UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
Albuquerque, New Mexico

Base flow in the Acme-Artesia reach of the Pecos River, New Mexico, 1957-71

By

G. E. Welder

Open-file report

Prepared by the U.S. Geological Survey in cooperation with the Pecos River Commission

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Abstract

The reach of the Pecos River between the Acme and Artesia stream-gaging stations is in Chaves and Eddy Counties, southeastern New Mexico. This southward-flowing reach, 82 river miles in length, gains in base flow between Acme, the upstream station, and Artesia, the downstream station. Estimation of the gain in base flow for 1957-71 is the main purpose of this study.

Contributions to base flow in the Acme-Artesia reach of the Pecos River are by seepage from the "principal artesian" and "shallow" aquifers of the Roswell basin, seepage from the water-table aquifer in the Artesia Group east of the river valley, and drain flow from the Roswell basin.

A graphical method of determining the base-flow contribution to the reach was used. Mean daily discharge records from the Acme and Artesia stations were plotted on the same graph for each of the 15 years of record, 1957-71. Daily river-pumpage estimates for pumpage from the Acme-Artesia reach were then added to the Artesia hydrographs. Next, lines separating base flow from surface runoff were drawn for both the Acme and Artesia stations, and the area between the lines was planimetered for each month.

Time-lag corrections from Acme to Artesia were not applied as it is unlikely that such corrections would be significant for a month of base-flow data. The method to a large extent allows separation of storm runoff from the tributaries to the study reach. One difficulty in the method, however, is that of separating base flow during high-flow events. Variations in the permeability of the "shallow" aquifer and the probable connection of the "principal artesian" aquifer with the river prevent theoretical definition of the distinction between ground-water discharge and water going into or out of bank storage, and their relation to high-flow events. For this reason, the base-flow separation lines were drawn relatively straight through the high-flow events.

The results of this study indicate that for 1957-71, the base flow in the Acme-Artesia reach of the Pecos River averaged 23,850 acre-feet per year and ranged from a high of 36,640 acre-feet in 1958 to a low of 15,250 acre-feet in 1964.

Introduction

Purpose and scope

This report presents the results of a study of the base-flow contribution to the reach of the Pecos River between the Acme and Artesia stream-gaging stations (fig.1) for 1957-71. The study was made by the U.S. Geological Survey in cooperation with the Pecos River Commission.

Base-flow data are useful in the quantitative study of the Roswell underground-water basin because a considerable part of the natural discharge from the basin occurs within the Acme-Artesia reach. These data also have use in the analysis of the effects of phreatophyte eradication and control along this part of the river valley. Initial clearing of the phreatophytes began in June 1967 and ended in April 1969 (fig. 2). A longer period of base-flow analysis prior to clearing would have been desirable, but detailed river-pumpage information needed for the analysis is not available before 1957. Records of pumpage for 1971 were the latest available at the time this work was done.

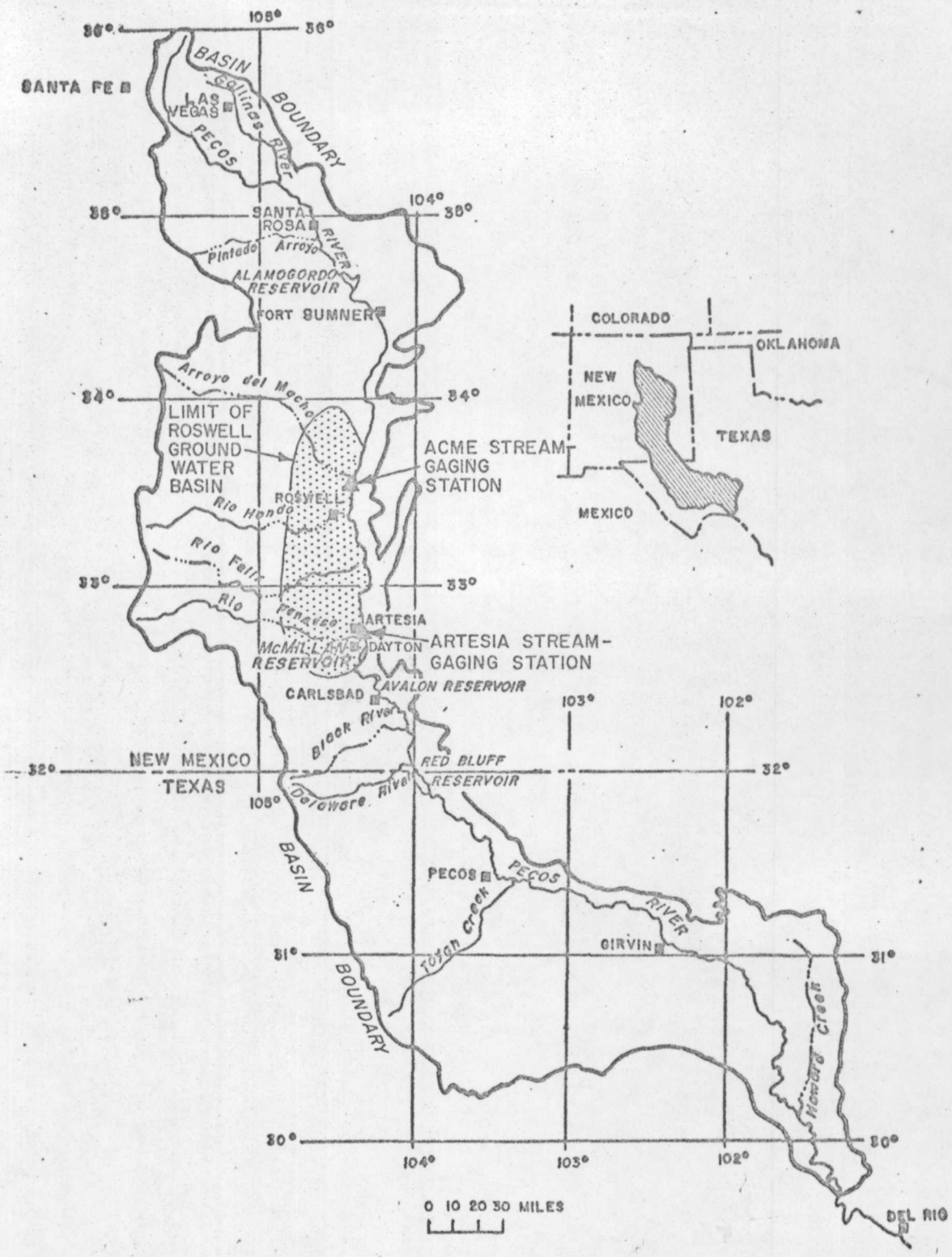

Figure 1.--Index map of Pecos River drainage basin, Roswell ground-water basin, and reach of the Pecos River between the Acme and Artesia stream-gaging stations.

Location and general geography

The reach of the Pecos River between the Acme and Artesia stream-gaging stations trends southward from southern Chaves to northern Eddy County in southeastern New Mexico (figs. 1 and 2). The upstream station near Acme is 14 miles northeast of Roswell and 3 miles south of U.S. Highway 70. The downstream station near Artesia is 4.3 miles east of the town of Artesia at the bridge on State Highway 83. The stations are 48 airline miles and 82 river miles apart (Mower and others, 1964, p. 9). In this reach the Pecos River descends 216 feet, from an altitude of 3,507 feet at the Acme station to an altitude of 3,291 feet at the Artesia station.

Drainage

The Pecos River, the main stream of southeastern New Mexico, is usually perennial in the reach between the Acme and Artesia stations. It is not uncommon, however, for the stream to dry up at the Acme station for 2 or 3 weeks; but flow at the Artesia station rarely ceases. The only tributaries of consequence that enter the reach between the stations are the Rio Hondo, Rio Felix, and Cottonwood Creek. These streams cross the Roswell basin and enter the Pecos River from the west. They carry runoff from precipitation several times a year but usually are dry, except near the Pecos River where ground-water seepage maintains flow during most of the year. Berrendo Creek, which flows into the Rio Hondo east of Roswell, and Zuber Draw, a short tributary of the Pecos half a mile north of Dexter, also have some spring flow near their mouths. All of the low flow and most of the high flow of the Rio Hondo are diverted into the Hagerman Canal downstream from the mouth of Berrendo Creek at a point about 3½ miles upstream from the Pecos River (fig. 2).

