blvd.
P. O. Box 511
El Paso, TX 79961-0001

SUBJECT: Request for A Copy of The Rio Grande Project Water Supply Allocation Procedures

Dear Mr. Archuleta:

It is our understanding that a request was made by both Mr. Conrad Keyes, Texas Engineer Advisor for the Rio Grande Compact Commission and yourself for a copy of the Rio Grande Project water supply allocation procedures. This request was made during the October 20, 1997, meeting of the New Mexico-Texas Water Commission.

Please find enclosed, one copy of the allocation procedures for the Rio Grande Project. If you should have further questions or need further assistance concerning the procedures, please contact Mr. Wayne Treers of our staff at 534-6321.

Sincerely,

Filiberto Cortez

Filiberto Cortez
Acting El Paso Field Division Manager

Enclosure

cc: Mr. Conrad Keyes, Texas Engineer Advisor, Rio Grande Compact Commission, 124 W. Castellano, Suite 211, El Paso, TX 79912

Mr. Jack Hammond, Texas Commissioner, Rio Grande Compact Commission, 124 W. Castellano, Suite 211, El Paso, TX 79912

Mr. Jay Groseclose, New Mexico Engineer Advisor, Rio Grande Compact Commission, Interstate Stream Commission, P. O. Box 25102, Santa Fe, NM 87504-5102

Mr. Tom Turney, New Mexico Commissioner, Rio Grande Compact Commission, P. O. Box 25102, Santa Fe, NM 87504-5102

Mr. Steve Vandiver, Colorado Engineer Advisor, Rio Grande Compact Commission, Colorado Division of Water Resources, P. O. Box 269, Alamosa, CO 81101

Mr. Hal Simpson, Colorado Commissioner, Rio Grande Compact Commission, 1313 Sherman St., Rm. 818, Denver, CO 80203

Mr. Kenneth Salazar, Chairman and Federal Representative, Rio Grande Compact Commission, 1801 California St., Suite 3600, Denver, CO 80202-2636

(copy of encl. to all above)

bc: Albuquerque Area Office,
ATTN: ALB-100, ALB-110
(w/o cy. of encl.)

WTreers:mr:10/31/97:rgcc1027.wp

RIO GRANDE PROJECT

WATER SUPPLY ALLOCATION PROCEDURES

October 30, 1997

RIO GRANDE PROJECT
ALLOTMENT PROCEDURES

REGRESSION ANALYSIS CURVE D-1

- Annual Data Used (1951-1978)

- Y-Axis - Sum of Deliveries, including:

  Acre-Feet Delivered to Farms
  Acre-Feet Delivered Internationally to Mexico
  Non-Farm Deliveries (M&I) in Acre-Feet

- X-Axis:

  Acre-Feet Releases from Storage

- Regression Analysis Curve D-1 Data:

Slope	=	0.8260932
Y-Intercept	=	- 102,305
Corr Coeff	=	0.9781202
Y Std Dev	=	160,375
X Std Dev	=	135,448

RIO GRANDE PROJECT
ALLOTMENT PROCEDURES

REGRESSION ANALYSIS CURVE D-2

- Annual Data Used (1951-1978)

- Y Axis - Total Diversions:

  Total Acre-Feet Diverted

- X-Axis - Total Releases:

  Water Supply Releases from Storage

- Regression Analysis Curve D-2 Data:

Slope	=	1.3377994
Y-Intercept	=	- 89,970
Corr Coeff	=	0.9754545
X Std Dev	=	160,375
Y Std Dev	=	219,948

RIO GRANDE PROJECT
ALLOTMENT PROCEDURES

- Full Allotment to U.S. Farms and Mexico:

  3.024 AF/Ac x 155,000 Ac = 468,720 AF

  Full Allotment to Mexico (1906 Treaty) + 60,000 AF

  528,720 AF

  Use: 528,700 AF

- Using D-1 Curve, Determine Release for Full Allotment:

  Slope = 0.8260932; Y-Intercept = -102,305 AF

  Y = (0.8260932) X + (-102,305 AF) = 528,700 AF

  $$X = \text{Releases} = \frac{(528{,}700 + 102{,}305)}{0.8260932} = 763{,}842 \text{ AF}$$

  Use: 763,840 AF

- Using D-2 Curve, Determine Total Diversions:

  Slope = 1.3377994; Y-Intercept = -89,970 AF

  Y = (1.3377994)(763,840)AF + (-89,970)AF = 931,841 AF

RIO GRANDE PROJECT
ALLOCATION PROCEDURES

- Full Water Supply Allocation:

Total Allocation Diversions:	931,841 AF
Allocation to Mexico (1906 Treaty):	-60,000 AF
Allocation to U.S. Districts	871,841 AF

- Full Allocation to U.S. Districts:

EBID = (88,000/155,000)(871,841)AF

= (0.56774)(871,841)AF = 494,979 AF

EPCWID = (67,000/155,000)(871,841)AF

= (0.43226)(871841)AF = 376,862 AF

RIO GRANDE PROJECT
ALLOTMENT PROCEDURES

- Example of a 100% Allocation:

Allotment Letter:

Mailed to the IBWC and U.S. Districts in Dec.
(Year prior to irrigation season)

Full allocation is based on:

Full Supply to authorized U.S. Lands:		468,700 AF
Full allocation to Mexico	:	+60,000 AF
		528,700 AF

From Curve D-1, release from storage is: 763,840 AF
(Full Allotment to U.S.Farms & Mexico)

From Curve D-2, total diversions are: 931,841 AF
(Full Allotment to U.S. Farms & Mexico)

Full Allocation to Mexico (1906 Treaty): 60,000 AF

Full Allocation to U.S. Districts: 871,841 AF

Full Allocation to EBID: 494,979 AF
(871,841)(0.56774)AF = 494,982 AF

Full Allocation to EPCWID: 376,862 AF
(871,841)(0.43226)AF = 376,862 AF

RIO GRANDE PROJECT
ALLOTMENT PROCEDURES

- Example - Allotment for Less than Full Supply:

Determine Project Water Supply Available in Storage:

Elephant Butte Reservoir		600,000 AF
Caballo Reservoir		+32,000 AF
	Total	632,000 AF
Minimum Pool	:	-50,000 AF
Evaporation Losses	:	-90,000 AF
Available In storage	:	492,000 AF

492,000 AF is less than the 763,840 AF which would provide a full supply to the U.S. Farms and Mexico.

From Curve D-1, 492,000 AF release would provide the U.S. Farms and Mexico with:

$$Y = (0.8260932)(492{,}000\ AF) + (-102{,}305) = 304{,}133\ AF$$

Mexico's Allotment = 11.3486% of the total deliveries to the U.S. Farms and Mexico:

$$(60{,}000\ AF/528{,}700\ AF)(100\%) = 11.3486\%$$

Mexico's Allotment would be:

$$(304{,}133\ AF)(0.113486) = 34{,}515\ AF$$

RIO GRANDE PROJECT
ALLOTMENT PROCEDURES

- Example - Allotment for Less than full Supply (Cont.):

Deliveries to U.S. Headings:

Available in Storage = 492,000 AF

From Curve D-2, Diversions to the U.S. Districts and Mexico:

(492,000)(1.3377994)AF + (-89,970)AF = 568,227 AF

Delivery to Mexico = -34,515 AF

Delivery to U.S. Headings = 533,712 AF

Allocations to U.S. Districts:

EBID = (533,712)AF(0.56774) = 303,010 AF

EPCWID = (533,712)AF(0.43226) = 230,702 AF

E. Definitions

1. Project Water Supply - stored water legally available for release from Elephant Butte and Caballo Reservoirs and including the legally appropriated waters reaching the bed of the Rio Grande between Caballo Dam and Riverside Diversion Dam.

2. Allocated Water - that portion of the project water supply, as defined in Article E.1. above, which is determined to be available for diversion and use by the Elephant Butte Irrigation District (EBID), and El Paso County Water Improvement District (EPCWID) and the Republic of Mexico during any irrigation season. The irrigation season is defined as that period of a year when storage releases are being made from Caballo Reservoir for irrigation purposes.

3. Non-Allocated Water - water in the Rio Grande, during non-irrigation season and after the closing of Caballo Dam gates, which originates from drain flows and other sources which may be diverted by the irrigation districts for application to irrigable land areas within their boundaries. All diversions made by the districts during the non-irrigation season utilizing return flow made by the districts during the non-irrigation season utilizing return flow waters shall not be charged against the Districts' respective allocations.

II. ALLOCATION

A. Procedure

The following procedure is used for the allotment and control of the Rio Grande Project water supply. It is required because the Bureau no longer delivers water at the farms, but rather at the districts' river headings. The procedure provides for an equitable distribution of project water between the U.S. and Mexico consistent with historic operations.

The 1906 Treaty with Mexico requires that Mexico be provided 60,000 AF/yr at the bed of the Rio Grande at the headworks of the Acequia Madre except in times of extraordinary drought or serious accident to the irrigation system in the United States. The amount delivered to the Mexican Canal (Acequia Madre) shall be diminished in same proportion as the water delivered to lands under said irrigation system in the United States. The first allocation to lands in the United States was made in 1951. An analysis done at that time established 3.024 AF/acre (applied to lands) as a full supply to U.S. farms of 468,720 AF (3.024 AF/acre x 155,000 acres) for the full project water right acreage of 155,000 acres. This analysis was based on the period of 1946 - 1950 during which a full water supply was available and deliveries were considered "normal".

Statistical evaluations of operational records for the period of 1951 through 1978 inclusive have been made. These evaluations have provided graphs, equations, and data that can be used to ensure that future allocations to Mexico and the allocations to the U.S. maintain the historical relationship between the delivery of water to U.S. farms and Mexico. The historical period of relationship is defined as the years 1951-1978 inclusive.

Curve D-1, enclosed as Exhibit No. 1, illustrates the historic water relationship between the water released from storage and the corresponding delivery to farms in the United States and to the heading of the Mexican Canal. Curve D-1 is used to determine the allocation to the Mexican heading and the two U.S. Irrigation Districts.

Prior to application of Curve D-1, it is necessary to determine the amount of water in storage available for release. This determination takes into account minimun pool requirements, non-project waters in storage, and estimated reservoir losses. Reservoir losses include evaporation, bank storage and seepage.

The amount available for irrigation to U.S. river headings is determined from Curve D-2, enclosed as Exhibit No. 3, which shows releases from Caballo vs. Net Diversions from the river (U.S. + Mexico). Mexico's allotment is subtracted from Net Diversions to obtain the amount available to the U.S. The diversion of water between the U.S. districts is based on acreage.

Curve D-1 will not be adjusted as it is based on the 1951-1978 period in which the allocations were made to farm deliveries. It should be noted that Curve D-2 is to be used as a guide and adjustments may be necessary due to current conditions. A review of the data base for curve D-2 will be made annually using the preceding year's data.

Reclamation will make the initial allocation of project water each year by December 1. In years of less than a full allotment, the allocation will be reviewed and updated as determined necessary. A review of the allocation will be made on a monthly basis and in conference with officials of EBID, EPCWID, and the U.S. Section of the IBWC, no later than the 10th of the following month.

B. Determination of Allotment for Full Supply

This procedure is based on a full supply of 468,700 acre-feet to authorized irrigated lands in the U.S. and full allocation to Mexico of 60,000 AF for a total of 528,700 AF.

Curve D-1 can be used to determine the historic release requirement necessary to deliver a full supply to U.S. authorized lands and Mexico (528,700 AF). From D-1, the required release from project storage is 763,800 AF. The release for a full supply is not limited to 763,800 AF.

$$\text{Release Required} = \frac{(\text{Full Supply}) - (\text{Y-Intercept})}{(\text{Slope})}$$

$$= \frac{(528{,}700) - (-102{,}305)}{(0.8260932)}$$

$$= 763{,}842 \text{ AF} \quad (763{,}800 \text{ AF})$$

From Curve D-2, the Net Diversion at Headings (US and Mexico) for a release of 763,800 AF is 931,841 AF (1951-1978 data).

$$\text{Net Diversions} = (\text{Slope})(\text{Release}) + (\text{Y-Intercept})$$

$$= (1.3377994)\,(763{,}800) + (-89{,}970)$$

$$= 931{,}841 \text{ AF}$$

Allocation for a full supply:

Delivery to U.S. Headings and to Mexico	=	931,841 AF
Delivery to Mexico	=	-60,000 AF
Delivery to U.S. Headings	=	871,841 AF

EBID Delivery to Headings = 56.774% of 871,841 AF = 494,979 AF
EPCWID Delivery to Headings = 43.226% of 871,841 AF = 376,862 AF

C. Example for 100% Allotment

Net diversion requirement for a full supply of 528,700 AF to authorized irrigated lands in the U.S. and Mexico has been found to be 931,841 AF.

Step 1. From Curve D-2, the Caballo release required to meet a net diversion at Headings of 931,841 AF is 763,800 AF.

Step 2. Determine amount of water in storage available for release.

Total Storage
-Estimated Reservoir Losses
-Storage for Others
=Water in Storage Available for Release

Storage for others is the City of Albuquerque which is limited to a maximum storage of 50,000 AF.

Water available for release is greater than 763,800 AF.

Step 3. If amount of water in storage available for release (from Step 2) equals or exceeds the release requirement (from Step 1), then the allotment is 100%. Then, the net diversions are 931,841 AF for a full supply to U.S. farms and Mexico.

Step 4. Available for diversions at headings:

Mexico	60,000 AF
EBID	494,979 AF
EPCWID	376,862 AF
	931,841 AF

D. Example of Allotment for Less Than Full Supply

Step 1. Determination of water in storage available for release assumed storage:

Elephant Butte	600,000 AF
Caballo Dam	32,000 AF
Total	632,000 AF
Minimum pool requirement	-50,000 AF
	582,000 AF
Estimated reservoir evaporation losses	-90,000 AF
Total water in storage available for release	492,000 AF

492,000 AF is less than 763,800 AF, the net diversion which would provide a full supply to U.S. farms and Mexico.

Step 2. From Curve D-1, total delivered to U.S. farms and Mexico vs. releases from storage

For a release of 492,000 AF, the total delivered to U.S. farms and Mexico = 304,133 AF

Step 3. Mexico's allotment = 11.3486% of total deliveries to U.S. farms and Mexico's headgate

$$\left[\frac{60,000}{528,700} = 0.113486\right]$$

304,133 X 0.113486 = 34,515 AF

Step 4. Delivery to U.S. Headings from Curve D-2, for:

Caballo releases of 492,000 AF

Delivery to U.S. Headings and to Mexico (492,000 x 1.3377994 - 89,970)	568,227 AF
Delivery to Mexico	34,515 AF
Delivery to U.S. Headings	533,712 AF

Step 5. Allocation to Districts:

EBID	= 56.774% of 533,712 =	303,010 AF
EPCWID#1	= 43.226% of 533,712 =	230,702 AF

III. Water Delivery and Accounting

A. Ordering of Water by the Districts

1. Diversion Points

The diversion points used for the districts are as follows:

EBID	EPCWID
Percha Lateral (Percha Diversion Dam	East Side Canal 1/ (Mesilla Diversion Dam)
Arrey Canal (Percha Diversion Dam	La Union East Canal 1/ (From West Side Canal)

CURVE D-1

CALENDER YEAR	DELIVERED TO FARMS ACRE-FEET	ACEQUIA MADRE ACRE-FEET	NON-FARM DELIVERIES ACRE-FEET	Y TOTAL DELIVERY ACRE-FEET	X RELEASE FROM STORAGE	X*Y	X^2	Y^2
1951	287,618	33,059	7,018	327,695	469,450	153836417750	2.2038E+11	1.0738E+11
1952	331,846	49,890	6,597	388,333	543,975	211243443675	2.9591E+11	1.5080E+11
1953	310,440	37,760	5,955	354,155	528,628	187216249340	2.7945E+11	1.2543E+11
1954	102,270	10,147	1,752	114,169	244,165	27876073885	5.9617E+10	1.3035E+10
1955	80,463	8,185	2,071	90,719	219,157	19881703883	4.8030E+10	8.2299E+09
1956	69,458	7,864	1,002	78,324	246,140	19278669360	6.0585E+10	6.1346E+09
1957	170,117	23,290	2,155	195,562	397,103	77658256886	1.5769E+11	3.8244E+10
1958	400,767	60,050	6,432	467,249	737,125	344420919125	5.4335E+11	2.1832E+11
1959	406,989	60,110	6,772	473,871	687,414	325745559594	4.7254E+11	2.2455E+11
1960	402,400	60,320	6,527	469,247	705,162	330895153014	4.9725E+11	2.2019E+11
1961	325,981	48,610	4,949	379,540	561,697	213186479380	3.1550E+11	1.4405E+11
1962	411,420	60,057	6,234	477,711	651,941	311439387051	4.2503E+11	2.2821E+11
1963	313,006	39,693	3,828	356,527	517,172	184385781644	2.6747E+11	1.2711E+11
1964	64,968	6,653	938	72,559	206,085	14953321515	4.2471E+10	5.2648E+09
1965	234,600	36,658	4,034	275,292	505,598	139187084616	2.5563E+11	7.5786E+10
1966	301,468	49,618	8,341	359,427	610,341	219373034607	3.7252E+11	1.2919E+11
1967	225,269	29,829	4,021	259,119	456,517	118292228523	2.0841E+11	6.7143E+10
1968	255,721	39,677	7,475	302,873	505,691	153160150243	2.5572E+11	9.1732E+10
1969	364,068	59,884	10,423	434,375	667,669	290018721875	4.4578E+11	1.8868E+11
1970	388,549	60,065	9,670	458,284	661,125	302983009500	4.3709E+11	2.1002E+11
1971	269,090	34,847	5,722	309,659	498,375	154326304125	2.4838E+11	9.5889E+10
1972	122,652	16,077	2,719	141,448	260,911	36905339128	6.8075E+10	2.0008E+10
1973	338,769	60,000	10,850	409,619	617,461	252923757359	3.8126E+11	1.6779E+11
1974	351,904	60,050	13,291	425,245	640,843	272515281535	4.1068E+11	1.8083E+11
1975	345,686	60,052	13,545	419,283	580,617	243442837611	3.3712E+11	1.7580E+11
1976	375,070	60,172	13,794	449,036	679,676	305198992336	4.6196E+11	2.0163E+11
1977	193,221	24,824	5,234	223,279	416,496	92994810384	1.7347E+11	4.9854E+10
1978	112,349	14,903	3,587	130,839	356,167	46600534113	1.2685E+11	1.7119E+10
TOTAL	7,556,159	1,112,344	174,936	8,843,439	14,172,701	5049939502057	7.8682E+12	3.2884E+12
AVG.	269,863	39,727	6,248	315,837	506,168	180,354,982,216	2.8101E+11	1.1744E+11

SLOPE= 0.8260932
Y-INTRCPT= -102,305
CORR. COEFF.= 0.9781202
X STD. DEV.= 160,375
Y STD. DEV.= 135,448

CURVE D-2 DATA 1951-1978

CALENDER YEAR	B ACEQUIA MADRE ACRE-FEET	E PROJECT NET SUPPLY ACRE-FEET	Y (B+E) TOTAL HEADING DIVERSIONS ACRE-FEET	X G RELEASE FROM STORAGE ACRE-FEET	X*Y	X^2	Y^2
1951	33,059	541,171	574,230	469,450	269572273500	2.2038E+11	3.2974E+11
1952	49,890	572,430	622,320	543,975	338526522000	2.9591E+11	3.8728E+11
1953	37,760	564,209	601,969	528,628	318217668532	2.7945E+11	3.6237E+11
1954	10,147	275,615	285,762	244,165	69773078730	5.9617E+10	8.1660E+10
1955	8,185	169,754	177,939	219,157	38996577423	4.8030E+10	3.1662E+10
1956	7,864	178,408	186,272	246,140	45848990080	6.0585E+10	3.4697E+10
1957	23,290	309,029	332,319	397,103	131964871857	1.5769E+11	1.1044E+11
1958	60,050	761,712	821,762	737,125	605741314250	5.4335E+11	6.7529E+11
1959	60,110	781,248	841,358	687,414	578361268212	4.7254E+11	7.0788E+11
1960	60,320	791,861	852,181	705,162	600925658322	4.9725E+11	7.2621E+11
1961	48,610	639,574	688,184	561,697	386550888248	3.1550E+11	4.7360E+11
1962	60,057	770,701	830,758	651,941	541605201278	4.2503E+11	6.9016E+11
1963	39,693	647,655	687,348	517,172	355477139856	2.6747E+11	4.7245E+11
1964	6,653	229,936	236,589	206,085	48757444065	4.2471E+10	5.5974E+10
1965	36,658	443,130	479,788	505,598	242579853224	2.5563E+11	2.3020E+11
1966	49,618	644,994	694,612	610,341	423950182692	3.7252E+11	4.8249E+11
1967	29,829	503,037	532,866	456,517	243262387722	2.0841E+11	2.8395E+11
1968	39,677	539,878	579,555	505,691	293075747505	2.5572E+11	3.3588E+11
1969	59,884	742,543	802,427	667,669	535755632663	4.4578E+11	6.4389E+11
1970	60,065	743,097	803,162	661,125	530990477250	4.3709E+11	6.4507E+11
1971	34,847	556,910	591,757	498,375	294916894875	2.4838E+11	3.5018E+11
1972	16,077	279,618	295,695	260,911	77150078145	6.8075E+10	8.7436E+10
1973	60,000	646,177	706,177	617,461	436036756597	3.8126E+11	4.9869E+11
1974	60,050	704,544	764,594	640,843	489984712742	4.1068E+11	5.8460E+11
1975	60,052	693,609	753,661	580,617	437588388837	3.3712E+11	5.6800E+11
1976	60,172	808,169	868,341	679,676	590190537516	4.6196E+11	7.5402E+11
1977	24,824	468,239	493,063	416,496	205358767248	1.7347E+11	2.4311E+11
1978	14,903	321,478	336,381	356,167	119807811627	1.2685E+11	1.1315E+11
TOTAL	1,112,344	15,328,726	16,441,070	14,172,701	9250967124996	7.8682E+12	1.0960E+13
AVG.	39,727	547,455	587,181	506,168	330,391,683,036	2.8101E+11	3.9143E+11

SLOPE=	1.3377994
Y-INTRCPT=	-89,970
CORR. COEFF.=	0.9754545
X STD. DEV.=	160375
Y STD. DEV.=	219948

INTERNATIONAL BOUNDARY AND WATER COMMISSION
UNITED STATES AND MEXICO
UNITED STATES SECTION

El Paso, Texas
June 29, 1956

Ex Exhibit 1.