The Pecos River flows along the east side of the Roswell basin (fig. 1) in a meander swath or flood plain that generally ranges in width from a quarter to half a mile (Mower and others, 1964, plate 8). In several places, however, it is wider than half a mile. Land surfaces in this long narrow strip are from 1 to 20 feet above the streambed. The flood plain is generally below the level of the Lakewood Terrace, which is 20 to 30 feet above the streambed (Fiedler and Nye, 1933, p. 11). Flooding normally is restricted to the lower parts of the flood plain.

Definition of base flow

Base flow is defined in this study as seepage to the Pecos River that generally originates from ground-water sources beyond the flood plain of the river, plus artesian water that reaches the channel through fractures and solution conduits. Thus, it would include ground water from the "principal artesian" and "shallow" aquifers of the Roswell basin, as well as ground water that moves from the water-table aquifer east of the river valley through the narrow strip of alluvium along the east side of the river. It also includes some of the water that seeps into the more distant parts of the flood plain when the river overflows its banks during floods. This water moves back to the channel so slowly that it can not be identified as part of the recession curve on a stream-discharge hydrograph. A somewhat similar source of base flow is water that seeps into the flood plain through playa-like flats where part of the surface runoff from tributaries is intercepted, instead of flowing directly to the river. The magnitude of the latter two types of seepage into the flood plain is not known.

Not included in this definition of base flow is water that seeps into the banks during channel-contained rises in river stage, and then returns to the stream quickly enough to be recognized as part of the recession curve on a stream-discharge hydrograph. Water-level observations in wells near the river indicate that much of the water that moves away from the stream during a 3-week release from Alamogordo Reservoir, for example, returns to the stream within 3 weeks. Some water, however, does not return to the river in this time, but continues to move away until the water-table slope toward the river is restored. Consequently, much of the seepage from the channel eventually returns to the river and is either separated from or included with base flow as defined above. Some of the seepage is lost to evapotranspiration, and a small amount is discharged by wells.

Base-flow gain or accretion is the ground-water discharge, as defined above, that enters the stream between the Acme and Artesia stream-gaging stations. It is the difference between the base flows at the two stations.

Base-flow estimates from previous studies

The Pecos River Joint Investigation estimated monthly inflow of ground water to the Pecos River from the Roswell basin for 1905-39 (National Resources Planning Board, 1942, table 31, p. 51). Stream-discharge records used in making the estimates were from the Fort Sumner and Dayton stream-gaging stations, the Acme and Dayton stations, and the Acme and Artesia stations. Out of a total of 420 months for the 35-year period, 138 station months of record were available, but only 39 station months of record had been collected simultaneously at the Acme and Artesia station sites, which mark the reach of major inflow. River-pumpage corrections for 1905-39 were estimated by using discharge measurements made at 15 pumping plants in 1940 and by estimates of irrigated acreage (National Resources Planning Board, 1942, p. 54).

Estimates of ground-water inflow to the Pecos River from the Roswell basin were prepared by the Pecos River Commission for the Pecos River Compact (1949, p. 48) between New Mexico and Texas. The base-flow figures of the Pecos River Joint Investigation were extended through 1946 by using the streamflow records at the Acme and Artesia stations, estimates of river pumpage, and estimates of the number of acres irrigated with river water.

The engineering firm of Tipton and Kalmbach, Inc. estimated base flows of the Acme-Artesia reach for 1919-57 (unpub. eng. rept., Sept. 1958) at the request of the Pecos River Commission. Base flows were estimated from the Dayton and Artesia stream-gaging stations at the lower end of the reach prior to July 1937. After the Acme station was installed in July 1937, records from Acme and Artesia were used along with estimates of river pumpage and irrigated acreage for 1919-54. Some river-pumpage estimates of the Pecos River Watermaster were available after 1954. The base-flow figures shown by Tipton and Kalmbach, Inc. in table 2 of their report are generally somewhat less than those shown by the Pecos River Joint Investigation for 1919-37.

Base-flow estimates for 1919-57 shown in tables A-8-1 and A-8-3 of the review of basic data for the Pecos River Commission (1960) are those of Tipton and Kalmbach, Inc., except that a storage-depletion factor was included for 1941-48 in table A-8-3.

Saleem and Jacob, in their report on a dynamic programming model of the Roswell basin, included in their table of base-flow data (1971, table 2, p. 14) the original figures of Tipton and Kalmbach, Inc. for 1919-57, plus estimates of base flow for 1958-68. The latter were estimates based on data from the files of the New Mexico State Engineer's Office. The left annual base-flow column of Saleem and Jacob's table 2 is the same as the data of Tipton and Kalmbach, Inc. for 1919-58, which includes a correction for river pumpage. Saleem and Jacob apparently doubled the correction for river pumpage and included it in the right column of their table 2, at least for the data taken from Tipton and Kalmbach, Inc.

The Pecos River Joint Investigation (National Resources Planning Board, 1942, p. 48) and Tipton and Kalmbach, Inc. employed numerical analysis and graphical methods, respectively, to determine base flow. Those figures were then corrected for river pumpage.

Acknowledgments

Numerous discussions concerning the base-flow relation to the hydrology of the Acme-Artesia reach with Mr. Forest P. Lyford, Hydrologist, U.S. Geological Survey, were of great help in developing a better concept of the relation between ground and surface water. Mr. Emerson Banta and Mrs. Opal Teague of the New Mexico State Engineer's Office provided information on many occasions about the early river-pumpage records; their efforts are greatly appreciated.

Ground water

The Acme-Artesia reach of the Pecos River is near the east boundary of the Roswell ground-water basin (fig. 1), which consists of a deep artesian aquifer ("principal artesian aquifer") and a shallow water-table aquifer ("shallow aquifer"). The river has cut into the east edge of the "shallow aquifer" along most of the reach and is hydraulically connected with it. Geologic and hydrologic data indicate that the "principal artesian aquifer" is connected to the "shallow aquifer" and, probably, to the river channel by fractures and solution passages that breach the Permian rocks separating the two aquifers.

A less known component of the hydrologic system is the water-table aquifer in the bedrock east of the alluvium of the river valley.

"Principal artesian aquifer"

The "principal artesian aquifer" consists of a zone of water-filled solution cavities and fractures in carbonate rock of the San Andres Limestone of Permian age and the overlying Grayburg Formation, which is the lowest member of the Artesia Group, also of Permian age. The San Andres crops out in a north-trending exposure 15 to 25 miles west of the Pecos River. It dips eastward beneath a wedge of clay, siltstone, sandstone, carbonate, and gypsum of the Artesia Group and the overlying Quaternary alluvium of the "shallow aquifer." This aquifer underlies essentially all of the "shallow aquifer," but extends about 10 miles farther north and 10 to 15 miles farther west. The depth to the top of the San Andres is about 600 feet at the river east of Roswell and about 1,100 feet at the river east of Artesia.

The permeable zone gradually moves upward from the basal part of the San Andres at the west edge of the aquifer in the outcrop area to the upper San Andres and lower Grayburg in the east. Here the aquifer is artesian because of the confining nature of the rocks of the Artesia Group. Irrigation wells produce from a permeable zone that generally ranges in thickness from 100 to 300 feet in the confined eastern part of the aquifer.

Recharge to the "principal artesian aquifer" is from precipitation, seepage of streamflow, and possibly from downward leakage of water in younger rocks during times when the "principal artesian aquifer" is heavily pumped. Discharge is by upward leakage to the "shallow aquifer" and the river and by pumpage. According to the records of the New Mexico State Engineer, 252,700 acre-feet of water was pumped from the "principal artesian aquifer" in 1971 (written commun., G. W. Brim and F. H. Henninghausen, 2-15-72).

"Shallow aquifer"

The "shallow aquifer" consists of unconfined water in pore spaces between grains of alluvial sand and gravel. The sand and gravel may be consolidated into layers of sandstone and conglomerate in some parts of the aquifer. Interbeds of clay and siltstone are common. Alluvium of the "shallow aquifer" extends southward from Arroyo del Macho about 75 miles to the vicinity of McMillan Reservoir, and westward from the Pecos River a distance of about 10 miles. The maximum thickness of the alluvial material of the "shallow aquifer" is about 300 feet. In places, the lowest part of the aquifer might be in hydraulic contact with permeable zones in the upper part of the underlying Artesia Group. The oldest part of the alluvium possibly is Pliocene in age, but most of the alluvial material is Pleistocene and Holocene in age.

Upward leakage from the "principal artesian aquifer", seepage from precipitation and streamflow, and return flow seepage from irrigation are the sources of recharge to the "shallow aquifer." Seepage to the river and the lower reaches of several tributaries, seepage to drains, pumpage, and evapotranspiration are the chief means of discharge from the "shallow aquifer." According to the records of the New Mexico State Engineer, 138,500 acre-feet of water was pumped in 1971 from the "shallow aquifer" (written commun., G. W. Brim and F. H. Henninghausen, 2-25-72).

"Aquifer east of river valley"

Another component of the hydrologic system, whose significance is not fully known, is the water-table aquifer in rocks of the Artesia Group east of the alluvial valley of the Pecos River. The characteristics and extent of this aquifer have never been studied. A few stock wells produce small quantities of ground water from sandstone and from solution cavities in gypsum of the Seven Rivers, Yates, and Tansill Formations of the Artesia Group. Several springs and the lakes of Bottomless Lakes State Park are natural discharge points for this aquifer. The water table in the aquifer dips steeply westward from the topographically high area east of the river valley and merges with the water table in the narrow band of alluvium east of the river.

Recharge to the aquifer east of the river valley is from precipitation and seepage from runoff in arroyos. There are no perennial streams in the area east of the river, but flow in Comanche Draw is sustained part of the year by springs.

Surface water

The average annual discharge of the Pecos River at the Artesia gage for 1957-71 is about 122,000 acre-feet. For the last 8 years (1964-71) discharge at the Artesia station has averaged about 100,000 acre-feet per year.

Streamflow of the Pecos River in the Acme-Artesia reach is maintained by releases of water from Alamogordo Reservoir, by surface runoff from precipitation, by drain flow from the Roswell basin, by groundwater seepage, and to a lesser extent by precipitation on the channel. Depletion of flow in the reach is principally by pumpage for irrigation and by evaporation from the water surface and the wet sandbars in the channel. Smaller losses result from phreatophytes whose roots actually enter the stream channel and from seepage in losing stretches of the reach. In general, the Acme-Artesia reach has been a gaining one, but in recent years water-level data indicate that the lower 12 miles of the reach might be starting to lose water. Only the more significant gains and losses will be discussed in this report.

Sources of flow

Releases from Alamogordo Reservoir

Flow of the Pecos River is regulated to a great extent by outflow from Alamogordo Reservoir, 116.5 river miles north of the Acme station. Generally, during the irrigation season, one to four releases ranging from 20,000 to about 50,000 acre-feet flow down the river to McMillan Reservoir for use in the Carlsbad Irrigation District. McMillan Reservoir is about 16 river miles south of the Artesia station. A release may last from 2 to about 5 weeks, depending on the need and availability of water. Stream discharge in the reach between the Acme and Artesia stations generally ranges from 700 to 900 cfs (cubic feet per second) during the release periods. These higher flows cause 1½- to 2½-foot stage rises in the stream level.

Surface runoff

Surface runoff from tributary streams such as Berrendo Creek, Rio Hondo, Rio Felix, and Cottonwood Creek adds to the flow of the Pecos River in the Acme-Artesia reach. The Felix and Hondo, in particular, generally have sizable flows each summer. The maximum discharge of record for the Felix, which occurred during the flood of October 7, 1954, was 74,000 cfs. The volume of tributary flows, however, is generally relatively small.

Surface runoff from tributaries above the Acme station and below Alamogordo Dam also supplement streamflow in the Acme-Artesia reach. Peak flows of 4,000 to 6,000 cfs are fairly common at Acme each summer. The maximum discharge of record at the Acme station was 53,000 cubic feet per second on May 28, 1937.

Drain flow

The Pecos River Watermaster in his 1971 annual report lists 18 drainage ditches or buried pipeline drains that supplement the flow of the Pecos River (Banta, 1972, p. 45). These are the remainder of numerous drains that were originally installed to facilitate drainage of areas in the Roswell basin where the water table was shallow and water-logged conditions existed. Discharge measurements of drain flow are made by the Watermaster every 4 to 8 weeks. In general, drain flow tends to follow the trend of water-level change in the aquifers of the Roswell basin. For the purpose of this report, drain flow is regarded as ground water that adds to the base flow of the Acme-Artesia reach; consequently, it is included in the estimates of base flow given in table 2. Total drain flow to the river in 1971 is estimated to be about 5,000 acre-feet.

Flow depletions

River pumpage diversions

Water-right records indicate that the first applications for pumping from the Pecos River were made in 1907. A survey by the U.S. Bureau of Reclamation found that 40 pumping plants on the Pecos between the Acme station and McMillan Reservoir and 4 on the Rio Felix were in use in 1940 (U.S. National Resources Planning Board, 1942, pt. X, p. 54). According to the 1971 report of the Pecos River Watermaster (Banta, 1972, p. 29), there were 23 pumps on the Pecos between the Acme and Artesia stations, 5 on the Rio Felix, 4 on Berrendo Creek, 1 on the Rio Hondo (Hagerman Canal Co. diversion excepted), and 1 each on Zuber Draw and Cottonwood Creek.

The 1972 annual duty of water, or diversion per acre, is set at 3.0 acre-feet except for 2 pumpers whose duty is 2.5 acre-feet. Pecos River and tributary water was used to irrigate 6,740 water-right acres in 1971 (written commun., G. W. Brim and F. H. Hennighausen, Feb. 25, 1972). Actual pumpage generally varies from year to year. (See table 1.)

Pumpage diversions from the Pecos River, Cottonwood Creek, Rio Felix, Zuber Draw, and Rio Hondo below the Hagerman Canal were used to determine base flow. Diversions from Berrendo Creek and the Rio Hondo above the Hagerman Canal were excluded because all but the highest flow of these streams goes into the Hagerman Canal. Although the channels of Zuber Draw and the Rio Hondo were partially clogged during some of the years of record studied, seepage measurements indicate that water in these tributaries reaches the river, at least part of each year. Therefore, corrections for the two pumpage diversions involved, one on each stream, were included in the base-flow analysis. It was assumed that low flows in the tributaries were essentially ground water that contributed to the base flow of the main stream.

During 1957-63 continuous flow-measuring devices had not yet been installed on a few of the river pumps and the annual diversions at these pumps were calculated by the Pecos River Watermaster from current-meter measurements, power records, acreage irrigated, and the duty of water allowed. The pumpage involved ranged from 27 percent of total water pumped in 1957 to 8 percent in 1963. For purposes of this study this type of pumpage was prorated on an equal daily basis from March 15 through September 15. This procedure is not the most desirable because pumping is often higher during releases from Alamogordo Reservoir and sometimes less during periods of large surface runoff. Analysis of the daily pumpage data during high flows after 1963 indicates that the error involved, however, is generally less than 5 percent.

Except for the pumpage referred to on the preceding page, all of the pumpage used in this report was measured with a Parshall flume and continuous analog recorder or a totalizing meter. Those pumps equipped with a totalizing meter were visited periodically and the pumpage was prorated daily for the interval between visits. All of the pumping plants pertinent to this study in 1969, for example, used 23 analog recorders and 2 totalizing meters.

Table 1 is a tabulation of the total daily, monthly, and annual pumpage figures compiled by the Geological Survey from data collected by the Pecos River Watermaster. The pumpage listed in table 1 is the actual amount of water pumped from the Pecos River and the selected tributaries. No adjustments have been made for conveyance loss.

Table 1 does not include flow in the Hagerman Canal. The canal is supplied by water from wells, by surface flow from Berrendo Creek and the Rio Hondo above the canal, and by a small amount of drain flow. For purposes of this report, most of the water in the canal is considered to be used in the process of irrigation. The Hagerman Canal Co. has, for many years, spilled excess water from the canal to the Rio Felix, Spring River, and other drainages several days each year. Partial records of spillage, however, are available only on the Rio Felix. From these sparse records the annual spillage from the canal is estimated to range between 0 and 800 acre-feet. The flow in the canal and the spillage are assumed to have been relatively constant during the period of study (1957-71) considered in this report; consequently, trends in base-flow change will be the same, although total base flow may differ slightly.