MEMORANDUM OF CONVERSATION - June 29, 1956

SUBJECT: 1906 Treaty Deliveries to Mexico

Participants: Project Manager W. F. Resch, Rio Grande Project, Bureau of Reclamation
Principal Engineer (Supervising) J. F. Friedkin and Chief of Operations C. S. Kerr, International Boundary and Water Commission

Pursuant to your instructions the writer and Mr. Kerr met with Mr. W. F. Resch in his office on June 29, 1956, to learn the manner of determination during years of inadequate supply, of the allotment of water to lands in United States Rio Grande Project, which allotment in turn determines the allotment to Mexico under the 1906 Treaty.

We explained to Mr. Resch that our inquiry stems from a request by the Mexican Section for information relative to the manner of determining Mexico's allotment.

In response Mr. Resch advised that the determination is made by the Bureau of Reclamation in conference with the Elephant Butte Irrigation District and the El Paso County Water Improvement District No. 1, on the following bases:

1) At the beginning of an irrigation season determination is made of the amount of water available for irrigation at that time, which is the amount of water then in project storage (Elephant Butte and Caballo Reservoirs) less the estimated evaporation losses from the reservoirs during the season and less silt encroachment since the last reservoir survey. He explained however that for the current year (1956) evaporation and silt

encroachment were not taken into account for the computation made in March as it appeared likely, and the risk was taken, that inflows into the reservoirs would be sufficient to offset evaporation and silt deposit so that for the current year the total amount in storage on March 1, 1956 - 229,800 acre-feet, was determined to be the supply available for the United States project and for 1906 Treaty deliveries to Mexico, and this amount was used as the basis of the first allotment. Mr. Resch emphasized that in making the first allotment no allowance is made for inflows which may later occur into the reservoirs, particularly when the monthly water supply forecasts are discouraging.

2) On the basis of experience and judgment, determination is then made as to the probable "operating efficiency" of the Rio Grande Project, which he defined as the ratio of the quantity of water applied to lands (delivery at the farmers' gates) to the total release at Caballo Dam. He explained that for the initial allotment for the current season the "efficiency" factor was estimated at 25%*. He explained that in previous years return flows had been taken into account in determining the "efficiency" factor, but in the current year such flows are practically negligible and accordingly no account was taken thereof.

3) The "efficiency" factor is then applied to the total amount in project storage to determine tentatively the water available for delivery to United States project lands (159,628 acres) and the resulting amount (57,450 acre-feet in 1956) is converted to inches per acre (4.3 inches in 1956). The percentage of normal delivery to the project lands is then computed on the basis of 36.26 inches being normal (the average during the period 1946 to

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* Mr. Resch explained that during years of full supply the efficiency factor ranges from 60% to 70%.

1950). For 1956 the tentative percentage thus computed of normal delivery amounted to 11.86%.

4) The tentative per cent of normal delivery to United States lands is then applied to Mexico's full treaty allotment to determine its tentative prorata allotment which for 1956 amounted to 7,116 acre-feet (11.86% x 60,000 = 7,116). This amount was then deducted from the first tentative total amount available for delivery to project lands.

5) The "efficiency" factor is then reapplied to the balance remaining for delivery to United States project lands and computations outlined in steps 3) and 4) are repeated until by trial and error process the percentage of full delivery to United States project lands is the same as the percentage of the full treaty allotment to Mexico. For 1956 the computations resulted in an allotment of slightly less than 4 inches to the project lands, but the gamble was taken that that amount (4 inches) or 11.0314% of the normal allotment would be available which in turn resulted in a determination of the allotment to Mexico of 11.0314% of its full allotment which amounted to 6,619 acre-feet.

6) In the event of inflows into the reservoirs following the first allotment additional allotments are made to United States project lands and to Mexico on the basis of the additional amount available in storage in the same manner as outlined above.

7) With respect to return flows, Mr. Resch considers that since such waters are developed within the project, they are separate from storage waters although principally of storage origin. He points out that they may or may not be available for use below the point of return and hence may or may not be available for delivery to Mexico. He explained that such

waters are included in and as a part of the allotted deliveries to project lands when the return waters occur during times when releases from storage are in the river. At other times the return waters are not included as a part of the allotment to the project lands. He points out, however, that in either event any return waters delivered to Mexico are included as a part of the treaty allotment to that country.

8) With respect to flood waters entering into the river below Caballo Dam, he explained that at times when the flood inflows are relatively small, and cannot as a practical matter be distinguished from the irrigation waters in the river, they are included as a part of the allotment to project lands. At times when the arroyo flows are relatively large or when they occur when there is no irrigation water in the river, they are not included as a part of the allotment to project lands.

Commenting upon the above formula, Mr. Resch stated that it is in strict accord with his understanding of the Treaty which distinguishes between deliveries to lands in the United States and to the head of the Acequia Madre for Mexico. Mr. Resch stated that to his knowledge there has heretofore been no question raised as to the procedure followed in making the allotment to Mexico.

Mr. Resch was most cooperative in describing the procedure followed which he emphasized is carried out jointly by the Bureau and the Elephant Butte and El Paso County Irrigation Districts. He stated that he would be glad to assist in any further way that he can to clarify our understandings of the procedure.

A. F. Friedkin

Subject 318

RIO GRANDE PROJECT

Water Charged to Farms, and Acres Irrigated

1946 - 1950

	Acre-Feet Charged To Farms	Project Lands Irrigated Acres
1946	498,960	156,899
1947	466,910	158,111
1948	451,750	155,809
1949	479,600	159,124
1950	488,023	158,783
Total	2,385,243	788,726

Average Charged to Farms $\frac{2,385,243}{788,726}$ = 3.0241 feet

3.0241 x 12 = 36.29 inches

7-1926 (11-71) Bureau of Reclamation	Transmitted	OFFICIAL FILE COPY					
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Blind Copy	Date 9-29-80						
	Time 9:30						

IN REPLY
REFER TO:

FAXOGRAM

September 29, 1980

To: Regional Director, Amarillo, Texas
Attn: SW-105 and SW-400
From: Project Superintendent, El Paso, Texas
Subject: Historic and Current Rio Grande Project Water Allocation Procedures

Enclosed is an outline of the Project's allocation procedures which has been requested by the International Boundary and Water Commission. We would appreciate your review and comments and also those of the Field Solicitor.

There are two changes in the procedure to consider. Seven hundred and ninety thousand (790,000) acre-feet has always been considered to be an upper limit on release from storage. Under current procedures the 790,000 acre-feet figure has taken on a slightly greater visibility. The second change is that the Project can no longer determine the efficiency of the distribution system and therefore can only allocate water to canal headings.

Commissioner Friedkin has requested this material be provided by September 29 if possible, therefore, your prompt review would be appreciated.

Kenneth R. Pedde

U.S. Government Printing Office-1978-677-078/1112

HISTORIC (1950 through 1978) ALLOCATION PROCEDURES FOR THE RIO GRANDE PROJECT

1. A determination of water available for Project purposes is made. The water available for Project purposes is the gross reservoir storage minus water committed or consumed for purposes other than meeting Project delivery requirements. Examples of commitment or consumption are sediment encroachment, any Rio Grande Compact water stored in the reservoir but not released for Project use and the minimum pool.

2. Next, an assessment of the physical and hydrological conditions that will affect delivery efficiency on the Project is made. Parameters used for this assessment include:

(1) ground water levels - the Project maintains a system of test wells to assess this condition.

(2) drain system return flows - flows are measured at specific stations in the drainage system.

(3) rainfall since last irrigation (soil moisture) - rainfall is recorded in a system of rain gauges and the records of the Weather Bureau are used.

(4) anticipated cropping patterns - information is obtained from farmers and from various publications providing information on pricing and surplus crops which may affect planting plans.

(5) temperatures

(6) long range weather forecast

(7) evaporation and bank losses in the reservoir

Snowpack conditions on the watershed were not directly considered in setting allotments. However, the condition of the watershed may have colored the thinking of those setting the allotments.

3. Based on the assessment of conditions on the Project, an estimated irrigation system efficiency was determined. Initial determination of efficiency was generally conservative in order to not commit water which could not be delivered.

4. The estimated efficiency was applied to the water available for irrigation release. This resulted in a quantity of water available for irrigation of Project water users, delivery to Mexico's head gates and ~~Mexican lands.~~

5. The water available for irrigation was divided by the authorized acreage of the Project, resulting in an allocation per acre of land.

6. The allocation to Mexico was determined by multiplying the ratio of the allocation to U. S. lands over 3.0241 acre-feet times 60,000 acre-feet.

$$\left(\frac{\text{allocation}}{3.0241} \times 60{,}000\right)$$

7. Since the allocation to Mexico was not taken off the water available for irrigation of lands, it was necessary to go back and make a slight reduction in the allocation per acre of land and the corresponding allotment to Mexico in order to provide a balanced allotment that did not exceed the amount of water available for irrigation.

If the initial allotment was less than 3.0241 acre-feet per acre, subsequent adjustments to this allotment were made based on water available. The subsequent adjustments included only additional water available and utilized efficiency factors for the year in progress. As allotment increases were made, a concurrent proportional increase in the Mexican allotment was made. The Rio Grande Project insured the water required for release did not exceed the 790,000 acre-feet set forth in the Rio Grande Compact. While this limit was always considered, this check was not of general knowledge or concern since the water users were more interested in the acre-foot per acre figure.

CURRENT RIO GRANDE PROJECT WATER ALLOCATION PROCEDURES

1. A determination of water available in storage for Project purposes is made. The water available for Project purposes is the gross reservoir storage minus water committed or consumed for purposes other than meeting Project delivery requirements. Examples of commitment or consumption are sediment encroachment, any Rio Grande Compact water stored in the reservoir but not released for Project use and the required minimum pool. The Rio Grande Project currently considers 790,000 acre-feet to be the upper limit of water available for irrigation.

The maximum allocation to all users is based on this limit. This limit is based on the terms set forth in the Rio Grande Compact.

2. Next, an assessment of the physical and hydrological conditions that will affect delivery efficiency to the headgate on the Project is made. Parameters used for this assessment include:

(1) ground water levels - the Project maintains a system of test wells to assess this condition.

(2) drain system return flows - flows are measured at specific stations in the drainage system.

(3) rainfall since last irrigation (soil moisture) - rainfall is recorded in a system of rain gauges and the records of the Weather Bureau are used.

(4) anticipated cropping patterns - information is obtained from farmers and from various publications providing information on pricing and surplus crops which may affect planting plans.

(5) temperatures

(6) long range weather forecast

(7) evaporation and bank losses in the reservoir

(8) river losses

Conditions on the watershed are not directly used in setting allotments. However, watershed conditions may affect the degree of conservatism included in efficiency computations.

3. Based on the assessment of conditions on the Project, an estimated river efficiency is determined. Initial determination of efficiency will generally be conservative in order to not commit water which cannot be delivered.

4. Based on past operating experience and available records, an allocation to the Mexican Treaty is made. The estimated river efficiency is applied to this allocation and a quantity necessary to be released from storage to meet the Treaty obligations is determined.

5. The water committed to the Mexican Treaty is subtracted from the quantity available for irrigation.

6. The remaining water available for irrigation is divided between the irrigation districts based on their authorized irrigable acreage. From this available water for each district is subtracted the estimated river losses. The resulting quantity of water is that water which will be available for delivery at each district's canal headings. This quanity of water available at canal headings includes the water that the districts will require to operate their systems. If the initial allocation is based on an available water supply of less than 790,000 acre-feet, further allocation will be made as additional water may be available in the reservoir. These allocations are made only on uncommitted water and the actual operating conditions for the year are used in assessing losses.

RECONNAISSANCE REPORT
on
WATER CONSERVATION PLANS
for
RIO GRANDE PROJECT
NEW MEXICO - TEXAS

APPENDICES

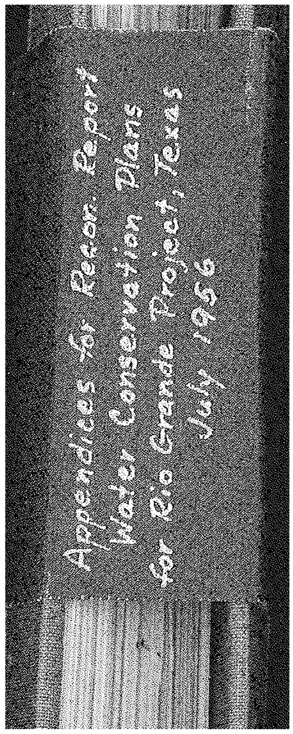
A - HYDROLOGY

B - ENGINEERING

C - AGRICULTURE ECONOMICS

July 1956

Bureau of Reclamation
Region 5
Amarillo, Texas


Appendices for Recor. Report
Water Conservation Plans
for Rio Grande Project, Texas
July 1956

APPENDIX A - HYDROLOGY

APPENDIX A - HYDROLOGY

Contents

Tables

Contents (Continued)

Tables

Plates

Contents (Continued)

Plates

APPENDIX A - HYDROLOGY

PURPOSE AND SCOPE

Purpose

The hydrology studies were made to derive reconnaissance grade estimates of:

1. The amount of usable salvaged water that could be provided on the Rio Grande Project in the reach of the Rio Grande between Caballo Dam and the southern boundary of the El Paso County Water Improvement District No. 1 by concrete lining the irrigation distribution system and/or providing a concrete lined conveyance channel from the Leasburg Diversion Dam to the vicinity of El Paso,

2. The effect upon the salt balance of the Rio Grande Project that would result from such lining, and

3. The sediment load that would occur at the Mesilla Diversion Dam and El Paso with a concrete lined conveyance channel constructed from the Leasburg Diversion Dam to the vicinity of El Paso.

Scope

Studies were made on an annual basis considering the estimated future cropping program in effect, for the following four conditions:

1. Historic conditions.

2. A concrete lined conveyance channel constructed between the Leasburg Diversion Dam and the vicinity of El Paso.

3. A concrete lined irrigation distribution system constructed from the Percha Diversion Dam to the southern boundary of the El Paso County Water Improvement District No. 1.

4. A concrete lined irrigation distribution system constructed from the Percha Diversion Dam to the southern boundary of the El Paso County Water Improvement District No. 1 with a concrete lined conveyance channel constructed between the Leasburg Diversion Dam and the vicinity of El Paso.

Inasmuch as the average annual river loss between Caballo Dam and the Leasburg Diversion Dam amounts to only about 6,000 acre-feet, no studies were made of the relatively minor salvage possibilities in this segment of the river.

The concrete lined conveyance channel between the Leasburg Diversion Dam and the vicinity of El Paso could be provided by constructing the channel in the river bed between the existing levees or by constructing the channel outside of the levees, and approximately parallel thereto, to carry all irrigation water in transit for diversion below the Leasburg Diversion Dam. The amount of water transported by a conveyance channel constructed in either location would be essentially the same. During periods of arroyo flood flows a conveyance channel constructed in the river between the levees would unavoidably carry some additional flood waters within the normal freeboard capacity of the conveyance channel.

Under the second and fourth conditions, listed above, it was considered that the flows of the wasteways and drains would discharge directly into the concrete lined conveyance channel.

RIO GRANDE COMPACT

The surface waters of the Rio Grande are apportioned among the States of Colorado, New Mexico and Texas in accordance with the Rio Grande Compact. The Compact was ratified by the three State Legislatures in February and March 1939, consented to by Congress under Public Act No. 96, 76th Congress, and approved by the President on May 31, 1939. The terms of the Compact protect the uses of water in the various sections of the Rio Grande Basin by setting up schedules of delivery of water. Colorado's obligation to deliver water at the Colorado-New Mexico state line is based upon the relationship between inflow and outflow of the San Luis Valley for the years 1928 to 1937 inclusive. New Mexico's obligation to deliver water at Elephant Butte Dam (originally at San Marcial) is based upon the relationship between inflow at Otowi and the outflow at San Marcial for all years of record prior to 1930. In order that the area above Elephant Butte Reservoir shall have the right to the consumption of water which would otherwise spill from Compact project storage (Elephant Butte and Caballo Reservoirs), the normal annual release from Compact project storage is established at 790,000 acre-feet, which includes 60,000 acre-feet required to be delivered to Mexico by the Treaty of 1906, and the maximum capacity of Compact project storage is fixed at 2,638,860 acre-feet, the original capacity of Elephant Butte Reservoir. The terms of the Rio Grande Compact permit construction and operation of additional reservoirs above Elephant Butte Reservoir to regulate the water and to capture and put to beneficial use water which otherwise would spill from Compact project storage.

Annual deliveries by Colorado and New Mexico in exact accordance with the schedules are not required. The Compact provides a system of accounting whereby deviations from the scheduled deliveries are set up as debits and credits. Such deviations may be caused by variations of run-off and the need for water and by storage of water in reservoirs constructed after 1937 in Colorado and 1929 in New Mexico. Deliveries of water by Colorado and New Mexico in excess of the scheduled requirements are credited so long as such excess deliveries remain in Compact project storage, though the annual credits cannot be accumulated in excess of 150,000 acre-feet per year. This limitation is designed to prevent unsound expansion of development which might result from temporary

accumulation of large annual credits. The over-releases and under-releases for the area below Elephant Butte Dam, defined as Texas under the Rio Grande Compact, are the differences between the actual annual release from Compact project storage and the established normal annual release of 790,000 acre-feet. Credits of Colorado and New Mexico in Compact project storage can be reduced in several ways. They may be reduced by subsequent debits caused by deficiencies in the actual deliveries; they will be reduced by evaporation, as such credits must bear their proportional share of the Compact proj-storage evaporation; and they may be lost by spill from Compact project storage.

Colorado and New Mexico can accumulate debits to the limits of 100,000 acre-feet and 200,000 acre-feet respectively, plus additional debits caused by holdover storage in reservoirs constructed after 1937 in Colorado and after 1929 in New Mexico, provided that, within the physical limitations of storage capacity in such reservoirs, Colorado and New Mexico shall retain water in storage at all times to the extent of its accrued debit. As in the case of credits, debits may also be reduced in several ways. They can be offset by subsequent credits; they can be reduced by evaporation as they must bear their proportional share of reservoir evaporation; they can be released to Compact project storage in accordance with certain provisions of the Compact; they can be reduced by having the unfilled capacity in Compact project storage becoming less than the amount of debit because the debit cannot exceed the amount of unfilled capacity in Compact project storage; or they can be cancelled by spill of usable water from Compact project storage. Any debit water in storage in excess of the unfilled capacity of Compact project storage becomes the property of the owner of the reservoir storing such debit water. In the event of spill of usable water from Compact project storage, all debits and credits are cancelled and the debit water in storage becomes the property of the owner of the reservoir storing such debit water.

The debits and credits that have been accumulated by Colorado and New Mexico and the over-releases and under-releases by Texas since the Compact became effective on January 1, 1940 are shown in Table 1. After the cancellation of credits occurred in 1942, Colorado gradually accrued credits, reaching a maximum of 144,700 acre-feet in 1949. During the subsequent drought years, the trend in Colorado reversed with a resultant accumulation, by unofficial computation, of 287,200 acre-feet of debit at the end of 1955. Since 1942, New Mexico has remained in a debit status. Construction of works under the Middle Rio Grande Project to salvage water above the Narrows of Elephant Butte Reservoir has resulted in a reduction in the rate of debit accumulation from 1952 through 1954 and a reduction of the accrued debit in 1955. During the time of World War II, the lack of adequate, skilled farm labor precluded attainment of maximum efficiency of operation on the Rio Grande Project resulting in releases of water from Caballo Reservoir in excess of the normal annual release of 790,000 acre-feet. The over-release thus accumulated was subsequently offset and at the end of 1950 a small under-release of 60,100 acre-feet had been accrued. During the following years, 1951 through 1955, the curtailment of releases because of the drought conditions has resulted in an accumulated under-release of 1,741,700 acre-feet, by unofficial computation, at the end of 1955.

Table 1. Accumulated debits and credits under terms of Rio Grande Compact at end of calendar year

Unit - 1,000 acre-feet

Calendar Year	Colorado	New Mexico	Texas
1939 1/	0	0	0
1940	19.3 Dr.	58.9 Dr.	55.5 Ur.
1941	127.0 Cr.	49.4 Cr.	138.1 Ur.
1942 2/	0.0	0.0	0.0
1943	28.7 Dr.	59.2 Dr.	115.9 Or.
1944	83.5 Cr.	136.6 Dr.	191.5 Or.
1945	69.4 Cr.	150.4 Dr.	246.5 Or.
1946	37.3 Cr.	105.4 Dr.	200.9 Or.
1947	18.8 Dr.	176.8 Dr.	122.7 Or.
1948	130.1 Cr.	286.4 Dr.	63.9 Or.
1949	144.7 Cr.	280.4 Dr.	14.3 Ur.
1950	25.0 Cr.	263.1 Dr.	60.1 Ur.
1951	0.9 Cr.	331.8 Dr.	362.3 Ur.
1952 3/	153.3 Dr.	453.2 Dr.	568.8 Ur.
1953 3/	171.4 Dr.	478.9 Dr.	774.1 Ur.
1954 3/	231.9 Dr.	497.7 Dr.	1,293.5 Ur.
1955 3/	287.2 Dr.	477.3 Dr.	1,741.7 Ur.

1/ Compact became effective January 1, 1940
2/ Credits cancelled by spill
3/ Unofficial compuations

WATER SUPPLY

Surface Water

The surface water supply for the Rio Grande Project consists of the inflow to Elephant Butte Reservoir from the Rio Grande at San Marcial and relatively minor and erratic amounts of water contributed by ephemeral tributaries between San Marcial and the southern boundary of the project. For the period from 1915 through 1937, the flow of the Rio Grande was controlled by Elephant Butte Reservoir. Beginning in 1938, control was afforded by both Elephant Butte and Caballo Reservoirs. Table 2 shows the reservoir inflow from the Rio Grande at San Marcial, the release of water from Elephant Butte and Caballo Reservoirs to the project lands, the reservoir content at the end of the year, and the acreage irrigated on the Rio Grande Project. Except for flood control release and spill, totaling 917,200 acre-feet, in 1942, the reservoirs have afforded complete control of the available supply over the 41-year period. During the period 1915 through 1950, the average annual release of water to the project lands, excluding the water released for flood control and spilled in 1942, amounted to 826,100 acre-feet which provided a full supply of water for irrigation. As a result of the current drought in the Rio Grande Basin, the water released to irrigate the project lands has had to be greatly curtailed since 1950. During the period 1951 through 1955, the release from Caballo Reservoir ranged from a minimum of 219,200 acre-feet to a maximum of 544,000 acre-feet as follows:

Table 2. Historic Reservoir Inflow, Outflow, and Content and Acreage Irrigated

Calendar Year	RIO GRANDE at San Marcial 1000 A.F.	RIO GRANDE below Elephant Butte Dam 1000 A.F.	RIO GRANDE below Caballo Dam 1000 A.F.	RESERVOIR CONTENT AT END OF YEAR Elephant Butte Reservoir 1000 A.F.	RESERVOIR CONTENT AT END OF YEAR Caballo Reservoir 1000 A.F.	RESERVOIR CONTENT AT END OF YEAR Total Reservoir content 1000 A.F.	Acreage irrigated on Rio Grande Project Acres
1915	1,354.2	969.7		350.1		350.1	33,876
1916	1,648.8	1,026.8		841.7		841.7	62,513
1917	1,055.6	1,304.0		506.3		506.3	64,308
1918	411.2	695.6		202.7		202.7	64,781
1919	1,579.4	674.0		983.3		983.3	70,012
1920	2,222.7	879.2		1,602.7		1,602.7	73,346
1921	1,625.1	979.6		1,670.8		1,670.8	84,451
1922	963.0	1,012.2		1,298.4		1,298.4	84,220
1923	1,223.9	844.1		1,386.2		1,386.2	92,186
1924	1,438.1	1,003.3		1,472		1,472	111,992
1925	418.8	816.5		983		983	130,911
1926	1,047.5	761.6		1,098		1,098	142,523
1927	1,349.0	880.7		1,384		1,384	137,553
1928	590.6	835.8		979		979	143,324
1929	1,464.1	702.1		1,541		1,541	144,197
1930	731.0	792.1		1,273		1,273	144,607
1931	489.8	750.7		924		924	144,290
1932	1,398.7	831.8		1,395		1,395	137,449
1933	716.6	827.0		1,125		1,125	139,206
1934	244.5	804.1		502		502	129,092
1935	1,029.1	637.5		672		672	120,075
1936	866.4	746.1		669		669	138,802
1937	1,557.8	758.0		1,166		1,166	145,011
1938	1,058.2		780.4	1,166.7	80.4	1,247.1	137,354
1939	524.9		789.1	814.1	79.3	893.4	139,967
1940	368.9		731.9	488.5	42.1	530.6	143,111
1941	2,832.1		703.5	1,937.7	277.3	2,215.0	147,860
1942	1,939.4		1,795.6	1,780.5	264.7	2,045.2	151,558

Table 2. (continued)

Calendar Year	RIO GRANDE at San Marcial 1000 A.F.	RIO GRANDE below Elephant Butte Dam 1000 A.F.	RIO GRANDE below Caballo Dam 1000 A.F.	RESERVOIR CONTENT AT END OF YEAR Elephant Butte Reservoir 1000 A.F.	RESERVOIR CONTENT AT END OF YEAR Caballo Reservoir 1000 A.F.	RESERVOIR CONTENT AT END OF YEAR Total Reservoir content 1000 A.F.	Acreage irrigated on Rio Grande Project Acres
1943	418.2		911.8	1,250.6	180.4	1,431.0	153,942
1944	1,024.3		866.5	1,290.6	207.1	1,497.7	154,322
1945	813.8		882.8	1,130.1	164.0	1,294.1	154,775
1946	289.1		763.8	584.3	204.5	788.8	156,899
1947	433.7		724.9	435.5	51.4	486.9	158,111
1948	933.8		741.2	492.0	99.5	591.5	155,808
1949	1,054.4		712.2	621.0	194.7	815.7	159,124
1950	307.1		719.3	335.4	70.6	406.0	158,783
1951	114.1		469.7	36.5	15.3	51.8	156,961
1952	1,004.0		544.0	376.9	30.3	407.2	158,512
1953	260.6		528.6	110.6	14.1	124.7	159,768
1954	215.7		244.1	97.6	17.5	115.1	142,868
1955	264.0		219.2	155.0	9.1	164.1	142,694

Period	Release from Caballo Reservoir 1,000 Acre-feet	Percent of 1915-1950 Mean
1915-1950 Mean	826.1*	
1951	469.7	56.9
1952	544.0	65.9
1953	528.6	64.0
1954	244.1	29.5
1955	219.2	26.5

* Excluding flood control release and spill in 1942

Comparison of the accumulated and annual debits of Colorado and New Mexico in Table 1 for the period 1951 through 1955 with the releases from Caballo Reservoir for the same period, shown in Table 2 and the above tabulation, indicate that even if Colorado and New Mexico had been able to make their scheduled deliveries the lands of the Rio Grande Project would still have suffered severe shortages of surface water during 1953, 1954 and 1955.

Ground Water

The lands of the Rio Grande Project are underlain by ground water that is recharged principally by infiltration of water applied to the land for irrigation, by seepage from the canal system and by seepage from some reaches of the Rio Grande. The average annual precipitation is slightly less than nine inches a year. Therefore, the recharge by direct infiltration of precipitation is small as is the recharge by underground inflow from the bordering highlands, which is estimated to be less than one cubic foot per second per mile of valley.

Prior to 1947 there were only 11 irrigation wells between Caballo Dam and El Paso. The number of wells has increased to 56 by the end of 1947 and 14 additional wells were completed or under construction during the first two months of 1948. By the end of 1955, the following total number of wells had been installed in and adjacent to the irrigated area below Caballo Dam:

Project Wells				
Rincon Valley	324			
Mesilla Valley	790	N.M.	86	Texas
El Paso Valley	485			
Total				1,685
Non-Project Wells (Bench or Arroyo)	46	N.M.	10	Texas
Total Project Wells	1,685			
Total Non-Project Wells	56			

Since the ground water is recharged principally as a result of irrigation operations and the minor supplies derived from precipitation and underground inflow from the bordering highlands are already reflected in the flow of the drains which is reused for irrigation, the water obtained by pumping does not represent an additional supply or new source of water for the project lands but is water that is normally intercepted and reused. Therefore, pumping represents only a change in the method, location and time of diversion of supplies already available.

The decline of the elevation of the ground water table resulting from the pumping during the period 1951 through June 1956 is depicted by Plates 1, 2 and 3. This decline of the ground water table has not only increased the head against which ground water must be pumped but has also resulted in water of questionable quality for continued irrigation use from many of the wells. Depletion of the ground water has been accompanied by an erratic increase in the loss of water from the river between Caballo Dam and El Paso, shown on Plate 4, as the depth to ground water increases and the Rio Grande becomes an influent stream providing recharge to the ground water. Upon return to normal use of surface water supplies, the depletion of the ground water will be replaced. It is probable that several years may be required before the depletion is replaced and the rate of loss from the river returns to normal.

Sources of Supplemental Water Supply

As in all other river basins in New Mexico, except the San Juan River Basin, there is no surplus water in the Rio Grande Basin above the southern boundary of the Rio Grande Project. Therefore, supplemental water for the Rio Grande Project could be obtained only through the importation of water from the San Juan River Basin or by conservation and salvage of the present supply.

The Bureau of Reclamation report of November 1955 titled "San Juan-Chama Project, Colorado-New Mexico" proposed the importation of 71,900 acre-feet of water annually to the Rio Grande from the San Juan River Basin to provide an annual increase of 55,100 acre-feet in the farm delivery within the Elephant Butte Irrigation District. After a series of meetings between the water users and the Board of Directors of that District, it was the opinion of the Board of Directors that the water users would not support a proposal to obligate their lands for the purpose of obtaining the imported water under the terms and conditions set forth in the Bureau of Reclamation report. The proposal did not include importation of water for use on the lands of the El Paso County Water Improvement District No. 1 in Texas because the terms of the Upper Colorado River Compact require that such imported water be used within the State of New Mexico.

Between Caballo Dam and El Paso there has been no major development for the purpose of the conservation and salvage of water since the canalization of the Rio Grande by the International Boundary and Water Commission during the late 1930's. The same agency also rectified the river channel between El Paso and Fort Quitman during that period. Farmers in the Ysleta Division of the El Paso County Water Improvement District No. 1 have lined about 30 miles of farm laterals. About 50 miles of farm laterals have also been lined in the Elephant Butte Irrigation District.

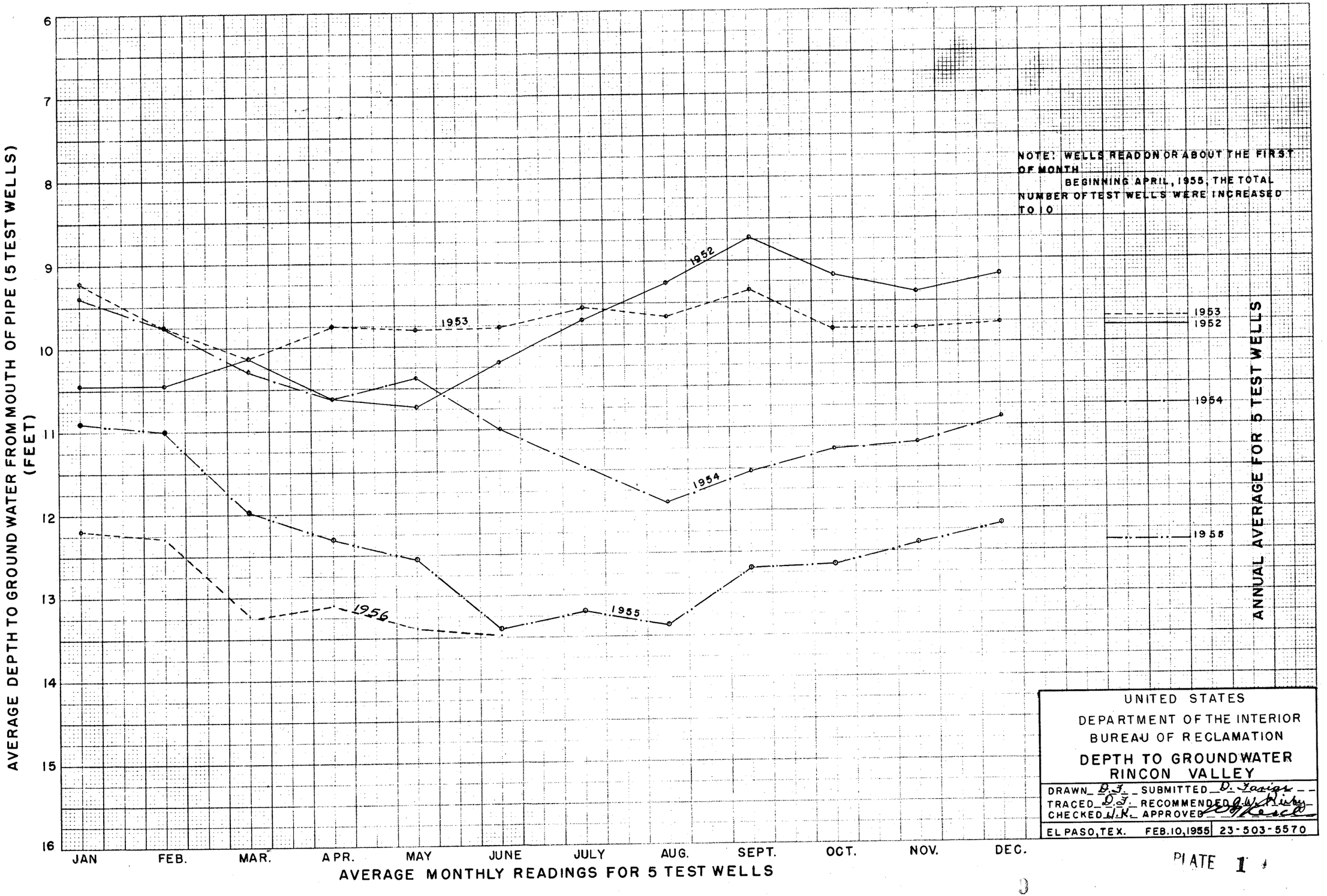


PLATE 1

US_MSJ_00005737

US0350261

DEPTH FROM NATURAL GROUND SURFACE TO WATER TABLE IN FEET

5.5
6.0
7.0
8.0
9.0
10.0
11.0
12.0
13.0
14.0
15.0
15.5

JAN. FEB. MAR. APR. MAY JUNE JULY AUG. SEPT. OCT. NOV. DEC.

AVERAGE MONTHLY READING FOR ALL TEST WELLS

1946
1947
1948
1949
1950
1951
1953
1952
1954
1955
1956

NOTE: WELLS READ BETWEEN THE 20TH AND THE END OF THE MONTH

1946
1947
1948
1949
1950
1951
1953
1952
1954
1955

NOTE: FROM 1946 TO 1951 THERE WERE A TOTAL OF 38 TEST WELLS. BEGINNING WITH 1952 THERE ARE A TOTAL OF 39 TEST WELLS

ANNUAL AVERAGE FOR ALL TEST WELLS
MESILLA VALLEY

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION

DEPTH TO GROUNDWATER
MESILLA VALLEY

DRAWN D.J. SUBMITTED D. Jarvis
TRACED D.J. RECOMMENDED [illegible]
CHECKED J.R. APPROVED [illegible]

EL PASO, TEX. FEB. 9, 1955 | 23-503-5452

PLATE 2

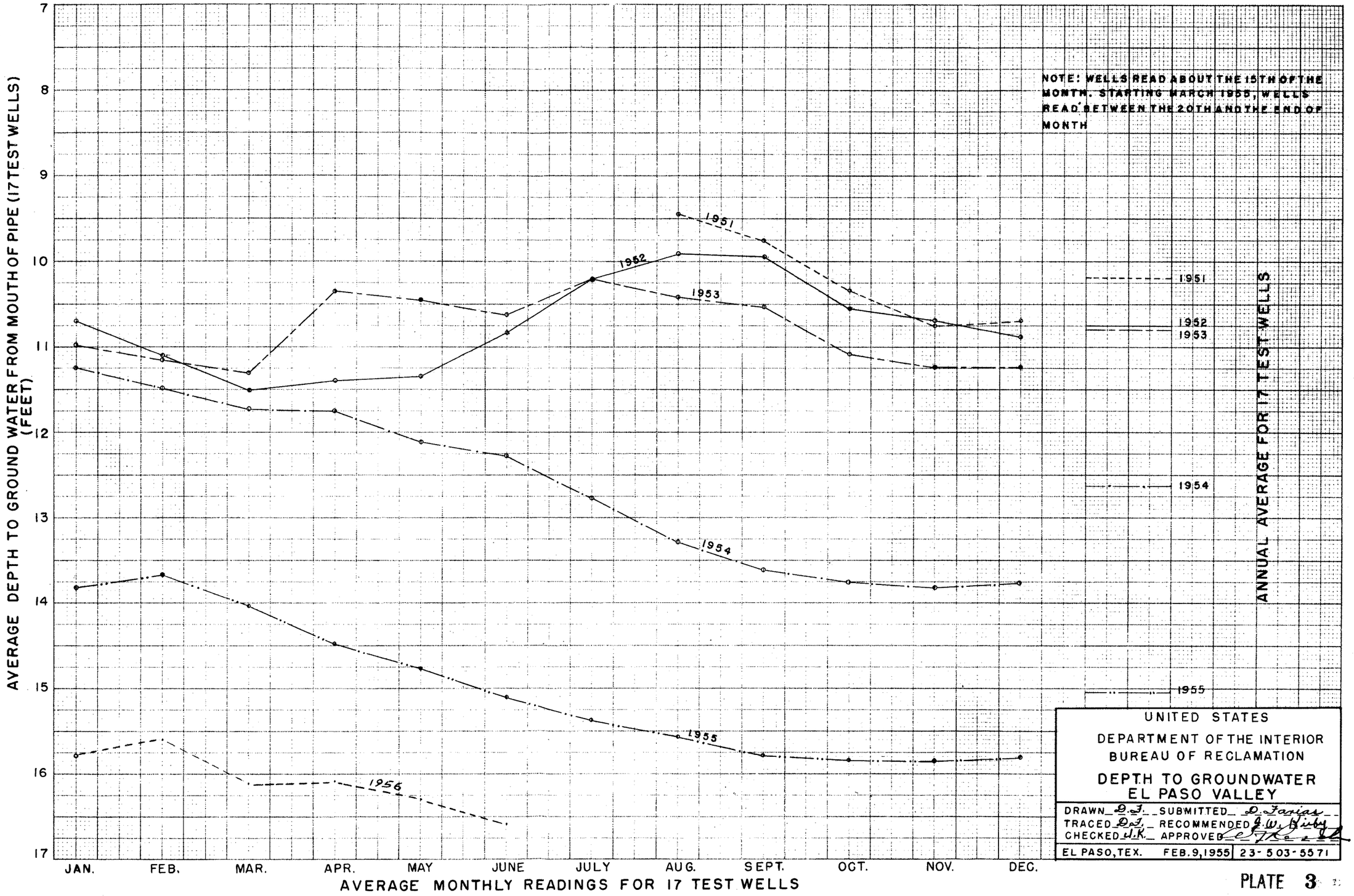
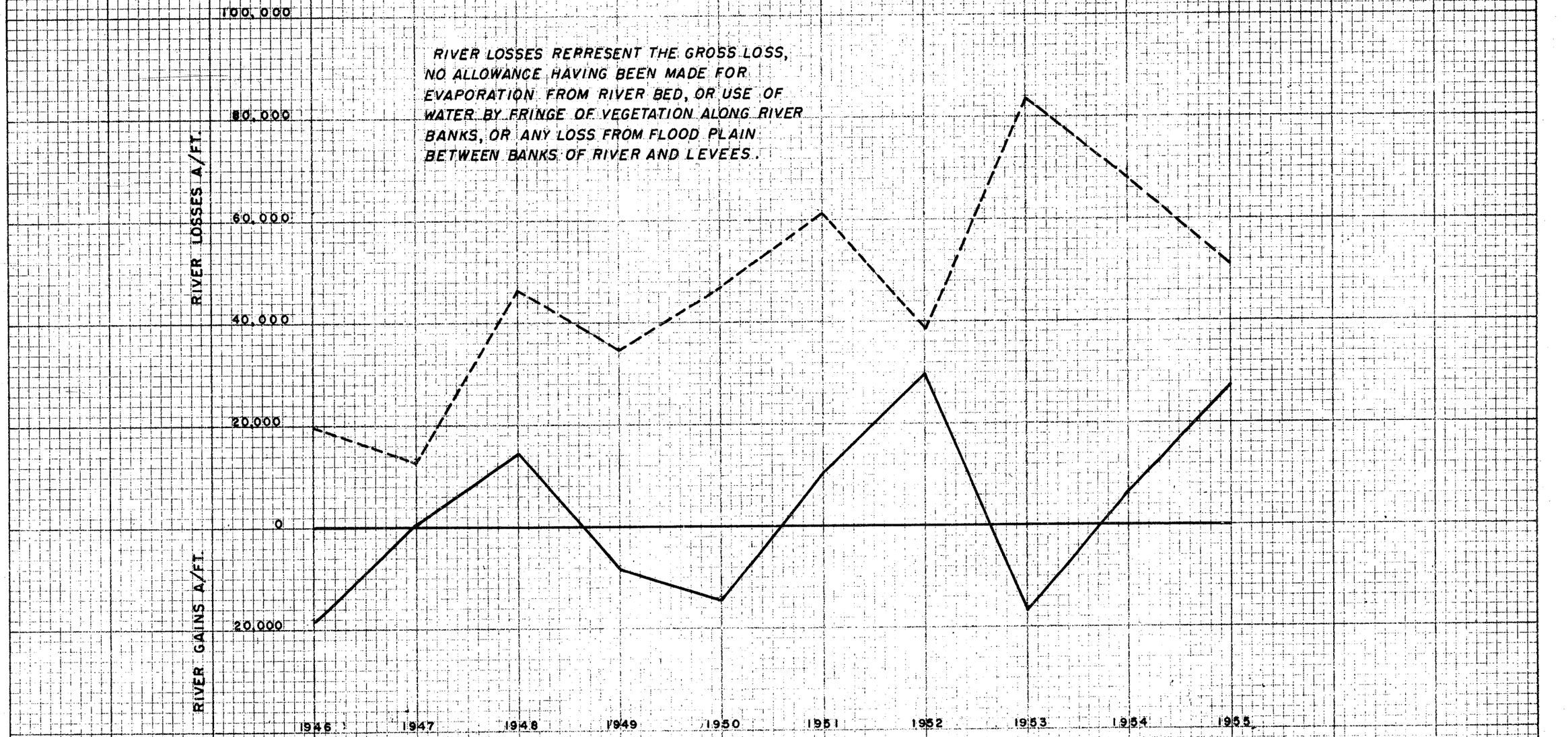


PLATE 3

RIVER LOSSES REPRESENT THE GROSS LOSS, NO ALLOWANCE HAVING BEEN MADE FOR EVAPORATION FROM RIVER BED, OR USE OF WATER BY FRINGE OF VEGETATION ALONG RIVER BANKS, OR ANY LOSS FROM FLOOD PLAIN BETWEEN BANKS OF RIVER AND LEVEES.