Table 1.--Daily pumpage from Pecos River between the Acme and Artesia stream-gaging stations, in cubic feet per second [1/]

Month	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	Monthly Total cfs-days	Monthly Total ac-ft
1957																																	
January	0.8	0	0.5	0.1	1.1	0.1	0	0.5	0	0.2	0	0	0	0.2	0	3.8	8.3	8.4	8.1	1.7	3.3	8.6	7.0	12.2	13.4	10.3	8.7	2.7	3.6	4.3	7.4	115.3	228.7
February	4.7	5.9	3.4	2.1	6.8	10.0	11.0	10.9	11.8	9.4	13.5	15.6	10.1	8.9	7.8	10.6	9.4	10.3	11.6	11.3	10.6	7.1	5.5	7.0	6.8	3.9	2.7	5.9	X	X	X	234.6	465.3
March	11.6	12.1	10.8	11.8	6.9	2.7	3.6	12.9	9.6	8.5	13.6	14.3	16.6	16.5	26.4	21.5	40.6	59.3	61.5	51.0	65.6	59.8	72.6	66.3	66.2	59.6	62.5	61.4	65.3	55.7	34.4	1,081.2	2,144.6
April	32.8	46.5	39.4	34.1	31.5	32.1	18.3	26.5	40.0	44.6	40.3	44.4	32.3	27.0	38.3	43.7	39.0	25.7	30.2	26.2	25.4	30.6	30.3	31.6	37.5	36.0	25.9	19.1	27.8	28.4	X	985.5	1,954.7
May	30.9	35.5	31.2	25.4	21.5	23.2	22.6	17.0	30.7	30.7	29.4	26.3	21.3	30.0	31.4	23.0	26.9	27.6	14.2	31.2	34.8	40.9	39.5	36.7	33.3	29.0	26.9	39.6	47.6	63.9	53.1	975.3	1,934.5
June	56.6	37.0	35.7	40.5	42.4	39.0	46.8	40.0	29.9	27.7	28.3	35.2	32.3	28.0	32.3	23.7	38.8	33.5	34.8	21.3	29.7	36.5	32.0	33.6	27.3	28.5	33.7	30.2	26.4	22.5	X	1,004.2	1,991.8
July	29.6	26.5	27.8	24.2	30.8	21.3	18.7	23.8	23.7	78.4	97.0	97.9	80.6	67.0	59.7	54.7	42.9	43.6	62.5	43.7	31.1	34.9	31.2	25.2	16.7	23.9	30.7	17.2	20.0	17.1	41.0	1,243.4	2,466.3
August	40.9	40.7	32.3	23.0	46.9	55.7	51.8	63.4	68.7	59.1	43.3	49.6	49.7	41.7	42.3	29.1	28.0	33.7	48.5	43.7	43.5	44.5	50.8	61.2	46.6	54.3	32.0	41.6	38.3	35.2	37.7	1,377.8	2,732.9
September	36.1	40.1	35.5	40.6	36.4	30.4	27.2	27.0	38.3	33.3	28.7	33.0	35.1	52.4	45.2	25.9	11.5	11.3	2.9	12.6	21.3	23.1	44.2	50.1	50.5	35.2	32.9	32.8	19.5	23.7	X	936.8	1,858.1
October	25.5	16.8	8.6	9.1	13.0	0.9	9.2	6.0	3.7	1.9	3.9	2.5	0.6	0.4	6.5	6.0	7.9	1.1	0	0	0	0	0	0	0	0.6	0	1.2	0.7	0.7	0	126.8	251.5
November	0	0	0	0	0	0	0	0	0	0	0	0	0	0.6	0.1	0	0	0	0	0.2	0	0	0	0	0.2	0	0.3	0	0	0.1	X	1.5	3.0
December	0	0	0	0.2	0.3	0	0.1	0	0	0	0.8	0.3	2.0	2.6	0	3.1	2.3	3.2	0	4.2	1.9	0.2	1.2	4.4	0.2	4.4	5.0	6.3	8.2	16.7	5.8	73.4	145.6
																														ANNUAL TOTAL		8,155.8	16,177.0
1958																																	
January	1.0	0.2	0	0	0	0	0	1.0	0	0	0.6	0	0.6	0	0.2	0	0	0.2	0	0	0.2	0	0	0.5	0	0	0.2	0	0	0.2	0.6	5.5	10.9
February	0.2	0	0	0.2	0.7	1.1	1.2	0	0	1.2	0.5	0	0.2	0	0.2	0	0	4.3	2.6	1.3	0	0	0	0.5	0	0	0.2	0	X	X	X	14.4	28.6
March	0	0	7.3	11.0	10.8	1.1	0.9	1.5	1.6	2.7	6.2	0	2.6	4.5	18.4	31.2	39.5	47.0	53.5	57.3	64.2	57.2	56.8	57.6	48.9	64.1	68.9	63.4	58.3	45.9	45.6	928.0	1,840.7
April	48.0	44.0	40.0	36.0	23.5	21.6	40.0	41.6	41.6	40.5	33.3	28.9	13.4	17.5	29.9	23.1	14.2	12.6	14.6	14.6	27.8	19.9	12.4	29.0	63.5	72.6	58.1	43.2	38.6	35.0	X	979.0	1,941.8
May	34.1	35.8	34.8	17.2	32.1	40.3	49.6	58.5	47.6	41.6	31.6	26.2	24.2	16.3	22.9	21.3	20.6	20.0	28.4	28.0	32.4	26.6	34.0	25.6	24.4	43.5	45.2	48.3	42.8	47.8	53.5	1,055.2	2,093.0
June	52.0	62.5	60.4	60.2	56.6	46.3	39.4	32.1	55.8	65.5	66.9	68.8	62.6	46.9	32.4	48.4	60.2	65.6	74.1	64.9	18.9	13.5	17.8	34.0	29.2	45.4	45.7	47.6	35.0	39.9	X	1,448.6	2,873.3
July	52.1	60.2	55.5	50.0	42.6	34.9	35.7	29.8	33.1	45.3	47.1	47.2	40.3	44.1	48.8	56.2	46.5	50.4	64.6	53.1	68.9	57.6	45.0	56.2	54.6	42.5	36.7	32.0	36.1	48.8	32.0	1,447.9	2,871.9
August	28.6	52.2	63.2	77.2	67.7	66.5	67.7	62.9	64.3	61.8	65.6	43.5	49.9	53.3	37.1	46.7	31.4	45.7	36.6	68.1	56.3	19.3	48.3	38.0	33.5	31.5	46.0	55.1	57.0	56.1	53.9	1,585.0	3,143.8
September	57.0	50.2	26.1	35.3	49.0	46.6	22.3	27.7	32.1	50.2	37.5	16.5	11.2	11.0	11.9	0.1	5.4	10.6	10.5	7.5	3.2	11.6	15.0	23.5	3.2	0.2	0.4	1.4	0	0	X	577.2	1,144.9
October	0	0	0	0	0	0	0	0	0.1	0	1.1	1.3	0.3	0	0	0	0	0.2	0	0.2	0	0.7	2.2	1.0	1.1	1.1	0.3	0	0	0	0	9.6	19.0
November	0	0	0	0	0	0	0	0	0	1.3	1.3	1.2	1.2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	X	5.0	9.9
December	1.2	1.3	0.1	0	1.7	0.4	0.3	2.2	3.2	3.3	2.8	2.0	0.1	0.1	1.5	1.4	1.3	1.9	2.8	1.9	0.4	1.1	0	1.8	0	0	0	0	0.4	0.1	0.2	33.5	66.4
																														ANNUAL TOTAL		8,088.9	16,044.2

Table 1.--Daily pumpage from Pecos River between the Acme and Artesia stream-gaging stations, in cubic feet per second [1/] - Continued