ANNUAL ESTIMATED RIVER LOSSES AND GAINS
1946 THRU 1955

——— CABALLO DAM TO LEASBURG DAM
- - - - - - - LEASBURG DAM TO EL PASO

EL PASO, TEXAS 4-11-1956 23-503-5767

PLATE 4

US_MSJ_00005740

US0350264

In 1951, the Elephant Butte Irrigation District, in cooperation with the State of New Mexico and the Middle Rio Grande Conservancy District, contributed funds in the amount of $8,515 which were used for pre-construction work on the emergency channelization program between the Narrows of Elephant Butte Reservoir and San Marcial. This emergency channelization program, carried out by the Bureau of Reclamation at a cost of $2,752,000, consists of a conveyance channel having a capacity of 2,000 cubic feet per second extending upstream about 33 miles from the Narrows of Elephant Butte Reservoir to a short distance above San Marcial. This channel conveys the normal and low flows of the Rio Grande through the delta area into Elephant Butte Reservoir. The conveyance channel is separated by a levee from a cleared floodway, having a capacity of 50,000 cubic feet per second above San Marcial and 25,000 cubic feet per second below that location, which carries the flood flows in excess of the conveyance channel capacity. The conveyance channel was placed in operation in 1954. From the beginning of pre-construction activities in May 1951 through October 1955, this emergency channelization has resulted in the salvage of 165,500 acre-feet. This salvage is included in the historic water supply for the project shown in Table 2.

HISTORIC CONDITIONS

Water Supply

As previously discussed, and shown by Table 2 a full water supply has been provided during the period 1915 through 1950 for the acreage irrigated on the Rio Grande Project. The acreage irrigated ranged from a minimum of 33,876 in 1915, the first year of operation, to a maximum of 159,768 in 1953.

During recent years of full water supply, 1943 through 1950, the average annual farm delivery on the Rio Grande Project has amounted to 3.1 acre-feet per acre. The average annual reservoir release, excluding the water released for flood control and spilled in 1942, of 826,100 acre-feet for the period 1915 through 1950 could have provided this average annual farm delivery to the repayment acreage of 159,650 acres under present physical conditions and efficiency of operation.

Since a full supply of water could have been provided from 1915 to 1942, any water not used during those years would have been retained in storage and spilled in 1942. Only that water that could be salvaged during the calendar years 1943 through 1950 would be available to augment the deficient surface water supply for irrigation during the 1951-55 period. Therefore, the studies were limited to the calendar years 1943 through 1955.

Table 3 presents a water account from Elephant Butte Reservoir to the southern boundary of the El Paso County Water Improvement District No. 1 for the period of study, 1943 through 1955. These data are used subsequently to derive the various hydrologic relationships required to make a reconnaissance grade determination of the usable salvaged water. In Table 3 and subsequent discussions, the terms "municipal use" and "use by the City of El Paso" designate the net diversions from the Franklin Canal and the Rio Grande to the El Paso water treatment plant.

Salt balance

The historic salt-balance conditions of the Rio Grande Project for the period 1943 through 1953, compiled from the available reports by the U. S. Salinity and Rubidoux Laboratories, Riverside, California, are shown in Table 4. In this table a gain (+) indicates the removal of salt, and therefore a favorable salt balance. A loss (-) indicates an accumulation of salt and an unfavorable balance. The reach between Caballo Dam and Leasburg Diversion Dam maintained an erratic, but generally favorable, balance throughout the period. During the last three years of the period when inadequate supplies of surface water were available, an unfavorable salt-balance occurred below the Leasburg Diversion Dam.

It should be noted that the data presented in Table 4 represents only the total tonnage of inflow, deposition or removal, and outflow of dissolved solids for various reaches of the Rio Grande below Elephant Butte Dam. It does not define the location of the deposition or removal of dissolved solids with respect to depth below the ground surface. If the deposition or removal takes place at depths greater than the normal root zone of the crops, and sufficient water is applied to attain the desirable degree of leaching through the normal root zone depth, accumulation of dissolved solids would not materially affect crop production.

Sediment

The recorded monthly suspended sediment discharge of the Rio Grande at El Paso, published in the International Boundary and Water Commission Bulletins, are set forth in Table 5. A suspended sediment curve derived from these data is presented on Plate 5.

FARM DELIVERY

The historic farm deliveries are shown in Table 3. For the period of adequate surface water supply for irrigation, 1943 through 1950, relationships were found to exist between the percent of irrigated area in alfalfa and the annual farm delivery expressed in acre-feet per acre. These relationships for the three hydrologic sub-divisions of the Rio Grande Project are shown on Plates 6, 7 and 8.

The anticipated average future cropping program, discussed in Appendix C, AGRICULTURAL ECONOMICS, consists of:

Crop	Percent of Irrigated Area
Alfalfa	25
Cotton	50
Other crops	18
Non-cropped	7
Total	100

Using 25 percent of the irrigated area in alfalfa and the relationships shown on Plates 6, 7 and 8, the farm delivery, in acre-feet per acre, required for a full water supply was computed to be that shown in Table 6. For the period 1951 through 1955, the required farm delivery was considered to be the average farm delivery required for a full water supply during the preceding five years, 1946 through 1950.

The required farm delivery in acre-feet per acre was applied to 93 percent of the maximum repayment acreage of the project which is as follows:

Reach	Maximum Repayment Acreage (Acres)
Caballo Dam to Leasburg Diversion Dam	16,339.58 1/
Leasburg Diversion Dam to El Paso	85,490.23
Below El Paso	57,820.19 2/
Total	159,650.00

1/ Includes 151.77 acres subject to reclassification as repayment acreage in Elephant Butte Irrigation District.

2/ Includes 101 acres subject to reclassification as repayment acreage in El Paso County Water Improvement District No. 1.

The total farm delivery required for a full water supply, in units of 1,000 acre-feet, is also shown in Table 6.

NET DIVERSIONS

Without Canal Lining

The historic net diversions are the diversions, shown in Table 3, less the wasteway discharges. Using the historic data from Table 3, relationships were developed between farm deliveries and net diversions for the three hydrologic subdivisions of the project, as shown on Plates 9, 10 and 11. These relationships were utilized in deriving the net diversions required to supply the farm deliveries for the future cropping program under historic conditions of development and under assumed future conditions with a concrete lined conveyance channel being provided between the Leasburg Diversion Dam and the vicinity of El Paso.

With Canal Lining

For estimating the evaporation losses from a lined irrigation distribution system, it was assumed that the system would be operated for a period of time each year equivalent to March through October at an average of 60 percent of normal capacity. Using the average of the net water surface evaporation rates at Caballo Dam, Las Cruces and Ysleta and the water surface area of a lined irrigation distribution system at 60 percent of normal capacity, the annual loss by evaporation was computed to be the values shown in Table 7.

Table 7. Estimated Future Canal Evaporation
(Unit - 1000 acre-feet)

Calendar Year	Between Percha and Leasburg Diversion Dams	Between Leasburg Diversion Dam and El Paso	Below El Paso
1943	0.3	1.4	1.1
1944	0.3	1.4	1.0
1945	0.4	1.6	1.2
1946	0.3	1.5	1.1
1947	0.3	1.5	1.1
1948	0.4	1.6	1.2
1949	0.3	1.4	1.0
1950	0.3	1.5	1.1
1951	0.4	1.6	1.2
1952	0.3	1.3	1.0
1953	0.3	1.5	1.2
1954	0.3	1.5	1.1
1955	0.3	1.5	1.1

Seepage losses from lined irrigation distribution systems may range from about 5 to 15 percent of the diversions. It was estimated that with the irrigation distribution system lined, the seepage losses from the canal system would average about 10 percent of the net diversions for the project. On the basis of the lengths and

hydraulic properties of the lined canals in each subdivision of the project, it was estimated that the seepage losses from the lined canal system would be as follows:

Canal system	Seepage loss in percent of net diversions
Between Percha and Leasburg Diversion Dams	4
Between Leasburg Diversion Dam and El Paso	14
Below El Paso	7

The net diversions required to supply the farm delivery for the future cropping program were computed by dividing the farm deliveries by 100 percent minus the seepage losses in percent of net diversions and adding the canal evaporation losses.

TOTAL DIVERSIONS AND OPERATIONAL WASTE

Using the historic data from Table 3, relationships were developed between total (gross) diversions and net diversions, with the operational waste being the difference between the total and net diversions. These relationships for the reaches between the Percha and Leasburg Diversion Dams and from the Leasburg Diversion Dam to El Paso are shown on Plates 12 and 13.

Below El Paso, the diversion of water into, and the waste of water from, the American Canal, the diversions to Mexico, the use of water by the city of El Paso, the occurrence of sewage effluent, and the diversions of water to that portion of the Rio Grande Project through both the Franklin Canal and the Riverside Heading precluded the derivation of a direct relationship between total and net diversions. Therefore, a relationship was derived, using historical data from Table 3, between the discharge of the Rio Grande at El Paso and the sum of the diversions to Mexico, use by the city of El Paso and net diversions to the Rio Grande Project less sewage outfall. This relationship is shown on Plate 14.

HYDROLOGIC BALANCE

The hydrologic balance of a stream is the interrelation of the total inflow, consumptive use, change in ground water storage, change in channel storage, and total outflow. A change in any factor is accompanied by a modification of one, or more, of the other factors. In its simplest form on an annual basis, the hydrologic balance is a linear relationship between the total inflow and the total outflow. Three correlations were derived to define the hydrologic balance. A relationship, shown on Plate 15, was derived between the discharge of the Rio Grande below Caballo Dam plus the computed arroyo inflow between the Percha and Leasburg Diversion Dams and the discharge of the Rio Grande above the Leasburg Diversion Dam. A second relationship, shown on Plate 16, was developed between the discharge of the

Rio Grande above the Leasburg Diversion Dam and the discharge of the Rio Grande at El Paso. In this second reach, only relatively minor amounts of arroyo inflow are discharged directly into the Rio Grande where they become intermingled with other waters to the extent they cannot be defined volumetrically. For the reach below El Paso, the relationship shown on Plate 17 was developed between the net flow below El Paso and the outflow from the Rio Grande Project at the Hudspeth County line. Prior to 1948, the outflow from the Rio Grande Project was generally the sum of the discharges at the county line of the Rio Grande and the Hudspeth Canal except in some instances when water was diverted directly from the Tornillo Drain to the Hudspeth Canal. Provision of the additional facilities was completed in 1947 causing a new relationship between the net flow below El Paso and the outflow from the Rio Grande Project at the County line. The very limited water supplies available to the portion of the project below El Paso in 1954 and 1955 resulted in abnormal conditions of outflow for those two years. Therefore, the data used to derive the relationship were limited to that for the calendar years 1948 through 1953.

The relationships for the reach from Caballo Dam to the Leasburg Diversion Dam and for the reach below El Paso were applied directly under all study conditions. In the reach between Caballo Dam and the Leasburg Diversion Dam, the changes in total inflow, in consumptive use under the anticipated future cropping program, and in drain discharge were considered to result in a corresponding residual adjustment in the river losses within the reach. Below El Paso the Rio Grande is an international stream and data are not available on the use of water by Mexico other than the total diversions into the Acequia Madre. Because of these conditions, only the outflow from the Rio Grande Project at the Hudspeth County line was computed.

The relationship between the Leasburg Diversion Dam and El Paso was used in two ways. For the study conditions which do not include the provision of a lined conveyance channel between the Leasburg Diversion Dam and El Paso, the relationship was used in the same manner as described above for the reach between Caballo Dam and the Leasburg Diversion Dam. For the study conditions which included the provision of the lined conveyance channel, it was considered that the inflow to the reach was the net diversions and that the undiverted flows and wasteway discharges carried through the reach in the lined conveyance with relatively minor losses were not an integral part of the hydrologic balance of the reach. Under this assumption, the drain discharge between the Leasburg Diversion Dam and El Paso cannot exceed the outflow at El Paso, exclusive of the flows carried through the reach in the conveyance channel.

DRAIN DISCHARGE

As previously discussed, the ground water underlying the project lands is recharged principally from irrigation operations. The ground water discharge is represented mainly by the discharge of the drains. Elimination or reduction of any source of ground water recharge would result in an increase in recharge from another source or a decrease in ground water discharge through the drains, or possibly both. As shown on Plates 18 and 19, relationships exist between the

annual net diversions (diversions minus wasteway discharge) and the annual discharge of the drains for the reaches between the Percha and Leasburg Diversion Dams and between the Leasburg Diversion Dam and El Paso. For the area below El Paso, the drain discharge is included in the outflow from the Rio Grande Project at the Hudspeth County line and no separate computation of drain flow was made.

Under the study conditions of historic conditions with the anticipated future cropping program and of the assumed future conditions with only the irrigation distribution system lined, the drain discharge would vary in accordance with the volume of net diversions. For the study conditions which include the provision of a lined conveyance channel between the Leasburg Diversion Dam and El Paso, the volume of drain discharge would be limited by the outflow from the reach computed using the relationship shown on Plate 16 with the inflow to the reach being the net diversions, as discussed in the preceding section.

CONVEYANCE CHANNEL LOSS

The flow carried by the conveyance channel between the Leasburg and Mesilla Diversion Dams would be the flow below the Leasburg Diversion Dam, the wasteway discharge in the reach and the minor amounts of flow contributed by the Selden Drain. The discharge of the Picacho Drain was not considered in deriving the channel loss in the reach because it enters the Rio Grande only a short distance above the Mesilla Diversion Dam. Similar components make up the discharge that would be carried by the conveyance channel in the Mesilla Diversion Dam-El Paso reach of the river. Using the average discharge in cubic feet per second and the hydraulic properties of the conveyance channel, the annual seepage loss from the conveyance channel was estimated to be about 900 acre-feet per year. Using the width of the conveyance channel, which would be rectangular, and the average of the net water surface evaporation rates at Caballo Dam Las Cruces and Ysleta, the annual evaporation loss from the conveyance channel and desilting basin at the end of the channel near El Paso was estimated to be about 1,100 acre-feet.

DIVERSIONS TO MEXICO

In the early 1890's water shortages occurred in the Mesilla and El Paso Valleys and the Mexican citizens near Juarez complained to their Government which filed a claim for damages alleging that the water shortages were due to increasing diversions in Colorado and New Mexico. Under the terms of the Mexican Treaty of 1906, the United States guaranteed to Mexico, in return for relinquishment of all claims for damages, an annual delivery, in perpetuity of 60,000 acre-feet in the Rio Grande at the head of the Mexican Canal. During periods of full water supply, Mexico receives their full annual delivery of 60,000 acre-feet. During periods of inadequate water supply, deliveries to Mexico are in direct proportion to the relation of the actual farm delivery to the farm delivery required for a full water supply. In the studies, it was considered that Mexico would receive its historic diversions during the period of adequate water supply from 1943 through 1950. During the period 1951 through 1955, the diversions to Mexico were computed in

direct proportion to the percent of full farm delivery on the Rio Grande Project but were not reduced below the annual diversions which occurred historically.

WATER SALVAGE

The water salvaged during the period of adequate water supply from 1943 through 1950 would be stored in Elephant Butte Reservoir for subsequent use during the period of inadequate water supply. Part of the salvaged water stored in the reservoir would be lost through evaporation and other reservoir losses. The usable salvaged water would be the sum of the increase in the farm deliveries on the Rio Grande Project, of the increase in the diversions to Mexico and of the amount of salvaged water in storage at the end of 1955, with the basic condition being historic conditions with future cropping program.

Operation studies were made for Elephant Butte Reservoir to determine the amount of water available for release to meet the irrigation demand and the amount of salvaged water available in storage at the end of 1955. It was assumed that Caballo Reservoir would be operated as it was historically and any change in the release from Elephant Butte Reservoir would result in a corresponding change in the release from Caballo Reservoir. The results of these studies are summarized in Table 8. With a lined conveyance channel provided between the Leasburg Diversion Dam and the vicinity of El Paso, Elephant Butte Reservoir would have been drawn down to its historic content at the end of 1951 and only the historic amounts of water would be available for release. With a lined irrigation distribution system, a full supply of water could be provided to the Rio Grande Project and Mexico during the period 1943 through 1955 with 26,200 acre-feet of salvaged water remaining in storage at the end of 1955. Providing the lined conveyance channel, in addition to lining the irrigation distribution system, would also result in a full supply of water during 1943-1955 period and increase the amount of salvaged water in storage to 171,400 acre-feet.

Table 8 also demonstrates the amount of salvaged water which would be lost through reservoir evaporation and other losses. Using the values from the historic conditions with the future cropping program study as a base, the amount of salvaged water lost would be:

Condition	Reduction in reservoir releases (In 1,000 acre-feet)	Increase in Evaporation	
		In 1,000 acre-feet	In percent of reduction in reservoir releases
With lined conveyance channel	42.6	42.6	100.0
With lined irrigation distribution system	926.6	900.4	97.2
With lined irrigation distribution system and lined conveyance channel	1,232.1	1,060.7	86.1

With the inflow of water and dissolved solids to Elephant Butte Reservoir remaining the same, the increase in evaporation would result in a gradual increase in the concentration of the dissolved solids in the release made from Elephant Butte Reservoir. This condition is analyzed in the next section of this appendix.

To determine the increase in the farm delivery on the Rio Grande Project and in the diversions to Mexico that would result from the provision of a lined irrigation distribution system and/or a lined conveyance channel from the Leasburg Diversion Dam to the vicinity of El Paso, the releases from Caballo Reservoir under the four study conditions were routed, on an anual basis, from Caballo Dam to the southern boundary of the El Paso County Water Improvement District No. 1 at the Hudspeth County line. The various hydrologic relationships previously discussed were utilized to accomplish the routing studies. For the study conditions of historic conditions with future cropping program and of provision of a lined conveyance channel from the Leasburg Diversion Dam to the vicinity of El Paso, the farm deliveries and the diversions to Mexico during the period 1951 through 1955, when a full supply of surface water could not be provided for irrigation, were computed by expressing the component parts of the routing studies and the hydrologic relationships as functions of the net diversions between the Leasburg Diversion Dam and El Paso. In making these computations for the period of inadequate water supply, it was also assumed that the distribution of the use of the available water supply would be the same as occurred historically. The results of these studies are presented in Tables 9 through 12.

An analysis of Table 9 furnishes an estimated of the amount of water, non-beneficially consumed and wasted from the lower end of the project, which would be available for salvage. The more detailed studies which would be required to refine the estimate of the amount of water available for salvage, and which are beyond the scope of the annual studies performed for this report, consist of detailed studies of consumptive use, of the origin of drain discharge with respect to the sources of ground water recharge, and of river losses below El Paso.

The total depletion by the Rio Grande Project, exclusive of the use by the city of El Paso, is estimated to be 3,695,800 acre-feet and 5,449,200 acre-feet for the periods 1943 through 1950 and 1943 through 1955, respectively, as derived in the following tabulation:

Item	1943-50 (1,000 acre-feet)	1943-55 (1,000 acre-feet)	
Release from Caballo Reservoir	+6,172.1	+~~8,265.9~~	8,262.9
Arroyo inflow between Caballo Dam and Leasburg Diversion Dam	+57.3	+107.7	
Sewage outfall below El Paso	+96.8	+168.2	
Total inflow	6,326.2	~~8,541.8~~	8,538.8
Outflow from Rio Grande Project	-2,102.9	-2,378.9	
Total depletion	4,223.3	~~6,162.9~~	6,159.9
Diversions by Mexico	-483.9	-631.0	
Use by city of El Paso	-43.6	-82.7	
Total Rio Grande Project depletion	3,695.8	~~5,449.2~~	5,446.2

Item	1943-50 (1,000 acre-feet)	1943-55 (1,000 acre-feet)
Rio Grande at El Paso	+4,011.4	+5,046.8
Diversions to Mexico	-483.9	-631.0
Use by city of El Paso	-43.6	-82.7
Sewage outfall	+96.8	+168.2
Net flow below El Paso	~~3,580.7~~ 3,508.7	4,501.3
Net diversions below El Paso	-2,228.7	-2,976.4
Waste at lower end of project	~~1,352.0~~ 1,280.0	1,524.9
Non-beneficial use	+1,616.3	~~+2,538.5~~ 2,535.5
Total water available for salvage	~~2,968.3~~ 2,896.3	~~4,063.4~~ 4,060.4
Average annual water available for salvage	~~371.0~~ 362.0	~~312.6~~ 312.3

Complete salvage of the non-beneficial use and waste can, of course, not be realized because there are unavoidable losses of water in transit for diversion through evaporation, unavoidable uses of both ground and surface waters by native vegetation, and unavoidable operational wastes. Also, a small part of the non-beneficial use is actually undefined municipal and domestic use.

The total estimated usable salvaged water that would result during the period 1943 through 1955 from the lining of the irrigation distribution system and/or providing a lined conveyance channel from the Leasburg Diversion Dam to the vicinity of El Paso is summarized as follows in units of 1,000 acre-feet.

Condition	Increase in Farm Delivery on the Rio Grande Project	Increase in Diversions to Mexico	Water in storage in Elephant Butte Reservoir	Total net usable salvage
With lined conveyance channel	227.8	30.8	0.0	258.6
With lined irrigation distribution system	1,255.3	152.9	26.2	1,434.4
With lined irrigation distribution system and lined conveyance channel	1,255.3	152.9	171.4	1,579.6

SALT BALANCE

The estimated salt balance for the four assumed study conditions is presented in Tables 13 through 16 and discussed in the following paragraphs. In this discussion, and the accompanying tables, the study conditions are referred to by number as follows:

Condition 1 - Historic conditions with future cropping program

Condition 2 - Lined conveyance between Leasburg Diversion Dam and El Paso with future cropping program

Condition 3 - Lined irrigation distribution system with future cropping program

Condition 4 - Lined irrigation distribution system and lined conveyance channel between the Leasburg Diversion Dam and El Paso with future cropping program

Elephant Butte Reservoir

As previously demonstrated, the reduction in releases from Elephant Butte Reservoir is accompanied by an increase in evaporation with a resultant increase in the concentration of the dissolved solids in the outflow from the reservoir. To estimate the increase in the concentration of the dissolved solids in the reservoir outflow, it was assumed that the accumulated concentration of dissolved solids would be inversely proportional to the total accumulated Elephant Butte Effective Supply. The annual Elephant Butte Effective Supply is the Rio Grande Compact measure of the net amount of water available at Elephant Butte Dam after accounting for reservoir losses and is the algebraic sum of the calendar year outflow from the reservoir (Rio Grande below Elephant Butte Dam) ± the change in the content of Elephant Butte Reservoir during the calendar year. The total accumulated Elephant Butte Effective Supply, as used in these studies, is the accumulated total of 1,780,500 acre-feet of water, considered to be in storage at the beginning of the study period, and the annual Elephant Butte Effective Supply. Using this method, the annual outflow of dissolved solids from Elephant Butte Reservoir was computed, as shown in Table 17, for each year of the four study conditions.

Only a moderate increase in the average concentration of the dissolved solids in the reservoir outflow would result as follows:

Condition	Average concentration of dissolved solids in the outflow from Elephant Butte Reservoir (Tons per acre-foot)
Historic	0.60
1	0.61
2	0.61
3	0.68
4	0.70

Caballo Dam to Leasburg Diversion Dam

To determine the outflow of dissolved solids from the reach at the Leasburg Diversion Dam, a relationship was derived between the accumulated annual flow above the Leasburg Diversion Dam, expressed in percent of the accumulated annual release from Caballo Reservoir, and the accumulated annual tonnage of dissolved solids above Leasburg Diversion Dam, expressed in percent of the accumulated annual tonnage of dissolved solids in the outflow from Caballo Reservoir. This relationship is shown on Plate 20. Using this relationship and the annual discharges below Caballo Dam and above the Leasburg Diversion Dam from Tables 9 through 12, the outflows of the tonnage of dissolved solids were computed, resulting in an erratic but over-all favorable balance under all four study conditions.

The average concentrations of the dissolved solids in the discharge of the river above the Leasburg Diversion Dam were computed to be as follows:

Condition	Average concentration of dissolved solids in the flow above the Leasburg Diversion Dam (Tons per acre-foot)
Historic	0.72
1	0.72
2	0.72
3	0.81
4	0.83

Leasburg Diversion Dam to El Paso

A more complicated relationship of inflow to outflow of dissolved solids exists in this reach. A multiple correlation, shown on Plate 21, was developed to determine the tonnage of dissolved solids in the outflow from the reach at El Paso. This multiple correlation is:

$$Y = - 0.3610 + 2.000\ X_2 + 2.0954\ X_3$$

Coefficient of correlation, $R = 0.945$

Standard error of estimate, $S = 0.0482$

Beta coefficient$_2$ $= 0.7080$

Beta coefficient$_3$ $= 0.6548$

where:

Y_1 = the tonnage of dissolved solids at El Paso expressed in percent of the tonnage of dissolved solids above Leasburg Diversion Dam

X_2 = the volume of drain discharge between the Leasburg Diversion Dam and El Paso expressed in percent of the flow above the Leasburg Diversion Dam

X_3 = the total discharge at El Paso minus the volume of drain discharge between the Leasburg Diversion Dam and El Paso expressed in percent of the flow above Leasburg Diversion Dam

Using this multiple relationship, the outflow of dissolved solids from the reach at El Paso was computed for the four study conditions in Tables 13 through 16. An unfavorable balance was found to exist except for Condition 2. An explanation of the unfavorable salt balance is shown in the following tabluation:

	Average Value of		
Condition	X_2	X_3	Balance in tons
2	32.38	36.71	+ 266,000
Historic	29.75	35.61	- 10,800
1	31.54	34.84	- 33,000
4	25.61	37.84	- 299,500
3	28.66	32.13	- 558,400

The above tabulation demonstrates that, in order to maintain a favorable salt-balance condition between the Leasburg Diversion Dam and El Paso, the composition of the flow at El Paso must be equivalent to about 32 percent drain water and 36 percent "river water" in terms of the flow above the Leasburg Diversion Dam. Under Conditions 3 and 4, the lining of the irrigation distribution system and the provision of a lined conveyance channel would reduce the recharge of the ground water through seepage and consequently would result in a reduction in the amount of drain discharge. Under historic conditions, the use of ground water for irrigation is equivalent to the reduction in recharge under Conditions 3 and 4 and also results in a reduction in the amount of drain discharge.

The average concentrations of dissolved solids in the discharge of the Rio Grande at El Paso were computed to be as follows:

Condition	Average concentration of dissolved solids in the flow at El Paso (Tons per acre-feet)
Historic	1.07
1	1.08
2	1.10
3	1.17
4	1.22

El Paso to the Hudspeth County Line

Part of the flow and dissolved solids at El Paso are diverted to Mexico through the Acequia Madre at the Mexican Dam. To derive the outflow of dissolved solids from the Rio Grande Project at the Hudspeth County line, a relationship, shown on Plate 22, was developed between the accumulated annual outflow from the Rio Grande Project, expressed in percent of the accumulated annual net flow below El Paso, and the accumulated annual tonnage of dissolved solids in the outflow at the County line, expressed in percent of the accumulated annual net volume of dissolved solids at El Paso after deducting the annual volumes of dissolved solids which would be diverted to Mexico. It was found that favorable salt balances would occur under Conditions 1 and 2 and unfavorable balances would occur under Conditions 3 and 4. Similar to the Mesilla Valley, the lining of the canals would reduce the recharge of the ground water from canal seepage and would result in a reduction in drain discharge and outflow of dissolved solids.

Effect Upon Crop Production

The waters of the Rio Grande above Fort Quitman have a relatively low sodium-adsorption ratio of 5.0 or less and may therefore be used with little danger of the development of harmful levels of exchangeable sodium providing the salinity hazard is not too great. The salinity hazard of irrigation water is measured in terms of the conductivity expressed in micromhos/centimeter (EC x 10^6) at 25 degrees centigrade. For the Rio Grande, the relationship between the concentration of dissolved solids in tons per acre-foot and the conductivity can be expressed by the equation:

$$\text{Tons per acre-foot} = 0.0008889(EC \times 10^6) + 0.00555$$

The dividing line between the medium and high salinity classifications of irrigation water is 750 micromhos per centimeter, which for the Rio Grande is equivalent to 0.70 tons of dissolved solids per acre-foot of water. The upper range of the high salinity classification is equivalent to 2.00 tons of dissolved solids per acre-foot of water.

With a sodium-adsorption ratio of 5.0 or less, the water released from Caballo Reservoir would be in the C2-S1 classification of irrigation water indicating low sodium hazard and medium salinity hazard. The water above Leasburg Diversion Dam would be of low sodium hazard and in the lower ranges of the high salinity classification thus falling in

the C3-S1 classification of irrigation water. The water at El Paso would be in the same classification as the water above the Leasburg Diversion Dam but with a greater salinity hazard. With the adequate drainage now being provided to the project lands and with the present irrigation practices which have been developed using water of high salinity hazard classification, it is concluded that the quality of water that would be available under Conditions 2, 3 and 4 would not materially effect crop production.

Under Conditions 3 and 4, with a full supply of surface water being provided for irrigation, the quality of the water applied to the land during the 1951-1955 period would be of much better quality than that applied historically with the use of ground water. The available data on the quality of the ground water used for irrigation from 1951 through 1955 is shown in Table 18. The concentration of the dissolved solids in the ground water was approximately twice as great as the concentration of the surface water supply that would be provided under Conditions 3 and 4.

The salt balances presented in Tables 13 through 16 portray only the estimated total tonnage of inflow, deposition or removal, and outflow of dissolved solids for the various reaches of the Rio Grande and do not define the location of the deposition or removal with respect to depth below the ground surface or with respect to the root zones of the crops grown on the project. Plates 2 and 3 indicate that normally the average depth to ground water in the reach from the Leasburg Diversion Dam to El Paso is approximately seven feet and is slightly greater in the reach below El Paso. The minimum depth to ground water of about 5.75 shown on Plate 2 is greater than the normal depth of crop root zone. Under Conditions 2, 3 and 4, with the reduction of the ground water recharge from seepage, it is expected that the depth to ground water would be greater than historical conditions of full water supply.

Under Conditions 2, 3 and 4, the same percentage of water applied to the irrigated lands would pass through the soil to the shallow ground water as occurred historically. Because the farm deliveries under these conditions would be greater than historical, the deep percolation from the irrigated lands would be greater in volume. It is, therefore, expected that injurious concentrations of dissolved solids would not occur within the root zone of the crops and materially effect crop production.

SEDIMENT

The sediment load is contributed principally by the arroyos which discharge directly into the river above the Leasburg Diversion Dam. Below the Leasburg Diversion Dam there are only about 109 square miles of arroyo drainage area directly tributary to the river. The suspended sediment load of the Rio Grande above the Leasburg Diversion Dam was estimated by use of the suspended sediment rating curve, shown on Plate 1, in dimensionless form and the mean monthly flows above the Leasburg Diversion Dam. For the period of normal water supply, the

suspended sediment load above the Leasburg Diversion Dam was estimated to average 580 acre-feet a year, at a density of 70 pounds per cubic foot, as shown by the following tabulation:

Year	Suspended sediment (Acre-feet)
1943	800
1944	652
1945	615
1946	538
1947	515
1948	567
1949	494
1950	464
Average	580

With an allowance of 10 percent for unmeasured load, the normal average total sediment load of the Rio Grande above the Leasburg Diversion Dam would be 640 acre-feet per year. This sediment would be contributed by the 567 square miles of arroyo drainage area directly tributary to the river between Caballo Dam and Leasburg Diversion Dam at an annual rate of 1.13 acre-feet per square mile.

During the three calendar years, 1948 through 1950, of normal water supply when records are available at El Paso, the suspended sediment load at El Paso averaged 300 acre-feet per year. Allowing 10 percent for unmeasured load, the average annual total sediment load would be 330 acre-feet. During this same period, the computed total sediment load above the Leasburg Diversion Dam averaged 560 acre-feet per year and the net diversions between the Leasburg Diversion Dam and El Paso averaged 61 percent of the flow above the Leasburg Diversion Dam. Assuming the sediment was diverted in proportion to the flow diverted, then an average of 340 acre-feet of sediment was diverted annually and 220 acre-feet of sediment were available for transport to El Paso. At a rate of about one acre-foot per square mile (560 acre-feet divided by 567 square miles), the 109 square miles of arroyo drainage area directly tributary to the river between the Leasburg Diversion Dam and El Paso would have contributed an average of about 110 acre-feet of sediment a year. Thus, the total available for transport would be 330 acre-feet. This comparison indicates that the Rio Grande is carrying essentially all of the undiverted sediment load through to El Paso and the construction of a lined conveyance channel between the Leasburg Diversion Dam and El Paso would not cause a significant increase in the total sediment load at El Paso during years of normal water supply.

Of the total net diversions, about 41 percent are made at the Leasburg Diversion Dam and about 59 percent are made at the Mesilla Diversion Dam. Under the study conditions in which a lined conveyance channel would be provided, the net diversions would amount to 26 percent and 37 percent of the discharge of the Rio Grande above the Leasburg Diversion Dam at the Leasburg and Mesilla Diversion Dams,

respectively. With the sediment diverted in proportion to the flow diverted, 150 acre-feet of sediment would be diverted at the Leasburg Diversion Dam and 215 acre-feet would be diverted at the Mesilla Diversion Dam. During years of normal water supply, the average annual inflow, diversion and outflow of sediment would be:

Item	Sediment in acre-feet
Inflow above Leasburg Diversion Dam	580
Diverted at Leasburg Diversion Dam	-150
Inflow above Mesilla Diversion Dam	430
Diverted at Mesilla Diversion Dam	-215
Arroyo Inflow	+120
Outflow at El Paso	335

It is estimated that about 20 percent of the sediment load is material coarser than 0.1 of a millimeter and could be removed by use of a desilting basin. If the desilting basin were located immediately above the Mesilla Diversion Dam, then the amount of material that would be deposited annually in the basin in years of normal water supply is estimated to amount to 86 acre-feet, or about 138,700 cubic yards. If the desilting basin were located at El Paso, about 67 acre-feet, or 108,100 cubic yards would be deposited in the desilting basin annually.

ADDITIONAL INVESTIGATIONS REQUIRED

The additional investigations required in preparation of a feasibility grade study would consist of:

1. Substantiation of the reconnaissance estimates of the usable salvage by performance of detailed hydrologic studies.

2. Substantiation of the estimates of quality of water and the salt balance by performance of detailed studies.

3. Detailed investigations by soil scientists and drainage engineers to substantiate the conclusions relative to the effect of the quality of water and salt balance conditions upon crop production.

4. Determination of the volume and composition of the total sediment load of the Rio Grande above Leasburg Diversion Dam and of the diversions at the Leasburg and Mesilla Diversion Dams by field measurements.

June 27, 1906

1A

DEPARTMENT OF THE INTERIOR

BUREAU OF RECLAMATION

RIO GRANDE IRRIGATION PROJECT

CONTRACT

Dated June 27, 1906

between

THE UNITED STATES OF AMERICA

and

THE ELEPHANT BUTTE WATER USERS' ASSOCIATION

and

THE EL PASO VALLEY WATER USERS' ASSOCIATION

For Project Construction

and

Repayment of Construction and

Operation and Maintenance Charges.

THESE ARTICLES OF AGREEMENT, made and entered into this 27th day of June, 1906, by and between the United States of America, acting in this behalf by Jesse E. Wilson, Acting Secretary of the Interior, party of the first part, and the Elephant Butte Water Users' Association of New Mexico, a corporation duly organized and existing under the laws of the Territory of New Mexico, and the El Paso Valley Water Users' Association, a corporation duly organized and existing under the laws of the Territory of Arizona, parties of the second part, their successors and assigns.

WITNESSETH, That whereas the Elephant Butte Water Users' Association of New Mexico is a corporation organized and existing under the laws of the Territory of New Mexico, and the El Paso Valley Water Users' Association is a corporation organized and existing under the laws of the Territory of Arizona for the purposes mentioned in their articles of incorporation and by-laws, copies of which are appended to this agreement and are, for every purpose of the interpretation, construction and consideration of this agreement and of the rights of the parties hereunder, to be deemed, held, read and considered as if fully written out or printed herein, and deemed a part hereof; and

WHEREAS, the lands embraced within the area proposed to be irrigated, as described in said articles of incorporation or by-laws, are naturally desert and arid and incapable of proper cultivation without irrigation, and will to a greater or less extent remain unclaimed, unfit for habitation, and uncultivated, in which condition they, or a great part thereof, now are, unless the waters of the Rio Grande in New Mexico, and its tributaries, be impounded and the flow thereof otherwise regulated and controlled, and,

Whereas, the said Secretary of the Interior contemplates the contruction of certain irrigation works under the provisions of an

Act of Congress entitled "An Act appropriating the receipts from the sale and disposal of public lands in certain States and Territories to the construction of irrigation works for the reclamation of arid lands, "approved June 17, 1902, for the irrigation and reclamation of the lands described in the said articles or by-laws; and

Whereas, the incorporators and shareholders of said Elephant Butte Water Users' Association of New Mexico, and El Paso Valley Water Users' Association are, and under the provisions of their articles of incorporation must be, owners and occupants of lands in said area, and in some cases are appropriators of water for the irrigation thereof, and in addition thereto such incorporators and shareholders and their successors or assigns must initiate rights to the use of water from the said proposed irrigation works, to be constructed by the said Secretary of the Interior as soon as such rights may be initiated, and thereafter complete the acquisition thereof in the manner and upon the terms and conditions to be prescribed therefor by the Secretary of the Interior, which rights shall be, and thereafter continue to be, forever appurtenant to designated lands owned by such shareholders; and,

Whereas, neither the relative priority nor the extent of the individual appropriations of such water heretofore made by said incorporators and shareholders for the lands described in said articles or by-laws, and which are now vested rights, have been ascertained or determined, but said incorporators and shareholders have agreed, among themselves, by the terms and provisions of said articles of incorporation and by-laws, upon the rules and principles by and upon which the relative priority and the extent of their several appropriations and vested rights to the use of such waters shall be determined;

Now, Therefore, it is agreed and understood by and between the parties hereto,

1. That if the said Secretary of the Interior shall authorize and cause the construction of said irrigation works, the said associations will take prompt action to secure the determination by the courts of the relative rights of their shareholders to the use of water for said lands, and that in the determination of such rights and of their respective rights to the use of water acquired under said Act of Congress, the rules and principles set out in said articles of incorporation and by-laws, for such determination, shall be deemed the established rules and principles for that purpose.

2. That only those who are or who may become members of said association, under the provisions of their articles of incorporation and by-laws, shall be accepted as applicants for rights to the use of water available by means of said proposed irrigation works.

3. That the aggregate amount of such rights to be issued shall, in no event, exceed the number of acres of land capable of irrigation by the total amount of water available for the purpose, being (1) the amount now appropriated by the shareholders of said associations, and (2) the amount to be delivered from all sources in excess of the water now appropriated; and that the Secretary of the Interior shall determine the number of acres so capable of such irrigation as aforesaid, his determination to be made upon due and expert consideration of all available data, and to be based upon and measured and limited by the beneficial use of water.

4. That the payments for the water rights to be issued to the shareholders of said associations under the provisions of said Act of Congress, shall be divided into not less than ten equal annual payments, the first of which shall be payable when the water is first

delivered from said works, or within a reasonable time thereafter, and after due notice thereof by the Secretary of the Interior to the Associations, and that the cost of said proposed irrigation works shall be apportioned equally per acre among those acquiring such rights.

Provided, that the charges apportioned under the integral part of the said irrigation works, known as the Leasburg Diversion Dam and Canal, the construction of which is now proposed, shall be paid in ten equal annual instalments, upon the terms herein specified.

Provided further, that in the assessment of the charges under the main Rio Grande project, when constructed, the Secretary of the Interior shall apportion equitably the charges therefor against the land irrigated under the Leasburg Diversion Dam and Canal, due allowance being made for the charges already paid under this agreement.

5. That the said Water Users' Associations hereby guarantee the payments for that part of the cost of the irrigation works which shall be apportioned by the Secretary of the Interior to their shareholders, and will promptly levy calls or assessments therefor and for the cost of maintenance and operation, as may be assessed from year to year by the Secretary of the Interior, and collect or require prompt payment thereof in such manner as the Secretary of the Interior may direct; that they will promptly pay the sums collected by them to the receivers of the local land offices for the districts in which said lands are situated; that they will promptly employ the means provided and authorized by the said articles of incorporation and by-laws for the enforcement of such collections, and will not change, alter or amend their articles of incorporation, or by-laws in any manner whereby such means of collection, or the lien given to them by the shareholders to secure the payment thereof, or of any assess-

ments contemplated or authorized thereby, shall be impaired, diminished or rendered less effective, without the consent of the Secretary of the Interior.

6. That the United States shall in no manner be responsible for the sums collected by said associations until they have been paid into the hands of the receiver of the local land office, as provided by the law, and in accordance with such regulations as may be prescribed by the Secretary of the Interior.

7. That for the purpose of enforcing said collections the associations will adopt and enforce proper by-laws, subject to the approval of the Secretary of the Interior, and not change them so as to in anywise impair their efficiency for said purpose, and will otherwise do any and all things they are authorized and empowered to do in the premises.

8. That the associations will adopt and enforce such rules and regulations as they are authorized by their articles of incorporation and by-laws to adopt and enforce, concerning the use of water by their shareholders and concerning the administration of the affairs of the associations to effectually carry out and promote the purposes of their organization, within the provisions of said articles of incorporation and by-laws, which rules and regulations shall be subject to the approval of the Secretary of the Interior, and that if the associations fail to make and adopt such rules and regulations, then the Secretary of the Interior may prescribe them; but in such event the Secretary of the Interior shall impose no rule or regulation interfering with any vested right of the shareholders of the associations, as defined or modified by said articles of incorporation and by-laws.

9. That persons who are not now members of the associations, but who may be the owners or occupants of land to be irrigated, as

described in their articles of incorporation or by-laws, or of added lands as therein provided for and to whom rights to the use of water from the proposed irrigation works may be issued by the United States, may, at the designation of the Secretary of the Interior, become members of the associations upon subscribing to the stock thereof and upon compliance with the other conditions prescribed for such membership.

10. That in all the relations between the United States and these associations and the members of the associations, the rights of the members of the associations to the use of water where the same have vested, are to be defined, determined and enjoyed in accordance with the provisions of the said act of Congress and of other acts of Congress on the subject of the acquisition and enjoyment of the rights to use water; and also by the laws of New Mexico and Texas, where not inconsistent therewith modified if modified at all, by the provisions of the articles of incorporation and by-laws of said associations.

11. That nothing contained in this agreement, or to be implied from the fact of its execution, shall be construed, held or deemed to be an approval by the Secretary of the Interior, nor an adoption by him of the articles of incorporation or by-laws of said associations in all their details as the form of organization of water users, contemplated and authorized by section 6 of the said Act of Congress of June 17, 1902; but such approval and adoption is expressly reserved until the conditions prescribed in said Act, authorizing such approval and adoption shall have arisen; and that when the Secretary of the Interior shall make, approve and promulgate rules and regulations for the administration of the water to be supplied from said proposed irrigation works, such rules and regulations and such modifications thereof as the Secretary may, from time to time, approve and

promulgate, shall be deemed and held to be obligatory upon these associations as fully and completely, and to every intent and purpose as if they were now made, approved, promulgated, and written out in full in this agreement, and the same are to be so read and construed.

12. It is further understood and agreed that the charges apportioned by the Secretary of the Interior for the construction of the Leasburg Diversion Dam and Canal against the lands irrigated thereunder, shall be upon the basis of the water available from the natural flow of the Rio Grande at said dam.