Month	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	Monthly Total cfs-days	Monthly Total ac-ft
1959																																	
January	0.1	0	0	0	0	0.5	0	1.8	1.5	1.1	0	1.1	0	0	0	0.1	0	0.1	1.0	0	1.2	1.3	1.5	1.7	2.9	2.0	4.4	7.3	8.1	1.2	2.3	41.2	81.7
February	0.7	0	0.3	3.3	4.8	4.3	8.1	6.2	3.7	6.9	10.3	13.1	15.2	12.8	4.5	15.7	9.7	15.3	13.9	5.2	1.5	4.0	16.3	17.7	20.9	30.4	28.5	23.4	X	X	X	296.7	588.5
March	15.9	14.7	19.1	13.5	11.9	16.0	20.1	17.2	19.0	18.9	15.8	18.9	14.5	11.5	19.7	30.4	39.1	50.9	56.0	51.2	59.1	51.9	59.3	59.7	59.9	60.1	52.8	54.8	43.8	51.8	52.7	1,080.2	2,142.6
April	62.3	62.5	59.7	62.1	52.2	61.0	49.4	50.3	46.5	53.4	46.5	25.2	30.3	39.7	32.2	37.6	39.5	42.3	25.4	41.8	40.8	36.1	36.4	33.2	36.0	32.1	40.5	32.0	26.6	32.8	X	1,266.4	2,511.9
May	20.1	44.5	50.0	54.4	42.6	46.7	16.3	14.0	15.1	20.7	33.2	33.7	21.7	22.4	14.0	18.2	17.7	17.5	20.7	29.6	24.0	33.2	30.3	20.0	36.7	41.3	37.8	38.6	44.0	35.2	30.6	924.8	1,834.3
June	35.7	35.5	32.9	50.8	54.0	36.5	21.6	37.7	43.8	44.7	44.1	39.9	33.2	27.5	33.1	46.2	47.2	41.4	40.2	35.9	45.7	64.7	73.5	66.4	54.4	59.1	59.4	61.2	64.2	44.4	X	1,374.9	2,727.1
July	40.8	51.5	44.3	35.1	16.3	20.1	18.5	40.5	47.6	50.3	42.0	42.6	59.2	60.8	73.0	84.4	43.0	54.8	44.6	53.0	58.5	57.5	58.1	56.2	52.5	29.2	50.5	54.8	60.6	60.4	64.2	1,524.9	3,024.6
August	61.8	53.8	64.1	79.2	83.2	68.4	65.1	71.5	48.7	66.9	51.8	69.0	60.5	56.1	67.1	60.9	62.4	71.6	59.2	65.3	54.9	55.7	43.5	51.5	52.3	50.3	55.2	61.6	64.2	45.4	54.1	1,875.3	3,719.7
September	67.9	76.0	71.8	73.8	58.7	35.7	47.9	45.1	43.9	29.9	44.5	39.4	26.9	32.1	32.7	24.9	19.3	22.4	18.9	6.6	19.4	19.4	19.6	15.5	10.2	10.0	5.1	11.0	9.5	7.9	X	946.0	1,876.4
October	2.2	2.3	7.1	3.0	4.0	7.6	4.7	3.3	2.5	0.7	0.7	2.2	3.0	5.4	7.7	10.7	11.1	5.4	6.8	8.9	8.0	5.0	6.0	4.8	4.6	12.7	14.8	13.7	11.3	7.6	5.0	192.8	382.4
November	7.4	6.8	5.7	8.2	6.8	10.2	10.6	8.9	8.7	8.3	0.8	2.9	6.1	4.7	4.8	8.4	9.8	9.7	9.8	5.1	4.1	4.2	4.2	4.3	4.3	4.3	2.5	0.7	0	0	X	172.3	341.8
December	0	1.1	2.6	3.3	1.3	0	4.5	4.3	4.3	5.0	5.0	1.1	0	3.1	5.5	0.8	1.2	1.8	0.3	0	0	1.2	2.1	1.1	0.8	1.6	0.9	6.5	9.5	7.0	8.9	84.8	168.2
																															ANNUAL TOTAL	9,780.3	19,399.2
1960																																	
January	1.0	1.1	0.1	2.5	0	1.5	1.3	0.5	0	0.1	0	0	0.1	1.1	0.1	0	0	0	0	0	1.1	0	0	0	0	2.9	3.3	2.2	2.2	2.4	0	23.5	46.6
February	0	0.4	1.4	8.5	8.2	4.4	0.9	3.2	0	0	0.3	0.5	4.0	13.1	16.7	15.5	9.3	18.0	4.0	1.6	2.6	3.2	0.3	0.3	0.3	0.7	3.3	2.2	3.5	X	X	126.4	250.7
March	3.9	4.3	3.0	2.0	1.6	2.3	3.1	6.3	14.0	13.1	9.2	5.1	2.7	5.1	15.8	13.4	14.2	17.4	19.2	27.2	42.2	56.3	55.5	53.3	55.7	65.0	64.5	71.8	63.8	66.3	60.3	837.6	1,661.4
April	83.5	75.5	69.0	93.4	88.8	84.1	88.7	77.1	58.9	39.4	29.9	37.1	34.8	30.2	32.2	25.5	22.8	34.2	36.1	36.0	31.8	38.1	39.8	38.2	42.6	45.2	35.3	31.1	29.9	24.1	X	1,433.3	2,843.0
May	17.4	35.1	34.9	35.2	30.8	32.9	31.1	17.4	17.7	18.4	23.3	25.0	32.6	31.4	19.0	30.2	48.3	56.1	68.2	62.8	47.3	45.7	49.9	50.2	63.1	56.2	56.8	61.3	37.5	23.8	22.6	1,182.2	2,344.9
June	20.5	33.7	38.9	23.9	21.6	26.3	24.0	26.8	27.5	30.6	31.7	15.7	19.6	19.3	21.1	21.0	25.8	32.1	34.5	35.6	42.6	49.6	56.9	43.8	50.9	45.2	38.5	55.0	47.6	45.8	X	1,006.1	1,995.6
July	37.3	28.3	20.9	23.1	29.9	18.6	13.4	13.4	13.4	13.4	14.3	18.7	18.0	23.6	32.3	30.1	26.0	29.5	28.0	29.5	33.9	48.8	49.3	32.4	41.2	62.9	72.7	70.8	70.4	63.5	50.4	1,058.0	2,098.5
August	58.1	66.2	58.8	65.5	66.9	61.4	49.7	68.6	69.7	48.2	58.7	37.5	40.5	24.2	41.3	44.3	44.7	41.9	44.5	42.5	27.2	50.4	55.7	61.9	62.5	43.9	42.5	36.8	43.5	40.4	37.8	1,535.8	3,046.3
September	41.5	44.2	40.8	37.6	51.4	52.0	48.4	47.7	54.3	36.3	14.2	33.3	40.8	33.5	32.0	24.5	19.2	10.6	26.6	33.0	31.7	23.9	9.6	4.7	1.8	3.2	6.0	4.7	6.8	5.0	X	819.3	1,625.1
October	6.6	10.1	23.7	21.0	27.3	22.8	10.6	17.7	4.7	2.2	6.2	8.1	4.0	4.3	2.1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	171.4	340.0
November	0	0	0	0	0	0	0	0	0	0	0.7	4.1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1.6	4.7	5.0	X	16.1	31.9
December	7.6	5.2	4.9	4.9	4.4	3.7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.7	0	0	0	0	31.4	62.3
																															ANNUAL TOTAL	8,241.1	16,346.3

Table 1.--Daily pumpage from Pecos River between the Acme and Artesia stream-gaging stations, in cubic feet per second [1/] - Continued