IN WITNESS WHEREOF, the undersigned have hereunto subscribed their names and affixed their seals the day and year first herein written.

JESSE E. WILSON.

Acting Secretary of the Interior.

For and on behalf of the United States of America.
PARTY OF THE FIRST PART.

ELEPHANT BUTTE WATER USERS' ASSOCIATION OF NEW MEXICO.

Attest:

N. C. Frenger,
Secretary,

By H. B. Holt, President

Attest:

F. Martine,
Secretary.

7

DEPARTMENT OF THE INTERIOR

BUREAU OF RECLAMATION

RIO GRANDE IRRIGATION PROJECT

CONTRACT

between

THE ELEPHANT BUTTE IRRIGATION DISTRICT

and

THE EL PASO COUNTY WATER IMPROVEMENT DISTRICT NO. 1

Dated February 16, 1938

Providing for a 3 per cent cushion on the Irrigable Area of the Rio Grande Reclamation Project as allocated to the Districts.

Approved by

Assistant Secretary of the Interior

April 11, 1938

CONTRACT

This contract made and entered into by and between the Elephant Butte Irrigation District of New Mexico and the El Paso County Water Improvement District No. 1 of Texas, pursuant to resolutions of the Board of Directors of the respective Districts, authorizing the same, WITNESSETH THAT:

WHEREAS, it is expedient that the acreage within each irrigation District which is to be irrigated should be cushioned by allowing the distribution of water to a small excess of acreage over and above that allotted to the two Districts under the Rio Grande New Mexico-Texas Reclamation Project, to the end that annual variations, within narrow limits, shall be permitted, and so that, each year, there will be within the Elephant Butte Irrigation District 88,000 acres of land, and within El Paso County Water Improvement District No. 1, 67,000 acres upon which construction and operation and maintenance charges may be levied;

THEREFORE, it is mutually agreed that either District may increase the acreage to be irrigated and to be subject to construction charges, not to exceed three (3%) per cent of the present authorized acreage in each District, that is to say, Elephant Butte Irrigation District, having an authorized acreage of 88,000 acres, may increase such acreage to the extent of three (3%) per cent thereof, amounting to not to exceed 2,640 acres; that El Paso County Water Improvement District No. 1, having a present authorized acreage of 67,000 acres, may increase such acreage to three (3%) per cent thereof, that is, not to exceed 2,010 acres, said additional lands, in any case, to be within the limits of the present irrigation Districts or any future extensions thereof.

It is further agreed and understood that the distribution of accounting between the two Districts under the Rio Grande Project, which has heretofore been 56.7742% to the Elephant Butte Irrigation District, and 43.2258% to the El Paso County Water Improvement District No. 1, shall remain in all respects unaltered, and unaffected by this agreement, and, in like manner, in the event of a shortage of water for irrigation in any year, distribution shall be made upon the percentage above stated.

(Correspondence on this contract in file 232.- Contract between Elephant Butte Irrig. Dist., and El Paso Co. Wat. Improvement Dist. #1, dated Feb. 16, 1938)

IN TESTIMONY WHEREOF, the parties hereunto have caused the same to be signed by the Presidents of their respective Boards of Directors, and attested by the Secretary with the seal of said corporation,

this 16th day of February, A. D. 1938

THE ELEPHANT BUTTE IRRIGATION DISTRICT
OF NEW MEXICO

By (Signed) Arthur Starr
President

(SEAL)

ATTEST: (Signed) Jose R. Lucero
Secretary, Elephant Butte
Irrigation District

EL PASO COUNTY WATER IMPROVEMENT
DISTRICT NO. 1 OF TEXAS

By (Signed) T. D. Porcher
President

(SEAL)

ATTEST: (Signed) Idus T. Gillett
Secretary, El Paso County Water
Improvement District No. 1

APPROVED THIS 11TH DAY OF APRIL, A. D. 1938

(Signed) Oscar L. Chapman
ASSISTANT SECRETARY OF THE INTERIOR

C O P Y

2-16-38

C O N T R A C T

This contract made and entered into by and between the Elephant Butte Irrigation District of New Mexico and El Paso County Water Improvement District No. 1 of Texas, pursuant to resolutions of the Board of Directors of the respective Districts, authorizing the same, WITNESSETH THAT:

WHEREAS, it is expedient that the acreage within each irrigation District which is to be irrigated should be cushioned by allowing the distribution of water to a small excess of acreage over and above that allotted to the two Districts under the Rio Grande New Mexico-Texas Reclamation Project, to the end that annual variations, within narrow limits, shall be permitted, and so that, each year, there will be within the Elephant Butte Irrigation District 88,000 acres of land, and within El Paso County Water Improvement District No. 1, 67,000 acres upon which construction and operation and maintenance charges may be levied;

THEREFORE, it is mutually agreed that either District may increase the acreage to be irrigated and to be subject to construction charges, not to exceed three (3%) per cent of the present authorized acreage in each District, that is to say, Elephant Butte Irrigation District, having an authorized acreage of 88,000 acres, may increase such acreage to the extent of three (3%) per cent thereof, amounting to not to exceed 2,640 acres; that El Paso County Water Improvement District No. 1, having a present authorized acreage o 67,000 acres, may increase such acreage to three (3%) per cent thereof, that is, not to exceed 2,010 acres, said additional lands, in any case, to be within the limits of the present irrigation Districts or any future extensions thereof.

It is further agreed and understood that in the event of a shortage of water for irrigation in any year, the distribution of the available supply in such year, shall so far as practicable, be made in the proportion of 67/155 thereof to the lands within El Paso County Water Improvement District No. 1, and 88/155 to the lands within the Elephant Butte Irrigation District.

It is further agreed and understood that the operation and maintenance costs of the project works (exclusive of the storage and power development) for the calendar year 1938 and thereafter shall be distributed between the two Districts in the same manner as similar costs were distributed for the calendar year 1937, and that the same ratios for the two Districts, respectively, that were applied to said costs for that year common to both Districts shall be used in 1938 and subsequent years.

This contract to be effective only during the period when the proposed contracts under Public No. 249, Seventy-fifth Congress, 1st Session, between, (1) the United States and Elephant Butte Irrigation District and (2) the United States and El Paso County Water Improvement District No. 1 are in force, and if either or both of said contracts should terminate after both

have become effective, this contract is also to terminate.

IN TESTIMONY WHEREOF, the parties hereunto have caused the same to be signed by the Presidents of their respective Boards of Directors, and attested by the Secretary with the seal of said corporation, this 16th day of February A. D. 1938.

THE ELEPHANT BUTTE IRRIGATION DISTRICT
OF NEW MEXICO.

By (Signed) Arthur Starr
President

(SEAL)

ATTEST: (Signed) Jose R. Lucero
Secretary, Elephant Butte
Irrigation District.

EL PASO COUNTY WATER IMPROVEMENT DISTRICT
DISTRICT NO. 1 OF TEXAS

By (Signed) T. D. Porcher
President

(SEAL)

ATTEST: (Signed) Idue T. Gillett
Secretary, El Paso County Water.
Improvement District No. 1.

APPROVED THIS 11TH DAY OF APRIL, A. D. 1938

(Signed) Oscar L. Chapman
ASSISTANT SECRETARY OF THE INTERIOR

2-26-74

(R0122178)
(R0011779)
(R0020579)

Contract No. 9-07-54-X0554

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION

CONTRACT BETWEEN THE UNITED STATES OF AMERICA, DEPARTMENT OF THE INTERIOR, BUREAU OF RECLAMATION, AND THE ELEPHANT BUTTE IRRIGATION DISTRICT FOR THE TRANSFER OF THE OPERATION AND MAINTENANCE OF PROJECT WORKS

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Contract No. 9-07-53-X0554

RIO GRANDE PROJECT
NEW MEXICO

CONTRACT BETWEEN THE

UNITED STATES OF AMERICA
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
and the
ELEPHANT BUTTE IRRIGATION DISTRICT
for the
Transfer of the Operation and Maintenance of Project Works

THIS CONTRACT is made this 15th date of February 1979, in pursuance of the Act of Congress of June 17, 1902 (32 Stat. 388), and acts amendatory thereof or supplementary thereto and particularly the Reclamation Project Act of 1939 and Acts of Congress of June 30, 1948 (62 Stat. 1171, 1179); of May 17, 1950 (64 Stat. 163, 176); of September 21, 1959 (73 Stat. 584); of July 14, 1960 (74 Stat. 480, 492); of March 26, 1964 (78 Stat. 171, 172); and of July 27, 1965 (79 Stat. 285), all herein styled the "Federal Reclamation Law," between the UNITED STATES OF AMERICA, herein styled the "United States," acting for this purpose through the Regional Director, Southwest Region, Bureau of Reclamation, herein referred to as "Contracting Officer," and the ELEPHANT BUTTE IRRIGATION DISTRICT, herein styled the "District," a quasi-municipal corporation organized and existing under the laws of the State of New Mexico having its principal office in the city of Las Cruces, New Mexico.

Preamble

WITNESSETH THAT:

EXPLANATORY RECITALS

WHEREAS, the United States and the District have entered into a series of contracts commencing in 1906 relating to the construction, operation, and maintenance of the Rio Grande Project, New Mexico and Texas, and this contract continues that program, and

WHEREAS, the series of contracts between the United States and the District includes contracts with the Elephant Butte Irrigation District dated November 9, 1937, amended October 1, 1939, which contracts cover the care, operation, and maintenance of the project and payment of the adjusted construction obligation allocated to irrigation, and are herein collectively referred to as the "basic repayment contract," and

WHEREAS, an interim agreement dated December 27, 1978, provided for the temporary operation and maintenance of the transferred District works by the District, starting January 1, 1979, and

WHEREAS the interim agreement dated December 27, 1978, is terminated upon execution of this contract, and

WHEREAS, the parties desire that the District assume permanent responsibility for operation and maintenance of the works of the District except certain components thereof as hereinafter more particularly described, and

NOW THEREFORE, the parties agree as follows:

DEFINITIONS

1. When used herein, unless otherwise distinctly expressed or manifestly incompatable with the intent hereof, the term:

a. "Secretary" or "Contracting Officer" shall mean the Secretary of the Interior of the United States, or his duly authorized representative.

b. "District" shall mean the Elephant Butte Irrigation District. In some standard articles the District is referred to as the "Contractor."

c. "Power and storage reserved works" shall mean the Elephant Butte Dam, Reservoir and Power System and the Caballo Dam and Reservoir.

d. "Water control and conveyance reserved works" shall mean the Percha, Leasburg, Mesilla, and Riverside diversion dams and appurtenances.

e. "Transferred District works" shall mean the remainder of the distribution system to be turned over to the district for operation and maintenance, more specifically identified on Exhibit "A" attached hereto and by this reference made a part of this contract.

f. "Calendar year" shall mean January 1 through December 31 of each year.

TRANSFER OF DISTRICT WORKS

2. Upon execution of this contract, the United States shall transfer to the Elephant Butte Irrigation District and the District shall assume

Art. 1
Art. 2

the operation and maintenance of the transferred District works as identified in paragraph 1.e. above and as shown on Exhibit "A." The United States reserves the right to establish, operate, and maintain hydrological and climatological monitoring devices on or in the transferred District works. Transfer of operation and maintenance of the "transferred District works" to the District shall be accomplished without expense to the United States.

PAYMENT OF OPERATION AND MAINTENANCE COSTS

3. a. On or before April 1 of each calendar year, the Contracting Officer will notify the District of the amount of the District's estimated operation and maintenance cost in operating and maintaining the water control and conveyance reserved works during the calendar year next succeeding the year in which the notice is given. Such notice will be in the form of an itemized budget and will state the District's share of such estimated cost (a) for the first 2 months of the calendar year next succeeding, (b) for the 5 next succeeding months, and (c) for the remaining 5 months of the calendar year for which notice is given. The amount stated for the first 2 months of the calendar year shall be due and payable on or before December 15 of the year in which the notice is given; the amount stated for the next succeeding 5 months shall be due and payable on or before February 15 of the calendar year next succeeding the year in which the notice is given; and the amount stated for the last 5 months of the calendar year shall be due and

Art. 2
Art. 3

payable on or before July 15 of the calendar year next succeeding the year in which the notice is given. If in the opinion of the Contracting Officer the estimate of such operation and maintenance cost appears to be insufficient to meet the actual cost thereof, he shall give notice of such threatened deficiency and his estimate of the amount thereof and the District's share thereof, and the District shall pay to the United States its proportion of the amount of such deficiency within 30 days from the date of such notice. As soon as practicable after the close of the calendar year for which notice of the estimated cost of operation and maintenance is given, the District will be furnished a statement of actual cost of such operation and maintenance and the District's proportionate share thereof, and any excess or deficit of payment upon the basis of estimated costs and actual costs shall be credited or billed with the payment due and payable by the District on July 15 next succeeding such calendar year.

b. The District shall be assessed 56.7742 percent of the reimbursable cost of operating and maintaining the water control and conveyance reserved works. The reimbursable costs are defined as the reasonable costs of accounting for and delivering the irrigation water at the several canal headings. Provided, That if the contractor and the El Paso County Water Improvement District No. 1 agree to a changed percentage of reimbursable costs, the above figure will be changed to reflect that percentage.

Art. 3

GENERAL OBLIGATION--BENEFITS CONDITIONED UPON PAYMENT

4. a. The obligation of the Contractor to pay the United States as provided in this contract is a general obligation of the Contractor notwithstanding the manner in which the obligation may be distributed among the Contractor's water users and notwithstanding the default of individual water users in their obligations to the Contractor.

b. The payment of charges becoming due hereunder is a condition precedent to receiving benefits under this contract. No water will be made available to the Contractor through project facilities during any period in which the Contractor may be in arrears in the advance payment of any operation and maintenance charges due the United States.

TRANSFER OF PLANT, EQUIPMENT, AND SUPPLIES

5. a. Title to United States-owned movable plant, equipment, and supplies useful in the operation and maintenance of said "transferred District works" shall be transferred to the District upon payment by the District to the United States of the value of the said transferred plant, equipment, and supplies as listed on the accounts of the United States. The District shall have access to said accounts for the purpose of verifying said values.

b. All unconsumed movable plant, equipment, and supplies in the custody of the United States before January 1, 1979, which were purchased by the District for the operation and maintenance of the said transferred District works shall be transferred to the District without expense to the District upon execution of this contract.

c. The United States and the District shall jointly prepare an inventory of the said movable plant, capitalized equipment, and stores' property recorded in and controlled by the General Ledger Accounts

Art. 4
Art. 5

of the United States, including an estimate of their values. All other materials, supplies, and equipment purchased for the operation and maintenance program of the District, the value of which is charged to expense or operating accounts of the United States, shall become the property of the District upon execution of this contract.

WATER CONTROL

6. a. The United States will make allocation of available stored project water among Elephant Butte Irrigation District, El Paso County Water Improvement District No. 1, and the Republic of Mexico.

b. The United States will ensure delivery of allocated irrigation water at district canal headings and at other diversion points to be specified by the Contracting Officer and at State line crossings and will make a prompt accounting of said water to the District.

c. In interstate canals, laterals, and drains, (those physically crossing State lines) the United States reserves the right to direct inter-canal diversions, deliveries, and maintenance of waterways and structures by the District to assure the delivery of water and protection of lands of the other involved entities outside District boundaries.

d. In case of extraordinary climatic conditions or major accident to the District's distribution facilities, the United States, at its discretion, may adjust spills of allocated water from the District

works. The United States will designate the respective facilities to be used for spill of such water. A detailed operational plan will be concluded between the United States and the District setting forth procedures for water delivery and accounting.

OPERATION AND MAINTENANCE OF TRANSFERRED WORKS

7. a. The District, without expense to the United States, shall care for, operate, and maintain the transferred District works in full compliance with the terms of this contract, and in such manner that said transferred District works will remain in good and efficient condition to perform the carriage and distribution of water as well and effectively as on the date of such transfer to the District.

b. The District shall promptly make any and all repairs to the Federal project works being operated by it which are necessary for proper care, operation, and maintenance in accordance with paragraph a above. In case of neglect or failure of the District to commence such repairs within 30 days following written notification, and to complete such repairs within a reasonable time, the Contracting Officer may cause the repairs to be made, and the cost thereof shall be paid by the District as prescribed by the Contracting Officer.

c. No substantial change shall be made by the District in any of the major transferred District works without first obtaining the written consent of the Contracting Officer. The request for said

Art. 6
Art. 7

change shall be made in writing and include a detailed design of the contemplated work. If the Contracting Officer does not reject such change within 60 days, the District may proceed with the work. Substantial change is defined herein as major relocations or changes in structures and facilities or changes in irrigation service areas.

d. The District shall hold the United States, its officers, agents, and employees harmless as to any and all damages which may in any manner grow out of the care, operation, and maintenance of any of the project works transferred to the District.

BOOKS, RECORDS, AND REPORTS

8. The District shall establish and maintain accounts and other books and records pertaining to its land use and crop census, water supply, water use, and changes of District operated works and to other matters as the Contracting Officer may require. Reports thereof shall be furnished to the Contracting Officer in such form and on such dates as he may require. The District will maintain its financial records and transactions in accordance with New Mexico State Law. Subject to applicable Federal laws and regulations, each party shall have the right during office hours to examine and make copies of each other's books and records relating to matters covered by this contract.

Art. 7
Art. 8

REVIEW AND INSPECTION OF PROJECT WORKS FOR DETERMINING ADEQUACY OF MAINTENANCE

9. a. The Contracting Officer with the Contractor may, from time to time, make reviews of maintenance of project works being operated by the Contractor with a view to assisting the Contractor in determining the condition of facilities and the adequacy of the maintenance program. This review may include any or all of the project facilities constructed by the United States and transferred to the Contractor or project facilities constructed by the Contractor with funds advanced by the United States. A report of the review, including recommendations, if any, will be prepared and copies will be furnished to the Contractor. Except for such participation by the Contractor as it may desire, the review will be without cost to the Contractor.

b. If deemed necessary by the Contracting Officer or requested by the Contractor, special inspections of any project works being operated by the Contractor and of the Contractor's books and records may be made to ascertain the extent of any operation and maintenance deficiencies, to determine the remedial measures required for their correction, and to assist the Contractor in solving specific problems. Any special inspection or audit shall, except in a case of emergency, be made after written notice to the Contractor and the actual cost thereof shall be paid by the Contractor to the United States for inspections requested by the Contractor.

COMPLIANCE WITH RULES AND REGULATIONS

10. The Secretary may from time to time promulgate rules and regulations to implement the Reclamation laws. The District agrees to abide by such final rules and regulations lawfully adopted. This contract is subject to all such rules and regulations now or hereafter in force when not inconsistent with any express and specific provisions herein. Such rules and regulations are made a part of this contract.

DETERMINATIONS

11. Where the terms of this contract provide for action to be based upon the opinion or determination of either party to this contract, whether or not stated to be conclusive, said terms shall not be construed as permitting such action to be predicated upon arbitrary, capricious, or unreasonable opinion or determinations. In the event that the District questions any factual determination made by the Contracting Officer, findings of facts shall be made by the Secretary or his designated representative only after consultation with the District and such findings of fact shall be deemed final agency action subject to judicial review.

RESERVE FUNDS

12. The District will maintain a reserve fund in an amount acceptable to the Contracting Officer and as permitted by State statutes under which the District is organized.

NOTICES (Standard)

13. Any notice, demand, or request authorized or required by this contract shall be deemed to have been given, on behalf of the District, when mailed, postage prepaid, or delivered to the Regional Director, Southwest Region, Bureau of Reclamation, Box H-4377 Herring Plaza, Amarillo, Texas, and on behalf of the United States, when mailed, postage prepaid, or delivered to the Elephant Butte Irrigation District, Post Office Drawer A, Las Cruces, New Mexico. The designation of the addressee or the address may be changed by notice given in the same manner as provided in this article for other notices.

ASSIGNMENT LIMITED--SUCCESSORS AND ASSIGNS OBLIGATED (Standard)

14. The provisions of this contract shall apply to and bind the successors and assigns of the parties hereto, but no assignment or transfer of this contract or any part or interest therein shall be valid until approved by the Contracting Officer.

EQUAL OPPORTUNITY (Standard)

15. During the performance of this contract, the Contractor agrees as follows:

a. The Contractor will not discriminate against any employee or applicant for employment because of race, color, religion, sex, age or national origin. The Contractor will take affirmative action to ensure that applicants are employed, and that employees are treated during employment, without regard to their race, color, religion, sex, age, or national origin. Such action shall include, but not be limited to, the following: Employment, upgrading, demotion, or transfer; recruitment or recruitment advertising; layoff or termination; rates of pay or other forms of compensation; and selection for training, including apprenticeship. The Contractor agrees to post in conspicuous places, available to employees and applicants for employment, notices to be provided by the Contracting Officer setting forth the provisions of this Equal Opportunity clause.

Art. 13
Art. 14
Art. 15

b. The Contractor will, in all solicitations or advertisements for employees placed by or on behalf of the Contractor, state that all qualified applicants will receive consideration for employment without regard to race, color, religion, sex, age or national origin.

c. The Contractor will send to each labor union or representative of workers with which it has a collective bargaining agreement or other contract or understanding, a notice to be provided by the Contracting Officer, advising the labor union or workers' representative of the Contractor's commitments under this Equal Opportunity clause, and shall post copies of the notice in conspicuous places available to employees and applicants for employment.

d. The Contractor will comply with all provisions of Executive Order No. 11246 of September 24, 1965, as amended, and of the rules, regulations, and relevant orders of the Secretary of Labor.

e. The Contractor will furnish all information and reports required by said amended Executive Order and by the rules, regulations, and orders of the Secretary of Labor, or pursuant thereto, and will permit access to its books, records, and accounts by the Contracting Officer and the Secretary of Labor for purposes of investigation to ascertain compliance with such rules, regulations, and orders.

f. In the event of the Contractor's noncompliance with the Equal Opportunity clause of this contract or with any of the said rules, regulations, or orders, this contract may be canceled, terminated, or suspended, in whole or in part, and the Contractor may be declared ineligible for further Government contracts in accordance with procedures authorized in said amended Executive Order, and such other sanctions may be imposed and remedies invoked as provided in said Executive Order, or by rule, regulation, or order of the Secretary of Labor, or as otherwise provided by law.

g. The Contractor will include the provisions of paragraph a. through g. in every subcontract or purchase order unless exempted by rules, regulations, or orders of the Secretary of Labor issued pursuant to Section 204 of said amended Executive Order, so that such provisions will be binding upon each subcontractor or vendor. The Contractor will take such action with respect to any subcontract or purchase order as the Contracting Officer may direct as a means of enforcing such provisions, including sanctions for noncompliance; Provided, however, That in the event the Contractor becomes involved in, or is threatened with, litigation with a subcontractor or vendor as a result of such direction by the Contracting Officer, the Contractor may request the United States to enter into such litigation to protect the interests of the United States.