Month	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	Monthly Total cfs-days	Monthly Total ac-ft
1961																																	
January	0	0	0	0	0.6	0	0	0	0.3	0	0	0	0	0	0	0	0	1.0	0	0	0	0	0	0	0	0	0	0	0	0	0	1.9	3.8
February	0	0	0	0	0	0	0	0	0	0	0	0	0	0.3	0.1	0	0	0.1	0	0	3.1	6.7	7.4	7.2	7.3	8.3	9.4	9.7	X	X	X	59.6	118.2
March	9.7	5.9	11.0	11.6	10.9	8.1	5.1	8.8	12.8	10.8	6.3	5.3	18.4	22.3	37.5	42.5	44.1	37.3	19.1	38.7	49.1	56.6	59.5	46.0	49.8	33.0	48.8	48.0	54.5	52.3	47.5	911.3	1,807.6
April	47.5	26.6	33.0	41.9	44.0	47.3	41.2	42.4	36.4	50.7	50.1	49.6	45.5	45.8	30.4	22.3	27.0	32.5	39.8	48.3	29.8	26.5	23.7	42.4	40.8	55.7	53.0	55.5	39.0	32.4	X	1,201.1	2,382.4
May	34.1	43.3	43.4	48.9	40.3	33.8	34.3	42.4	31.9	32.1	22.3	22.8	28.3	18.6	31.8	31.0	27.3	39.5	43.8	39.6	31.4	36.4	42.4	47.0	43.7	43.8	39.8	29.2	37.7	47.4	45.5	1,133.8	2,248.9
June	42.0	37.4	38.6	40.1	45.0	50.5	59.3	67.8	69.8	45.7	27.8	52.6	57.3	49.0	24.8	27.4	23.4	19.5	30.5	31.1	37.6	44.8	56.0	44.8	28.0	37.7	48.6	55.9	53.0	45.1	X	1,291.1	2,560.9
July	41.7	39.2	46.0	30.8	43.5	51.7	48.6	35.9	26.6	35.2	36.9	26.5	19.8	43.5	49.4	44.5	65.9	70.4	77.4	70.2	67.5	52.1	44.6	51.3	42.4	38.1	39.3	49.9	45.0	43.3	49.6	1,426.8	2,830.1
August	60.4	68.9	72.0	65.2	58.9	57.1	58.2	65.1	53.7	55.1	52.8	60.7	48.0	46.8	45.3	32.9	40.7	34.1	31.6	25.4	26.8	44.9	48.5	58.3	59.0	46.8	42.8	63.4	52.9	47.8	45.0	1,569.1	3,112.3
September	45.4	48.6	43.3	46.2	41.0	28.0	20.6	27.2	25.5	20.9	23.4	18.6	17.1	19.2	20.9	20.7	26.6	39.6	45.3	47.5	30.7	26.5	22.8	14.2	20.0	15.9	13.6	13.3	8.3	8.6	X	799.5	1,585.8
October	5.7	10.3	3.9	4.3	8.4	8.3	8.8	7.9	5.8	14.9	18.9	17.1	13.9	14.4	6.2	10.9	14.0	6.8	4.3	2.8	4.6	3.4	3.7	2.3	2.8	7.6	6.8	0.8	0	6.1	4.6	230.3	456.8
November	4.5	11.4	15.8	18.7	15.4	10.0	14.7	9.1	3.4	5.7	1.1	0	0	0	0	0	0	0	0	0	0	0	0	0.6	0.3	1.2	0	0	0	0	X	111.9	222.0
December	0.9	0	0	0	0	0	0	0	0	0	0.8	0	0.5	0	0	0	0	0	0	0	0.5	0	0	0	0	0	0	0	0	0	0	2.7	5.4
																															ANNUAL TOTAL	8,739.1	17,334.2
1962																																	
January	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.9	0.9	1.8
February	1.8	1.2	2.2	3.5	4.6	8.5	8.2	10.5	9.8	5.1	2.4	5.0	3.1	0	5.1	6.8	6.7	6.8	3.0	6.4	4.8	7.3	7.6	12.4	10.8	13.0	5.3	13.3	X	X	X	175.2	347.5
March	12.8	5.4	1.4	2.0	9.7	17.4	13.8	13.1	10.7	0.7	20.5	47.5	43.9	35.8	34.4	48.6	38.3	28.2	54.4	53.6	63.8	57.8	54.6	50.4	36.0	64.8	76.8	66.0	79.3	80.5	72.8	1,195.0	2,370.3
April	53.6	47.7	46.2	39.8	42.2	30.4	23.5	21.6	43.1	41.1	28.1	28.1	27.8	23.2	17.9	25.1	21.6	28.6	34.1	28.4	28.0	19.5	26.0	29.7	24.8	23.1	26.5	21.7	14.9	19.5	X	885.8	1,757.0
May	23.3	23.2	13.9	15.9	14.0	9.7	19.0	18.0	31.3	29.4	23.1	19.5	13.7	25.7	21.3	24.3	22.7	25.8	23.6	11.7	19.3	22.9	18.9	18.2	20.7	14.4	9.3	14.5	48.2	60.3	63.9	719.7	1,427.5
June	58.8	44.9	30.1	59.1	51.8	35.3	30.9	28.3	23.2	5.9	17.0	37.6	36.0	34.7	26.9	40.0	38.4	48.0	49.6	49.9	48.9	36.5	26.7	16.0	27.1	21.0	26.2	29.2	32.9	28.4	X	1,039.3	2,061.5
July	29.5	34.9	28.0	12.6	12.4	16.2	23.3	15.1	32.4	52.6	58.6	40.0	43.3	29.7	15.8	32.2	33.3	15.1	24.5	22.1	23.8	17.6	22.6	32.0	22.6	26.9	28.0	36.7	10.6	18.4	22.3	833.1	1,652.5
August	17.4	10.3	13.7	21.2	24.9	30.2	34.4	38.6	47.7	42.9	34.3	24.5	37.5	28.5	25.0	24.9	21.3	19.6	20.0	20.5	17.2	17.9	16.0	20.3	20.0	13.8	18.4	18.3	15.0	48.7	92.1	835.1	1,656.4
September	95.7	33.3	36.8	43.3	31.5	18.5	23.6	36.1	29.1	37.8	35.9	47.7	43.0	40.3	32.3	29.4	32.9	37.8	25.4	22.3	22.1	15.8	4.8	11.3	3.9	9.4	17.7	11.9	3.1	0	X	832.7	1,651.7
October	7.4	9.1	6.0	6.0	3.9	2.8	1.3	0	1.8	1.9	2.3	3.7	3.2	0	6.4	8.4	0.9	2.1	2.2	2.6	1.4	2.3	2.3	2.3	1.9	2.4	0	0	0	0	0	84.6	167.8
November	7.4	13.7	12.1	12.5	11.2	10.4	12.2	14.0	13.6	9.7	6.1	4.0	0	0	0	0	0	0	0	0	0	0	1.1	2.6	1.7	2.3	2.8	1.1	0.2	0	X	138.7	275.1
December	0	0	0	0.7	0	0	0	0	0	0	0	0	0	0.9	0	0	0	0.4	3.1	3.6	1.0	0	0	0	0	0.8	0.8	0	1.4	2.3	4.2	19.2	38.1
																															ANNUAL TOTAL	6,759.3	13,407.2

Table 1.--Daily pumpage from Pecos River between the Acme and Artesia stream-gaging stations, in cubic feet per second [1/] - Continued