CERTIFICATION OF NONSEGREGATED FACILITIES (Standard)

16. The Contractor hereby certifies that it does not maintain or provide for its employees any segregated facilities at any of its establishments, and that it does not permit its employees to perform their services at any location, under its control, where segregated facilities are maintained. It certifies further that it will not maintain or provide for its employees any segregated facilities at any of its establishments, and that it will not permit its employees to perform their services at any location, under its control, where segregated facilities are maintained. The Contractor agrees that a breach of this certification is a violation of the Equal Opportunity clause in this contract. As used in this certification, the term "segregated facilities" means any waiting rooms, work areas, rest rooms and wash rooms, restaurants and other eating areas, time clocks, locker rooms and other storage or dressing areas, parking lots, drinking fountains, recreation or entertainment areas, transportation, and housing facilities provided for employees which are segregated by explicit directive or are in fact segregated on the basis of race, creed, color, or national origin, because of habit, local custom, or otherwise. The Contractor further agrees that (except where it has obtained identical certifications from proposed subcontractors for specific time periods) it will obtain identical certifications from proposed subcontractors prior to the award of subcontracts exceeding $10,000 which are not exempt from the provisions of the Equal Opportunity clause; that it will retain such certifications in its files; and that it will forward the following notice to such proposed subcontractors (except where the proposed subcontractors have submitted identical certifications for specific time periods):

NOTICE TO PROSPECTIVE SUBCONTRACTORS OF REQUIREMENTT FOR CERTIFICATIONS OF NONSEGREGATED FACILITIES

A Certification of Nonsegregated Facilities must be submitted prior to the award of a subcontract exceeding $10,000 which is not exempt from the provisions of the Equal Opportunity clause. The certification may be submitted either for each subcontract or for all subcontracts during a period (i.e., quarterly, semiannually, or annually). Note: The penalty for making false statements in offers is prescribed in 18 U.S.C. 1001.

Art. 16

PENALTY FOR DELINQUENT PAYMENTS

17. The District shall pay a penalty on installments or charges which become delinquent computed at the rate of 1 percent per month of the amount of such delinquent installments or charges for each day from such delinquency until paid: Provided, That no penalty shall be charged to the District unless such delinquency continues for more than 30 days in which event the penalty shall accrue from the initial date of delinquency.

WATER AND AIR POLLUTION CONTROL (Standard)

18. The District, in carrying out this contract, shall comply with all applicable water and air pollution laws and regulations of the United States and the State of New Mexico and shall obtain all required permits or licenses from the appropriate Federal, State, or local authorities.

ALL PRIOR CONTRACTS TO REMAIN IN EFFECT

19. All prior contracts shall remain in full force and effect in all respects not herein specifically revised or modified, and its terms shall be equally applicable to this contract.

OFFICIALS NOT TO BENEFIT (Standard)

20. a. No Member of or Delegate to Congress or Resident Commissioner shall be admitted to any share or part of this contract or to any benefit that may arise herefrom, but this restriction shall not be construed to extend to this contract if made with a corporation or company for its general benefit.

Art. 17
Art. 18
Art. 19
Art. 20

(RO112878)
(RO011779)

b. No official of the Contractor shall receive any benefit that may arise by reason of this contract other than as a landowner within the project and in the same manner as other landowners within the project.

IN WITNESS WHEREOF, this contract has been executed as of the day and year first hereinabove written.

THE UNITED STATES OF AMERICA

By Robert H. Weimer
Contracting Officer

ATTEST:

O. E. Anderson

February 26, 1979
Secretary of the Elephant Butte Irrigation District of New Mexico

ELEPHANT BUTTE IRRIGATION DISTRICT of New Mexico

By L. E. Anderson
President

Art. 20
Signatures

10

(R0092779)
(Revised W. O. 100579)

UNITED STATES
DEPARTMENT OF THE INTERIOR
WATER AND POWER RESOURCES SERVICE
RIO GRANDE PROJECT
TEXAS - NEW MEXICO

CONTRACT BETWEEN THE UNITED STATES OF AMERICA AND
EL PASO COUNTY WATER IMPROVEMENT DISTRICT NO. 1
TRANSFER OF THE OPERATION AND MAINTENANCE OF PROJECT WORKS

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Contract No. 0-07-54-X0904

RIO GRANDE PROJECT
TEXAS - NEW MEXICO

CONTRACT BETWEEN THE

UNITED STATES OF AMERICA
DEPARTMENT OF THE INTERIOR
WATER AND POWER RESOURCES SERVICE
and the
EL PASO COUNTY WATER IMPROVEMENT DISTRICT NO. 1
for the
Transfer of the Operation and Maintenance of Project Works

THIS CONTRACT is made this 14th day of March 1980, in pursuance of the Act of Congress of June 17, 1902 (32 Stat. 388), and acts amendatory thereof or supplementary thereto and particularly the Reclamation Project Act of 1939 and Acts of Congress of June 30, 1948 (62 Stat. 1171, 1179); of May 17, 1950 (64 Stat. 163, 176); of September 21, 1959 (73 Stat. 584); of July 14, 1960 (74 Stat. 480, 492); of March 26, 1964 (78 Stat. 171, 172); and of July 27, 1965 (79 Stat. 285), all herein styled the "Federal Reclamation Law," between the UNITED STATES OF AMERICA, herein styled the "United States," acting for this purpose through the Regional Director, Southwest Region, Water and Power Resources Service (formerly Bureau of Reclamation), herein referred to as "Contracting Officer," and the EL PASO COUNTY WATER IMPROVEMENT DISTRICT NO. 1, herein styled the "District," (a Water Improvement District existing under and by virtue of Article XVI, Section 59, of the Constitution of the State of Texas),

Preamble

WITNESSETH THAT:

EXPLANATORY RECITALS

WHEREAS, the Rio Grande Project was authorized by Act of Congress in 1905 and subsequent thereto the United States, the District, and the Elephant Butte Irrigation District have entered into a series of contracts relating to the construction, operation and maintenance, and repayment of the costs allocated to the irrigation function of the Rio Grande Project, and

WHEREAS, the series of contracts between the United States and the District includes contracts with the El Paso County Water Improvement District No. 1 dated November 10, 1937, amended October 1, 1939, which contracts cover the care, operation, and maintenance of the project and payment of the adjusted construction obligation allocated to irrigation, and are herein collectively referred to as the "basic repayment contract;" and

WHEREAS, the District has entered into certain contracts for rehabilitation and betterment of the District works, which contracts are dated May 15, 1959; (extended November 16, 1966); and February 12, 1971; and

WHEREAS, full repayment to the United States by the District has been made of all construction costs other than those covered by said rehabilitation contracts; and

WHEREAS, the parties desire that the District assume permanent responsibility for operation and maintenance of the District works in the District except certain components thereof as hereinafter more particularly described.

NOW THEREFORE, the parties agree as follows:

DEFINITIONS

1. When used herein, unless otherwise distinctly expressed or manifestly incompatible with the intent hereof, the term:

a. "Secretary" or "Contracting Officer" shall mean the Secretary of the Interior of the United States or his duly authorized representative.

b. "District" shall mean the El Paso County Water Improvement District No. 1. In some standard articles, the District is referred to as the "Contractor."

c. "Power and storage reserved works" shall mean the Elephant Butte Dam, Reservoir, and Power System and the Caballo Dam and Reservoir.

d. "Water control and conveyance reserved works" shall mean the Percha, Leasburg, Mesilla, and Riverside Diversion Dams and appurtenances.

Explanatory Recitals
Art. 1

e. "Transferred District works" shall mean the remainder of the distribution and drainage system to be turned over to the district for operation and maintenance, more specifically identified on Exhibit "A," attached hereto and by this reference made a part of this contract.

f. "Calendar year" shall mean January 1 through December 31 of each year.

g. "Project Water Supply" shall mean stored water legally available for release in the Elephant Butte and Caballo Reservoirs and including the legally appropriated waters reaching the bed of the Rio Grande River between Caballo Dam and Riverside Diversion Dam.

TRANSFER OF DISTRICT WORKS

2. Effective October 1, 1980, the United States shall transfer to the El Paso County Water Improvement District No. 1 and the District shall assume the operation and maintenance of the transferred District works as identified in paragraph 1.e. above and as shown on Exhibit "A." The United States reserves the right to establish, operate, and maintain hydrological and climatological monitoring devices on or in the transferred District works. Transfer of operation and maintenance of the "transferred District works" to the District shall be accomplished without expense to the United States. It is understood that the District may contest any expenses incident to such transfer that it feels are inappropriate in nature or amount or inconsistent with the relation of the parties under this agreement or their other existing contracts.

PAYMENT OF OPERATION AND MAINTENANCE COSTS

3. a. Each year the District shall pay the United States for all costs of maintaining the Riverside Diversion Dam and appurtenances, 20.54845 percent of the cost of maintaining Mesilla Diversion Dam and appurtenances and 43.2258 percent of all costs of operating the water control and conveyance reserved works. Only costs properly allocable to the irrigation function of said works shall be charged to the District, and the District shall not be obligated to pay any costs of operation or maintenance of such works properly allocable to storage and delivery of water to Mexico. Although the Riverside Diversion Dam and appurtenances are not transferred hereunder to the District, it is understood that the United States may permit the District to conduct and perform all maintenance and operations of Riverside Dam and appurtenances incident to the irrigation function through the District's own personnel or contractors.

b. On or before April 1 of each calendar year, the Contracting Officer shall furnish the District a preliminary budget of the costs to the United States anticipated for the next succeeding year which will be charged to the District under this and the other contracts between the parties. Such preliminary budget shall be in the form of an itemized ~~operating and maintenance~~ budget detailing the estimated items of cost. Itemized personnel costs of the United States shall be shown including the numbers and classification levels of

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personnel to be employed and the percentage of each individual's time estimated to be spent in servicing the irrigation function. Prior to submission of any charges to the District, whether estimated or actual, the Contracting Officer shall allocate the costs of the United States in operating and maintaining the Rio Grande Project among the several functions and entities served and shall identify those costs properly allocable to the irrigation function. After opportunity for review and comments by the District, as hereinafter provided, the Contracting Officer shall, on or before June 1 of each year, notify the District of the amount of the District's share of the then estimated costs to be incurred by the United States during the next succeeding year. Such notice shall be in the form of a detailed operating budget containing the types of information above specified. It shall state the District's share of such estimated costs (a) for the first 3 months of the District's fiscal year next succeeding, (b) for the next 3 succeeding months, (c) for the next 3 succeeding months, and (d) for the remaining 3 months of the District's fiscal year for which notice is given. The amount stated for the first quarter of the District's fiscal year shall be due and payable on or before September 1 of the year in which the notice is given; the amount stated for the next quarter shall be due and payable on or before December 1 of the year in which the notice is given; the amount stated for the third quarter shall be due and payable on or before March 1 of the year next succeeding the year in which the notice is given; and the amount stated for the fourth quarter shall be due and payable on

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or before June 1 of the year next succeeding the year in which notice is given. If at any time after said notice is given, in the opinion of the Contracting Officer, the estimate of the operation and maintenance costs appears to be insufficient to meet the actual costs to be incurred, he shall so inform the District, and, after opportunity for the District to review and comment as hereinafter provided, give notice to the District of the then estimated amount of the threatened deficiency and an itemized budget supporting his estimate thereof and the District's share thereof, and the District shall pay its share of such deficiency within 30 days from date of such notice. As soon as practicable after the close of the year for which notice of the District's share of the estimated costs contemplated under this Article is given, the Contracting Officer shall furnish the District an itemized statement of the actual cost of such operation and maintenance incurred during the District's fiscal year, and the District's share thereof, and any excess or deficit of payment due to any difference between estimated costs and actual costs shall be credited or billed in connection with the payment due and payable by the District on July 1 next succeeding such fiscal year. With respect to all budgetary and payment matters (including any notice of deficiency), preliminary estimates or findings shall be furnished to the District, and the District shall be given not less than 30 days in which to examine supporting data, reports, and calculations; to review and comment; and to file any objections thereto before any notice is given or any final determinations made by the Contracting Officer.

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GENERAL OBLIGATION--BENEFITS CONDITIONED UPON PAYMENT

4. a. The obligation of the Contractor to pay the United States as provided in this contract is a general obligation of the Contractor notwithstanding the manner in which the obligation may be distributed among the Contractor's water users and notwithstanding the default of individual water users in their obligations to the Contractor.

b. The payment of charges becoming due hereunder is a condition precedent to receiving benefits under this contract. No water will be made available to the Contractor through project facilities during any period in which the Contractor may be in arrears in the advance payment of any operation and maintenance charges due the United States.

TRANSFER OF PLANT, EQUIPMENT, AND SUPPLIES

5. a. Title to United States-owned movable plant, equipment, and supplies not purchased with District funds or charged to the District that is excess to the needs of the United States and useful in the operation and maintenance of said "transferred District works" shall be transferred to the District upon payment by the District to the United States of the value of said transferred plant, equipment, and supplies as listed on the accounts of the United States. The District shall have access to said accounts for the purpose of verifying said values.

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Art. 5

b. Title to as much of all movable plant, equipment, and supplies which were purchased for use in the performance of the said rehabilitation contracts and which is desired by the District shall be transferred to the District at the time of said transfer of operations and maintenance, and the remaining value thereof shown on the accounts of United States and previously uncharged to the District shall be added to the unpaid balance remaining on the said rehabilitation contracts, to be paid by the District as it retires such balance under said rehabilitation contracts and in accordance with the schedule set forth in such contracts.

c. All unconsumed movable plant, equipment, and supplies in the custody of the United States before October 1, 1980, which were purchased by or charged to the District for the operation and maintenance of the said transferred District works shall be transferred to the District without expense to the District on October 1, 1980.

d. The United States and the District shall jointly prepare an inventory of the said movable plant, capitalized equipment, and stores' property recorded in and controlled by the General Ledger Accounts of the United States, including an estimate of their values. All other materials, supplies, and equipment purchased for the operation and maintenance program of the District, the value of which is charged to expense or operating accounts of the United States, shall become the property of the District on or before October 1, 1980.

WATER CONTROL

6. a. The United States shall allocate legally available stored project water among Elephant Butte Irrigation District, El Paso County Water Improvement District No. 1, and the Republic of Mexico in accordance with the Rio Grande Project Act of 1905, all applicable Federal Reclamation Laws, the Convention With Mexico For The Upper Rio Grande proclaimed in 1907, all vested rights of the District under all applicable State and Federal law, court decisions, and this contract.

b. The United States will insure delivery of project water supply allocated to the District at District canal headings and other diversion points to be specified by the Contracting Officer, and at State line crossings and will make a prompt accounting of said water deliveries to the District.

c. In interstate canals, laterals, and drains (those physically crossing State lines), the United States reserves the right to direct inter-canal diversions, deliveries, and maintenance of waterways and structures by the District to assure the delivery of water and protection of lands of the other involved entities outside District boundaries.

d. In case of extraordinary climatic conditions or major accident to the District's distribution facilities, the United States, at its discretion, may adjust spills of allotted water from the District works. The United States

will designate the respective facilities to be used for spill of such water. A detailed operational plan will be concluded between the United States and the District setting forth procedures for water delivery and accounting.

OPERATION AND MAINTENANCE OF TRANSFERRED WORKS

7. a. The District, without expense to the United States shall care for, operate, and maintain the transferred District works in full compliance with the terms of this contract, and in such manner that said transferred District works will remain in good and efficient condition to perform the carriage, distribution, and drainage of water as well and efficiently as on the date of such transfer to the District.

b. The District shall promptly commence and diligently prosecute any and all repairs to the Federal project works being operated and maintained by the District which are necessary for the proper care, operation, and maintenance in accordance with paragraph a. immediately above. In case of neglect or failure of the District to commence such repairs within 45 days following written notification and to complete such repairs within a reasonable time, the Contracting Officer may cause the repairs to be made, and the cost thereof shall be paid by the District as prescribed by the Contracting Officer.

c. No substantial change shall be made by the District in any of the major transferred District works without first obtaining written consent of

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the Contracting Officer. The request for said change shall be made in writing and include a detailed design of the contemplated work. If the Contracting Officer does not reject such change within 60 days, the District may proceed with the work. Substantial change is defined herein as major relocations or major changes in structures and facilities.

d. The District shall hold the United States, its officers, agents, and employees harmless as to any and all damages which may in any manner grow out of the care, operation, and maintenance by the District of any of the project works transferred to the District.

e. If, during the period of any District indebtedness to the United States for construction or rehabilitation of the project or District works, should the District become more than 60 days delinquent in the payment of any amount due on said indebtedness, then at election of the Contracting Officer, the United States may take over from the District the care, operation, and maintenance of such transferred works by giving written notice to the District of such election and of the effective date thereof and retain the same until such indebtedness is brought current by the District.

BOOKS, RECORDS, AND REPORTS

8. The District shall establish and maintain accounts and other books and records pertaining to its financial condition, land use and crop census, water

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supply, water use, and changes of transferred District works. Reports thereof shall be furnished to the Contracting Officer in such form and on such dates as he may require. Subject to applicable Federal laws and regulations, each party shall have the right during office hours to examine and make copies of each other's books and records relating to matters covered by this contract.

DETERMINATIONS

9. Where the terms of this contract provide for action to be based upon the opinion or determination of either party to this contract, whether or not stated to be conclusive, said terms shall not be construed as permitting such action to be predicated upon arbitrary, capricious, or unreasonable opinion or determinations. In the event that the District questions any factual determination made by the Contracting Officer, findings of facts shall be made by the Secretary or his designated representative only after consultation with the District and such findings of fact shall be deemed final agency action subject to judicial review.

PENALTY FOR DELINQUENT PAYMENTS

10. The Contractor shall pay a penalty on installments or charges which become delinquent computed at the rate of 1 percent per month of the amount of such delinquent installments or charges for each day from such delinquency until paid: Provided, That no penalty shall be charged to the Contractor unless such

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delinquency continues for more than 30 days in which event the penalty shall accrue from the initial date of delinquency and no penalty shall be charged which will exceed the maximum permitted by Texas law to be paid by the District but in no event shall the penalty charged be less than 1/2 of 1 percent per month.

REVIEW AND INSPECTION OF PROJECT WORKS FOR DETERMINING ADEQUACY OF MAINTENANCE

11. a. The Contracting Officer with the Contractor may, from time to time, make reviews of maintenance of project works being operated by the Contractor with a view to assisting the Contractor in determining the condition of facilities and adequacy of the maintenance program. This review may include any or all of the project facilities constructed by the United States and transferred to the Contractor or project facilities constructed by the Contractor with funds advanced by the United States. A report of the review, including recommendations, if any, will be prepared and copies will be furnished to the Contractor. Except for such participation by the Contractor as it may desire, the review will be without cost to the Contractor.

b. If deemed necessary by the Contracting Officer or requested by the Contractor, special inspections of any project works being operated by the Contractor and of the Contractor's books and records may be made to ascertain the extent of any operation and maintenance deficiencies, to determine remedial measures required for their correction, and to assist the Contractor in solving specific problems. Any special inspection or audit shall, except in a case of

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emergency, be made after written notice to the Contractor, and the actual reasonable cost thereof shall be paid by the Contractor to the United States for inspections requested by the Contractor.

RESERVE FUND

12. Commencing with 1981 and continuing until such time as all sums of money be coming due hereunder shall have been paid to the United States, the Contractor shall accumulate and maintain a reserve fund which will be available for use in the manner, for the purposes, and in the circumstances hereinafter set forth. Such reserve fund shall consist of annual deposits by the Contractor of not less than $25,000 to a special account created by the Contractor for the purpose. Such annual deposits shall continue until the amount in the reserve fund is not less than $250,000. Expenditures shall be made from such reserve fund only for meeting major unforeseen extraordinary costs of operation and maintenance, repair, betterment and replacement of project works, and for operation and maintenance during periods of special stress such as might be caused by drought, hurricane storms, sudden or unexpected major structural failures, or other emergencies. Whenever said reserve funds are reduced below $250,000 by expenditures therefrom, it shall be restored by the accumulation of annual deposits of $25,000 commencing with the next year following that in which the fund is reduced below said amount. During any period in which any of the project

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works are operated and maintained by the United States, such fund shall be available for like use by the United States. At the option of the Contractor, the reserve fund may be withdrawn to the extent permitted by law; provided that such reserve fund may be made available within a reasonable time to meet the expenses for the purpose for which it was accumulated: Provided, That upon mutual agreement, said fund and the annual installments may be adjusted to reflect the addition, deletion, or changes in project facilities and operation and maintenance costs not contemplated when this contract was executed.

COMPLIANCE WITH RULES AND REGULATIONS

13. The Secretary may from time to time promulgate rules and regulations to implement the Reclamation laws. The District agrees to abide by such final rules and regulations lawfully adopted. This contract is subject to all such lawful rules and regulations now or hereafter in force when not inconsistent with any express and specific provisions herein. Such rules and regulations are made a part of this contract.