Month	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	Monthly Total cfs-days	Monthly Total ac-ft
1963																																	
January	2.4	1.6	3.0	3.0	1.6	0	2.7	2.8	2.4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1.1	0	1.3	0	0	0	0.1	22.0	43.6
February	1.4	0.6	0.4	2.3	5.1	5.1	4.6	4.8	5.6	5.8	0	0	0	0	1.4	0.5	0	3.8	5.7	5.9	5.4	6.4	7.9	7.4	7.9	15.5	14.2	13.0	X	X	X	130.7	259.2
March	16.4	20.2	21.3	18.6	18.9	19.3	19.0	19.6	12.6	7.9	37.5	57.1	55.8	58.2	54.5	52.1	37.1	42.7	54.2	73.0	81.9	86.2	80.3	64.8	79.2	75.0	69.9	65.0	61.5	58.0	40.2	1,458.0	2,891.9
April	60.1	64.1	43.8	39.9	33.1	27.8	24.6	33.3	26.6	29.9	28.5	35.9	26.6	11.7	20.6	21.5	21.9	33.5	35.0	29.5	16.4	22.4	26.8	27.3	29.5	13.3	11.0	16.6	34.6	22.3	X	868.1	1,721.9
May	13.1	17.1	19.7	14.4	8.7	15.0	19.4	22.6	25.1	28.0	18.7	14.3	26.4	26.5	27.6	28.0	23.9	25.6	18.5	21.3	21.9	24.5	35.1	33.4	24.7	13.8	22.1	24.8	17.4	31.4	43.0	706.0	1,400.4
June	18.0	18.6	29.1	27.3	34.8	36.3	33.1	21.5	24.5	32.6	47.3	52.4	29.7	19.7	14.0	11.1	13.4	20.6	22.3	16.7	30.0	41.2	35.8	32.5	48.0	57.5	55.8	46.3	45.0	41.0	X	956.1	1,896.4
July	40.9	38.3	27.2	14.5	23.4	19.3	18.0	25.1	26.0	28.7	29.8	24.7	21.5	35.5	51.6	64.7	64.4	56.7	48.1	54.1	36.0	71.4	68.1	67.7	58.9	59.2	51.6	28.9	47.3	49.1	66.3	1,317.0	2,612.3
August	91.7	81.8	59.0	31.3	56.7	61.3	60.7	61.8	65.3	55.8	47.7	60.7	64.9	32.5	29.7	44.4	43.0	37.8	49.7	44.1	49.4	46.2	41.8	37.6	35.1	49.9	47.7	44.5	40.4	26.2	43.0	1,541.7	3,058.0
September	24.3	25.9	33.6	28.3	21.6	22.3	22.7	26.2	46.0	48.3	40.2	38.9	39.6	36.2	26.0	34.3	33.1	35.0	35.4	32.6	14.8	4.9	13.7	14.2	14.4	11.8	16.2	15.4	17.0	19.4	X	792.3	1,571.5
October	21.2	11.3	11.1	9.4	11.9	7.6	8.7	7.0	5.1	6.5	4.4	5.7	2.7	5.7	6.9	7.5	9.3	7.4	5.3	6.0	7.1	12.0	15.5	12.1	12.5	18.2	9.8	7.1	3.8	7.9	6.5	273.2	541.9
November	4.4	3.0	1.8	0	0	0	2.9	6.3	7.7	0	7.2	2.0	3.7	3.2	5.3	5.8	0.9	1.3	0.9	4.0	2.0	3.7	1.8	0	0	1.4	1.1	0	0	1.3	X	71.7	142.2
December	0	1.7	1.8	0.7	1.3	2.1	1.5	0	0	0	0	0	0	0	0	2.1	1.3	0	0	0	0	0	0.7	0	0	0	0.3	0	0	0	2.3	15.8	31.3
																														ANNUAL TOTAL		8,152.6	16,170.6
1964																																	
January	0	0	0	0	0	3.7	6.7	5.4	2.8	0	1.0	0	0.9	0	0	2.1	4.5	6.2	3.8	2.6	4.9	4.9	3.4	4.7	6.4	5.8	11.0	6.2	7.4	11.9	9.1	115.4	228.9
February	6.9	6.4	2.6	0	2.5	4.5	6.8	8.0	8.1	10.3	8.8	9.3	6.9	6.7	8.5	5.0	7.0	7.4	4.8	4.6	3.4	0	0	3.3	4.9	2.5	0.3	6.2	6.9	X	X	152.6	302.7
March	7.6	10.1	13.0	13.6	19.8	24.3	15.0	6.9	13.8	26.0	20.2	20.3	20.9	17.5	17.8	19.3	16.9	7.8	12.7	9.8	8.2	2.8	9.3	12.9	12.4	9.0	9.5	11.5	13.1	26.3	32.5	460.8	914.0
April	29.9	28.9	36.0	20.2	16.4	31.4	21.4	22.4	34.1	78.4	84.5	85.1	94.4	98.9	98.1	78.0	75.7	60.2	41.8	53.2	48.3	55.6	52.7	54.7	48.9	40.6	21.7	18.4	15.6	23.0	X	1,468.5	2,912.8
May	18.3	11.8	10.0	23.7	26.8	25.0	25.2	14.2	11.6	6.6	6.2	14.2	19.5	13.3	11.8	7.7	0.3	10.1	9.7	6.8	7.8	9.3	9.2	11.0	13.2	13.7	11.9	12.3	13.5	7.4	8.2	390.3	774.2
June	15.2	14.5	15.5	12.8	14.6	5.7	5.4	13.6	13.3	13.0	12.6	11.0	9.8	9.5	15.4	20.0	21.9	7.4	4.1	4.2	2.9	5.2	6.8	10.9	14.9	13.1	8.4	4.1	6.3	7.0	X	319.1	632.9
July	29.9	87.5	97.0	83.6	65.2	78.3	79.6	76.4	72.9	70.5	57.5	51.9	72.1	69.4	49.7	38.7	34.5	34.4	17.1	24.6	21.8	31.1	14.3	11.1	8.5	8.2	16.1	7.5	5.6	5.5	7.4	1,327.9	2,633.9
August	7.2	5.6	6.0	9.4	4.9	5.4	4.6	6.1	3.1	4.6	6.2	23.8	20.9	18.9	11.2	4.8	4.4	4.1	4.1	5.9	4.7	2.2	2.4	2.9	3.9	4.0	3.8	4.4	3.8	3.3	7.6	204.2	405.0
September	6.8	3.9	4.0	4.1	2.6	2.9	3.6	3.1	3.2	3.0	4.6	2.1	4.5	3.8	4.6	3.2	5.2	6.7	3.8	6.2	5.6	5.8	10.8	46.5	33.6	9.8	13.3	32.0	33.7	28.0	X	301.0	597.0
October	12.2	14.2	5.5	2.6	11.2	10.2	14.9	8.7	6.7	3.6	7.2	7.1	7.3	6.4	7.0	8.2	9.0	6.0	10.1	8.9	12.7	12.5	7.2	9.2	7.1	9.2	10.4	11.9	4.9	5.8	8.3	266.2	528.0
November	2.7	6.9	7.6	3.0	9.5	13.3	13.8	3.0	9.5	13.4	16.7	20.0	15.6	10.6	12.8	14.8	12.3	16.2	24.3	13.0	5.4	5.9	4.6	2.5	1.7	1.8	0.5	1.6	1.8	4.9	X	269.7	534.9
December	11.3	12.7	13.0	3.6	0	0	3.7	2.3	7.4	6.7	1.0	1.7	1.4	2.2	4.9	4.1	2.0	2.5	0	4.3	13.9	14.5	7.3	0	0	0	0	0	0	0	0	120.5	239.0
																														ANNUAL TOTAL		5,396.2	10,703.3

Table 1.--Daily pumpage from Pecos River between the Acme and Artesia stream-gaging stations, in cubic feet per second [1/] - Continued

Month	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	Monthly Total cfs-days	Monthly Total ac-ft
1965																																	
January	0	0	0	0	0	0	0.3	0	0	0	0	0	0.4	0	0	0	0	0	0	0	0	0	0	0	1.6	0.3	0	0	0	1.7	1.6	5.9	11.7
February	1.7	1.7	1.6	2.7	1.1	0	0	0	0	2.7	0.8	0	2.5	5.7	6.7	8.6	3.0	4.0	5.2	9.9	9.6	10.1	9.8	5.4	8.7	9.2	8.3	2.2	X	X	X	121.2	240.4
March	8.1	10.5	8.2	7.5	3.0	5.1	4.9	6.3	9.7	10.0	8.0	5.5	1.3	1.3	6.6	5.9	3.9	7.9	38.8	55.4	55.8	77.1	90.4	93.6	80.5	87.1	85.4	69.5	73.7	74.5	75.8	1,071.3	2,124.9
April	74.7	74.7	61.9	49.7	37.4	39.2	37.7	28.4	17.4	10.1	8.6	10.4	8.8	6.2	13.7	21.6	21.1	15.2	18.6	18.2	17.8	22.6	22.3	14.1	9.7	13.8	18.2	16.6	16.8	13.9	X	739.4	1,466.6
May	14.5	10.9	19.2	21.4	20.0	16.6	15.9	10.6	4.2	11.6	5.8	2.6	8.6	4.6	35.9	44.4	54.1	47.1	34.8	22.4	16.6	13.2	10.0	17.7	23.3	43.4	50.4	48.2	26.6	13.3	16.3	684.2	1,357.1
June	16.2	22.4	16.3	16.4	14.7	11.6	18.3	16.2	10.2	14.3	16.3	26.1	34.3	45.2	34.5	20.5	17.1	13.6	7.8	1.9	19.4	30.7	46.2	48.2	60.5	51.9	40.9	65.6	68.4	72.1	X	877.8	1,741.1
July	65.9	58.5	44.5	32.0	17.1	27.8	40.2	46.5	32.6	48.7	53.5	72.4	63.4	61.7	51.9	47.6	17.2	11.1	25.1	28.4	17.0	15.0	12.7	10.2	9.3	9.6	8.3	12.1	8.0	11.8	9.5	969.6	1,923.2
August	13.2	27.1	35.3	23.4	15.2	12.7	22.3	33.9	38.8	31.6	38.9	36.0	34.5	21.9	12.6	19.3	17.5	18.4	16.6	15.0	14.2	14.8	33.0	36.7	46.7	46.1	48.6	37.5	16.3	16.3	11.3	805.7	1,598.1
September	14.2	26.1	31.1	20.0	19.8	26.0	39.5	39.0	32.0	30.4	20.9	12.6	28.4	41.5	35.2	24.6	2.5	9.6	4.4	20.6	27.6	22.4	25.2	23.3	22.8	10.9	9.9	7.4	10.1	10.7	X	648.7	1,286.7
October	8.0	5.4	4.7	5.0	0.6	0	0.3	4.8	5.0	4.7	4.7	4.7	4.7	1.7	2.0	2.3	0	2.8	0	2.6	2.0	1.1	1.0	0	0	1.4	2.7	4.4	6.1	8.1	6.8	97.6	193.6
November	8.4	8.4	6.8	6.7	4.9	5.5	5.2	8.9	12.4	11.1	9.4	9.5	4.7	0	2.6	0	0	2.9	2.6	1.5	0	0	0	0	0	0	0.7	0	0	0	X	112.2	222.5
December	0.4	0.2	0	0	0	0	2.8	0.9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1.8	0.7	0	0	0.2	7.0	13.9
																														ANNUAL TOTAL		6,140.6	12,179.8
1966																																	
January	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
February	0.3	0.6	1.3	1.0	0	0	0	1.4	1.4	0.6	0	0	0	0	0	0	1.1	1.6	1.7	0	0	0	0	0	0	0	0	3.2	X	X	X	14.2	28.2
March	7.8	6.4	1.7	3.7	4.8	4.2	3.4	8.4	8.6	7.3	6.1	5.1	4.0	9.8	42.8	59.3	71.1	73.9	66.2	60.2	68.9	71.8	66.1	69.0	72.0	69.8	87.4	88.8	97.0	85.2	87.4	1,318.2	2,614.6
April	81.4	60.2	42.8	33.3	28.1	35.7	33.6	21.1	12.3	10.4	21.8	17.3	15.0	16.8	14.7	15.2	11.8	12.1	10.8	10.1	8.3	9.3	10.5	6.2	3.5	12.6	21.5	15.2	17.2	15.2	X	624.0	1,237.7
May	3.7	9.9	11.8	9.2	7.1	7.1	11.2	11.0	8.2	6.8	7.8	12.6	12.7	12.5	5.8	6.5	14.4	19.8	16.9	20.6	17.1	12.6	18.7	13.0	15.0	17.5	22.5	20.4	18.7	23.3	29.5	423.9	840.8
June	29.5	24.7	24.4	12.8	12.1	35.3	36.2	21.8	18.2	15.2	7.4	12.1	11.8	8.1	9.7	9.6	14.8	10.3	27.7	53.6	53.8	58.7	41.9	39.8	45.3	38.6	47.5	55.3	34.5	37.3	X	848.0	1,682.0
July	30.8	16.7	25.7	23.2	34.8	36.3	42.3	49.0	56.6	53.3	52.6	40.0	53.3	39.8	22.0	25.3	20.3	23.4	19.5	25.1	21.3	14.2	13.0	9.7	11.0	6.4	5.6	7.2	33.7	24.2	30.4	866.7	1,719.1
August	28.3	17.5	41.8	83.7	71.8	55.4	41.1	43.1	44.3	46.0	39.9	24.3	23.6	12.0	27.4	31.8	30.3	42.7	37.6	34.5	20.9	14.4	6.2	5.6	5.0	4.6	4.2	4.0	5.8	5.1	4.3	857.2	1,700.3
September	4.7	0.9	2.7	3.5	9.1	10.9	8.6	10.0	17.1	18.7	10.4	26.4	20.1	17.4	23.9	29.8	21.2	19.3	19.6	18.6	24.2	17.4	23.8	26.5	28.9	36.6	37.9	34.9	34.6	18.7	X	576.4	1,143.3
October	4.1	3.4	9.6	14.6	10.7	12.9	7.3	10.0	9.0	6.4	8.5	13.0	14.5	10.4	2.8	0.2	3.4	7.2	6.5	6.7	11.6	14.8	17.1	14.9	14.6	11.2	9.2	12.0	10.0	10.1	10.5	297.2	589.5
November	3.6	2.2	2.4	2.9	2.8	0.8	3.4	4.8	3.1	3.0	3.0	3.7	2.6	5.4	6.8	2.8	2.6	2.6	1.0	1.0	3.3	3.6	8.1	8.0	7.2	9.5	13.2	10.9	11.3	16.3	X	151.9	301.3
December	18.4	19.5	15.4	16.2	14.1	12.1	6.7	10.3	8.2	6.3	6.3	5.2	6.2	9.8	9.5	8.2	7.6	2.9	20.5	21.5	11.6	5.0	3.0	3.9	5.0	4.2	7.9	7.0	9.7	7.5	3.9	293.6	582.4
																														ANNUAL TOTAL		6,271.3	12,439.2