NOTICES

14. Any notice, demand, or request authorized or required by this contract shall be deemed to have been given, on behalf of the District, when mailed, postage prepaid, by certified or registered mail with return receipt requested, or delivered to the Regional Director, Southwest Region, Water and

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Power Resources Service, 714 South Tyler, Suite 201, Amarillo, Texas 79101, and on behalf of the United States, when mailed, postage prepaid, or delivered to the El Paso County Water Improvement District No. 1, 294 Candelaria Street, El Paso, Texas 79907. The designation of the addressee or the address may be changed by notice given in the same manner as provided in this article for other notices.

ASSIGNMENT LIMITED--SUCCESSORS AND ASSIGNS OBLIGATED (Standard)

15. The provisions of this contract shall apply to and bind the successors and assigns of the parties hereto, but no assignment or transfer of this contract or any part or interest therein shall be valid until approved by the Contracting Officer.

EQUAL OPPORTUNITY (Standard)

16. During the performance of this contract, the Contractor agrees as follows:

(1) The Contractor will not discriminate against any employee or applicant for employment because of race, color, religion, sex, or national origin. The Contractor will take affirmative action to ensure that applicants are employed, and that employees are treated during employment, without regard to their race, color, religion, sex, age, or national origin. Such action shall include, but not be limited to the following: Employment; upgrading; demotion or transfer; recruitment or recruitment advertising; layoff or termination; rates of pay or other forms of compensation; and selection for training, including apprenticeship. The Contractor agrees to post in conspicuous places, available to employees and applicants for employment, notices to be provided by the Contracting Officer setting forth the provisions of this nondiscrimination clause.

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(2) The Contractor will, in all solicitations or advertisements for employees placed by or on behalf of the Contractor, state that all qualified applicants will receive consideration for employment without regard to race [illegible] or national origin.

(3) The contractor will send to each labor union or representative of workers with which it has a collective bargaining agreement or other contract or understanding, a notice, to be provided by the Contracting Officer, advising the labor union or workers' representative of the Contractor's commitments under section 202 of Executive Order 11246 of September 24, 1965, and shall post copies of the notice in conspicuous places available to employees and applicants for employment.

(4) The Contractor will comply with all provisions of Executive Order No. 11246 of September 24, 1965, as amended, and of the rules, regulations, and relevant orders of the Secretary of Labor.

(5) The Contractor will furnish all information and reports required by said amended Executive Order and by the rules, regulations, and orders of the Secretary of Labor, or pursuant thereto, and will permit access to its books, records, and accounts by the Contracting Officer and the Secretary of Labor for purposes of investigation to ascertain compliance with such rules, regulations, and orders.

(6) In the event of the Contractor's noncompliance with the nondiscrimination clauses of this contract or with any of the said rules, regulations, or orders, this contract may be canceled, terminated, or suspended, in whole or in part, and the Contractor may be declared ineligible for further Government contracts in accordance with procedures authorized in said amended Executive Order, and such other sanctions may be imposed and remedies invoked as provided in said Executive order or by rule, regulation, or order of the Secretary of Labor, or as otherwise provided by law.

(7) The Contractor will include the provisions of paragraphs a. through g. in every subcontract or purchase order unless exempted by rules, regulations, or orders of the Secretary of Labor issued pursuant to Section 204 of said amended Executive Order, so that such provisions will be binding upon each subcontractor or vendor. The Contractor will take such action with respect to any subcontract or purchase order as may be directed by the Secretary of Labor as a means of enforcing such provisions, including sanctions for noncompliance; Provided, however, That in the event the Contractor becomes

involved in, or is threatened with, litigation with a subcontractor or vendor as a result of such direction, the Contractor may request the United States to enter into such litigation to protect the interests of the United States.

CERTIFICATION OF NONSEGREGATED FACILITIES (Standard)

17. The Contractor hereby certifies that it does not maintain or provide for its employees any segregated facilities at any of its establishments, and that it does not permit its employees to perform their services at any location, under its control, where segregated facilities are maintained. It certifies further that it will not maintain or provide for its employees any segregated facilities at any of its establishments, and that it will not permit its employees to perform their services at any location, under its control, where segregated facilities are maintained. The Contractor agrees that a breach of this certification is a violation of the Equal Opportunity clause in this contract. As used in this certification, the term "segregated facilities" means any waiting rooms, work areas, restrooms and washrooms, restaurants or other eating areas, time clocks, locker rooms and other storage or dressing areas, parking lots, drinking fountains, recreation or entertainment areas, transportation, and housing facilities provided for employees which are segregated by explicit directive or are in fact segregated on the basis of race, creed, color, or national origin, because of habit, local custom, or otherwise. The Contractor further agrees that (except where it has obtained identical certifications from proposed subcontractors for specific time periods) it will obtain identical certifications from proposed subcontractors prior to the award of subcontracts exceeding $10,000 which are not exempt from the provisions of the Equal Opportunity clause; that it will retain such certifications in its files; and that it will forward the following notice to such proposed subcontractors (except where the proposed subcontractors have submitted identical certifications for specific time periods):

NOTICE TO PROSPECTIVE SUBCONTRACTORS OF REQUIREMENT FOR CERTIFICATIONS OF NONSEGREGATED FACILITIES

A Certification of Nonsegregated Facilities must be submitted prior to the award of a subcontract exceeding $10,000 which is not exempt from the provisions of the Equal Opportunity clause. The certification may be submitted either for each subcontract or for all subcontracts during a period (i.e., quarterly, semiannually, or annually). Note: The penalty for making false statements in offers is prescribed in 18 U.S.C. 1001.

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WATER AND AIR POLLUTION CONTROL (Standard)

18. The District, in carrying out this contract, shall comply with all applicable water and air pollution laws and regulations of the United States and the State of Texas and shall obtain all required permits or licenses from the appropriate Federal, State, or local authorities.

ALL PRIOR CONTRACTS TO REMAIN IN EFFECT

19. All prior contracts shall remain in full force and effect in all respects not herein specifically revised or modified, and their terms shall be equally applicable to this contract.

OFFICIALS NOT TO BENEFIT (Standard)

20. a. No Member of or Delegate to Congress or Resident Commissioner shall be admitted to any share or part of this contract or to any benefit that may arise herefrom, but this restriction shall not be construed to extend to this contract if made with a corporation or company for its general benefit.

b. No official of the Contractor shall receive any benefit that may arise by reason of this contract other than as a landowner within the project and in the same manner as other landowners within the project.

TRANSFER SUBJECT TO APPROVAL

21. The transfer herein contemplated is subject to the approval of this contract at an election of the District in which that proposition is submitted in accordance with the law of the State of Texas, and if deemed necessary by the Board of Directors of the District, to a judgment of validation from a court of competent jurisdiction.

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IN WITNESS WHEREOF, this contract has been executed as of the day and year first hereinabove written.

THE UNITED STATES OF AMERICA
WATER AND POWER RESOURCES SERVICE

By Robert H. Weiner
Contracting Officer

ATTEST:

EL PASO COUNTY WATER IMPROVEMENT
DISTRICT NO. 1

By Jack H. Stallings
President.

Johnny Stubbs
Secretary of the El Paso
County Water Improvement
District No. 1

Signatures

United States Department of the Interior

OFFICE OF THE SECRETARY
WASHINGTON, D.C. 20240

October 30, 1973

Mr. Jack H. Stallings
President
El Paso County Water Improvement
District No. 1
294 Candelaria
El Paso, Texas 79907

Dear Mr. Stallings:

The El Paso County Water Improvement District No. 1 completed payment of its original share of the construction costs of the Rio Grande Project facilities on March 13, 1975. You have requested that I determine that a general pattern of family sized ownerships has been established in your district and that, therefore, the district is no longer bound by the acreage limitation provisions of Reclamation law. Solicitor's Opinion M-36634, 68 I.D. 372, 405 (1961).

The Department has carefully reviewed the factual information with regard to ownership holdings in the district. My Solicitor has advised me that in order to meet the requisite standard, it is not necessary to find that all parcels are now held in ownerships of 160 acres or less. Instead, I must determine whether, in general, the breakup of excess acreage as required by Reclamation law into family size farms has been achieved.

The evidence indicates that 11,267 or 99.56 percent of the landowners in the district own less than 160 acres and are in full compliance. The remaining 49 landowners hold 12,170 acres which appears to be in excess status upon strict application of the 160-acre limitation; however, 2 of the ownerships are by religious or charitable nonprofit corporations holding 2,967 acres, 4 ownerships of 405 acres are either being subdivided for residential purpose or being held for industrial development, and 43 are held by multimember family corporations, trust, or estates. Most of these multimember family ownerships have been family farm enterprises for over a quarter of a century. The excess landowners took appropriate action in the early 1950's to bring their landholdings into full compliance with the payout procedures then in effect. These efforts represented a good faith effort by the excess landowners to come into compliance with the law and procedures in effect at that time.

I conclude that a general pattern of family sized ownerships has been established in the El Paso County Water Improvement District No. 1. The district is exempt from the acreage limitation provisions of Reclamation law.

Sincerely,

Cecil R. Andrus

SECRETARY

RIO GRANDE PROJECT

CONTRACT

JAN. 17, 1920

EL PASO COUNTY WATER IMPROVEMENT

DISTRICT NO. 1.

Director

17th January

1. THIS AGREEMENT made this the [illegible] day of [illegible] 1920, by and between the UNITED STATES OF AMERICA, acting for this purpose by John Barton Payne, Secretary of the Interior, hereinafter styled the "Secretary", under the provisions of the Act of Congress approved June 17, 1902, (32 Stat., 388) and acts amendatory thereof and supplemental thereto, hereinafter styled the "Reclamation Law"; the EL PASO COUNTY [illegible] DISTRICT NO. 1, a public corporation duly formed under the laws of the State of Texas, with irrigation and drainage powers, having its principal place of business at El Paso, in El Paso County, Texas, hereinafter styled the "District"; and the EL PASO VALLEY LAND [illegible], a private corporation, organized under the laws of the State of [illegible] and having its principal place of business in the City of El Paso, Texas, hereinafter styled the "Association";

Approved as to form
[signature]
Division Counsel
1920

WITNESSETH: THAT -

2. WHEREAS, the association executed contract with the United States dated June 27, 1906, whereby that corporation agreed to pay for that part of the cost of the irrigation works of the Rio Grande project which should be apportioned by the Secretary to the shareholders of the association, and it is now the desire of the said shareholders that the lien in favor of the association primarily for the purpose of securing reimbursement to the United States, be released and that

V. P. Copy.

FEB1620 8306

the association be dissolved; and,

3. WHEREAS, the District desires to cooperate with the United States as authorized by law and particularly for the construction of drainage works and for the construction of works for the distribution and delivery of water for irrigation purposes to the irrigable lands of the District;

4. NOW, THEREFORE, In consideration of the covenants herein contained, it is agreed between the parties as follows:

5. The United States will expend, in addition to the amount heretofore expended, the sum of One Million Six Hundred Twenty-four Thousand ($1,624,000) Dollars, or so much thereof as may be necessary, for the improvement, construction and extension of the irrigation system for the storage, distribution and delivery of water to the irrigable district lands and for the construction of drainage works for the restoration and maintenance of the irrigability of district lands, subject always, however, to appropriation therefor being made by Congress. In the improvement and extension of the distribution system, the United States shall use such portions of the system already in existence as may be utilized to advantage to the extent that the title to said systems and control thereover may be acquired from the owners thereof for use by the United States. The tentative plan prepared by the United States in connection with the work is as follows:

DISTRIBUTION DISTRICT

The enlargement and extension of the following named lateral systems, or districts to provide for the irrigation of the areas shown, respectively:

Name of System	Approximate Area to be Irrigated
Upper Franklin	[illegible] acres
Juan d'Herrera	7700 "
Jornada	3720 "
Socorro	1510 "
Yala	4450 "
San Elisario	6270 "
Salatral	1700 "
Clint	2420 "
Island	2400 "
Lower Franklin	6070 "
Montoya in Texas	2600 "
La Union District in Texas	5600 "
Three Points District in Texas	1000 "

The cost of the La Union and Three Points Districts will include a part of the cost of the Hemlin diversion dam, and East and West Side Canal Systems in Mesilla Valley, prorated according to the area irrigated from them. The work as tentatively laid out is shown on map entitled "Plan and Improvement District No. 1, Proposed Lateral System, dated July 1915, on file in the office of the Project Manager, Rio Grande Project.

It is understood to be the desire of the District that in the expenditure of the money for drainage work, the agents of the United States shall avail themselves of all information as to sub-surface formation and other conditions to be obtained as the work shall progress, to the end that the drainage system may be built in an efficient manner, and that therefore it is not to the interest of the [illegible] of the

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district that exact dimensions, alignment or extent of drainage canals and ditches be prescribed in advance of the progress of actual construction work.

There have been prepared by the United States Section plans and schedules of drainage works which it is planned to construct approximately according to the sub-joined table:

Primary Drains

Drain	Length Miles	Excavation Cu. Yards
Moon	23.0	1,100,000
Middle	13.9	655,000
Franklin	12.7	564,000
River	7.0	350,000
San Elisario	6.0	400,000
Ireland	8.0	320,000
Fabens	6.3	240,000
Total primary	78.9	3,640,000

Secondary Drains

Drain	Length Miles	Excavation Cu. Yards
Clint Spur	1.1	70,000
Socorro	2.0	80,000
Valley Gate	3.5	140,000
Val Verde	2.5	100,000
Border	5.0	200,000
Fabens	4.5	180,000
Total Secondary	18.6	770,000

Mesilla Valley Drains in excess

Montoya	12.6	504,000
Reneaus	6.8	340,143
Vinton	3.6	143,378
Lower West	4.6	240,000
Total in Mesilla	27.6	1,143,521

Total for District 125.1 Miles — 4,777,251 Cubic Yards.

The bottom width of drains will vary from 24 feet to 10 feet, average approximately 12 feet, with side slopes 1½ : 1, and average cut 10 feet.

Structures will be required approximately as follows:

100 Timber Highway Bridges
200 Timber Farm Bridges
200 Metal Flumes
50 Drain Inlets
50 Special Structures for Canal, Highway and Railroad Crossings.

6. It is understood that the plans for the drainage and the construction of the distribution system hereinbefore described in Paragraph 5, are necessarily dependent upon conditions variable and uncertain. Such plans are, therefore, tentative merely, and to the end that said works may be constructed, operated and maintained so as to attain the best results, it is understood that the United States reserves the right to change any and all of said plans or conditions developing from time to time may justify and render necessary or advisable. No change, however, shall be made which will defeat the general purpose sought to be accomplished, or subvert the general tenor of this contract, but all work done under this contract shall be in accordance with plans and specifications approved by the Chief Engineer of the United States Reclamation Service.

7. The United States will continue the operation and maintenance of the irrigation and drainage system until otherwise provided by contract after a vote by the electorate of the i-

trict, or until the payments required by the Reclamation Law are made for the major portion of the irrigable lands of the district, subject, however, to appropriation for such maintenance and operation work being made by Congress, and provided always that such operation and maintenance shall be performed only in case the Secretary shall receive satisfactory assurance that lawful assessments and levies are being made or tolls and charges are being imposed, sufficient to meet the expenses thereof, and provided further, that full repayment of the cost of the operation and maintenance for previous years shall have been made to the United States. There shall be considered as a part of the operation expense a storage cost of fifty cents per acre for the area of the district actually irrigated, whether or not stored water is used. The water shall be diverted and distributed in such manner as may be hereafter arranged between the Board of Directors of said District and the United States. The United States will so continue to operate and maintain said project works until the issuance by the Secretary of public notice as provided in Section 4 of Reclamation Act approved June 17, 1902 (32 Stat., 388), whereupon the United States will continue the operation and maintenance of the said project in lands under the reclamation law and public notice issued thereunder.

8. The District hereby assumes the liability for the reimbursement to the United States of the appropriation represented by the cost of the irrigation and drainage works hereto-

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heretofore constructed or hereafter to be constructed for the use and benefit of District lands, and across to pay the same and each installment thereof. Such aggregate sum shall include the District's proportionate share of the cost for construction of the Elephant Butte Reservoir. The total liability assumed by the District for irrigation and drainage construction purposes, exclusive of penalties, shall in no case exceed the aggregate sum of Four Million Nine Hundred Forty-one Thousand ($4,941,000.00) Dollars.

9. The charge for construction of the Elephant Butte reservoir assumed by the District her under and included in the amount estimated and set forth in the preceding paragraph, is based upon the irrigable area of the project in the States of New Mexico and Texas and included within the boundaries of the Elephant Butte Irrigation District and the El Paso County water Improvement District No. 1, as such districts are now constituted. Should a contract or contracts be hereafter made between the United States and the El Paso County Conservation and Reclamation District No. 2, or any other similar district or organization, comprising land in the States of Texas and New Mexico, or either of them, by which the payment or any part of the storage charge for the construction of the Elephant Butte Reservoir is assumed, the amount payable by the District under this contract shall be reduced in such sum as will equitably adjust

and apportion the charge to be paid for the construction of said reservoir by the District hereunder with the amount to be paid on account of other lands in Texas and in Mexico which shall receive stored water from said reservoir.

10. Should the boundary line between the State of New Mexico and Texas be changed as a result of the suit now pending in the Supreme Court of the United States entitled State of New Mexico vs. State of Texas, in such manner that the boundaries of the District and the irrigable area of land within it therein are modified, the obligations under this contract shall be reduced in proportion to the acreage which may be eliminated from said District.

11. From time to time as the Secretary may determine that specified areas of irrigable district lands, not necessarily contiguous, should commence payment for the assistance and irrigation works herein provided for, he shall render a statement to such effect to the District, designating the areas of said District lands, and shall state the amount payable for such designated areas on account of the work herein provided for; and the District will pay such amount in installments of the same percentages and subject to the penalties of the same amounts and terms as specified in Sections 2 and 3 of the Reclamation Extension Act approved August 13, 1914. Such installments shall be due on such annual date as may be specified in said statement

conformable to the state laws. The installments may, however, be divided and become payable semi-annually by contract between the Secretary and the District.

12. Until all amounts payable to the United States for the construction of the works herein provided for have been fully paid and discharged, there is reserved to the Secretary the right to make reasonable rules and regulations and to modify the same in his discretion, not, however, contrary to this contract, but to the end that the true intent of the law and of this contract shall be carried into effect, and the District agrees to use its powers for the purpose of carrying out such rules and regulations and the purposes of this contract. The proper officials of the District shall have full and free access to the project books and official records of the United States Reclamation Service relative to the costs of the works herein provided for and the operation and maintenance thereof, with the right at any time during office hours to make copies of and from the same. The representatives of the United States shall have the same rights in respect to the books and records of the District.

13. The Secretary, in his discretion, may cause lands within the District temporarily incapable of profitable cultivation on account of poor soil, alkali or other conditions, and notify the District that it will be relieved from payment of the amounts payable, or any part thereof, on account of such

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lands for a specified period or until further notice, whereupon the District shall exempt from assessment and levy the lands as specified during the period named. Nothing in this paragraph, however, shall be deemed to relieve the District or individual landowners from any reasonable responsibility for improving drainage conditions and for using reasonable economy in the use of water. If the Secretary of the Interior shall deem any lands of the project permanently insusceptible of reclamation on account of seepage or other conditions, he may, in his discretion, contract with the District for the severance of the water rights from such lands and for their becoming appurtenant to the other lands within or without the District or to lands which by appropriate proceedings are brought within the District. Nothing in this paragraph contained however, shall be deemed to release the District from its liability for the reimbursement of the reclamation funds for the cost of the said works, but if transfers of water rights be made to lands without the District, as in this paragraph provided and the United States shall thereby be satisfactorily secured for proportionate reimbursement, the obligation of the District shall be reduced to the same extent.

14. It is agreed that as soon as the affairs of the Association will permit, there shall be executed the necessary instruments of release of all the lands in Hale County, Texas, included within the boundaries of the District, from the liens existing under subscriptions to stock in the trust agree-

ments with said Association to the end that said lands shall be clear of encumbrances for the carrying out of the reclamation law, except such as shall be created by annual assessments by the District. No such release, however, shall be made until decree in confirmation of the proceedings for the authorization of the contract indebtedness herein undertaken and the confirmation of the validity of this contract shall have been rendered by a District court of Texas having jurisdiction or decision rendered by any appellate court to which appeal shall be taken.

15. The indebtedness herein assumed by the District is understood not to be cumulative with that of one million dollars for construction purposes undertaken in favor of the United States by the district by contract of December 15, 1917, between the parties hereto, but that the maximum amount of indebtedness to the United States for construction purposes set forth in paragraph 8 hereof includes such preexisting obligation to the United States.

16. No Member of or Delegate to Congress, or Resident Commissioner, after his election or appointment, or either before or after he has qualified and during his continuance in office, and no officer, agent, or employee of the Government shall be admitted to any share or part of this contract or agreement, or to any benefit to arise thereupon. Nothing, however, herein contained shall be construed to extend to any incorporation or company, as provided in Section 116 of the Act of Congress

approved March 4, 1909 (35 Stat., L., 1109).

IN WITNESS WHEREOF, this contract has been executed on behalf of the parties hereto and certified copies of resolutions of the boards of Directors of the District and the Association hereto attached and the respective seals of the said corporations hereto affixed.

JUN 24 1920 THE DEPARTMENT OF THE INTERIOR

(Sgd) By John Barton Payne
Secretary of the Interior

EL PASO COUNTY WATER IMPROVEMENT DISTRICT No. 1

By J. A. Smith
President

ATTEST:

(Sgd) T. D. Forbes
Secretary El Paso County
Water Improvement District No. 1

EL PASO VALLEY WATER USERS' ASSOCIATION

By J. A. Smith
President

(Sgd) Bernice Flores
Secretary El Paso Valley Water Users' Association.

August 18, 1920.

The officials who executed this contract on behalf of El Paso County Water Improvement District No. 1 were the officials thereof on the date they signed the same, January 17, 1920, but were not such officials on the date the Secretary of the Interior signed it, June 24, 1920. The date has been changed to show the true date, January 17, 1920, and the date the Secretary executed the contract, June 24, 1920, has been stamped opposite his name.

Morris Bien
Acting Director.

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