Table 1.--Daily pumpage from Pecos River between the Acme and Artesia stream-gaging stations, in cubic feet per second [1/] - Continued

Month	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	Monthly Total cfs-days	Monthly Total ac-ft
1967																																	
January	2.7	2.9	7.1	9.8	9.4	6.5	4.2	3.7	3.6	3.7	3.8	4.1	4.4	4.2	4.3	4.3	4.2	4.6	5.0	4.9	5.1	5.1	6.0	11.8	11.0	8.5	7.0	5.7	5.8	5.7	5.4	174.5	346.1
February	5.0	4.1	2.3	2.1	1.7	2.4	2.3	4.1	5.2	6.3	3.8	0.9	4.3	4.4	4.3	3.3	3.2	6.5	6.8	3.8	1.8	1.5	2.2	2.2	2.0	0	1.1	5.8	X	X	X	93.4	185.3
March	8.9	9.9	9.8	6.6	6.4	6.8	12.2	7.5	9.6	3.4	4.4	5.7	9.2	13.6	16.0	21.1	28.3	20.8	18.0	27.3	30.3	30.2	26.7	31.3	20.0	12.7	28.8	27.2	24.9	25.8	23.7	527.1	1,045.5
April	19.1	20.9	21.0	17.2	13.9	9.1	16.7	17.2	6.7	8.0	7.7	12.8	12.8	14.1	14.3	7.1	15.0	19.5	14.0	11.1	12.6	7.7	9.6	15.7	11.9	9.1	8.5	8.8	9.1	2.9	X	374.1	742.0
May	6.1	8.4	55.0	77.4	71.5	71.1	53.1	56.9	59.6	66.4	62.3	67.5	42.1	26.4	39.0	40.2	43.9	56.3	65.1	58.9	44.4	48.9	56.9	52.6	21.4	33.3	29.0	19.6	34.5	30.0	32.5	1,430.3	2,837.0
June	46.1	37.7	39.8	20.3	24.6	10.3	19.9	34.2	25.2	15.4	14.3	20.5	27.4	22.1	17.7	10.1	12.9	4.9	25.1	30.3	38.2	29.6	24.7	20.1	14.0	29.0	29.2	22.6	20.9	7.5	X	694.6	1,377.7
July	10.2	17.7	25.8	25.6	40.2	41.6	46.0	43.3	36.0	55.9	57.6	49.1	34.1	38.3	28.1	19.8	39.2	36.8	27.6	17.6	14.2	9.6	10.5	9.6	9.1	10.2	8.2	9.9	12.2	10.8	8.7	803.5	1,593.7
August	11.5	10.1	9.9	8.6	9.8	60.5	98.8	110.7	81.3	20.5	34.5	30.7	22.7	36.3	46.6	38.2	38.8	45.1	32.9	28.1	52.0	67.1	65.5	42.2	30.7	30.6	28.8	50.0	43.1	31.9	23.5	1,241.0	2,461.5
September	27.1	15.2	8.7	13.1	14.1	16.0	18.2	15.1	7.7	7.6	22.2	25.0	20.2	15.3	11.6	11.4	4.6	10.4	13.3	15.7	26.8	23.6	18.9	14.0	16.5	13.5	18.8	14.8	6.2	3.6	X	449.2	891.0
October	2.6	8.7	14.0	13.3	13.7	14.0	8.5	6.6	5.0	3.3	5.0	6.9	9.2	5.4	8.4	7.5	6.2	5.4	5.6	8.2	7.9	2.5	2.7	4.1	4.8	5.8	3.6	3.0	0	2.4	0	194.3	385.4
November	0	0.6	1.4	1.4	4.4	3.5	4.1	2.4	0.9	1.4	2.6	0	1.8	5.4	5.5	6.0	8.6	8.3	2.8	9.6	5.1	4.7	4.9	4.3	2.4	2.3	8.6	4.8	0	0	X	107.8	213.8
December	0	0.7	0	0	5.0	8.1	11.2	15.3	5.3	0	8.4	7.1	7.3	3.2	0	0	0	0	0	3.0	3.1	4.7	3.2	0	0	2.2	4.4	3.6	2.7	1.8	0.9	101.2	200.7
																															ANNUAL TOTAL	6,191.0	12,279.7
1968																																	
January	2.4	0	0	0	0	0	0	0	0	0	0.2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2.6	5.2
February	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	X	X	0	0
March	1.2	6.2	8.1	14.8	6.7	8.1	13.6	15.6	16.1	16.5	1.0	1.8	8.4	14.2	17.0	16.0	5.2	13.4	35.7	16.7	23.9	27.9	41.6	48.2	70.7	75.0	80.8	86.3	87.9	78.4	52.8	909.8	1,804.6
April	60.0	65.5	72.3	77.0	72.0	56.3	38.0	42.3	43.7	52.3	37.4	32.6	21.8	9.9	20.0	17.5	10.9	16.2	19.3	18.0	19.1	27.3	29.7	24.7	10.4	10.9	8.8	4.6	16.7	16.8	X	952.0	1,888.3
May	15.6	14.9	7.3	5.6	1.8	7.1	5.2	10.6	13.6	16.4	5.9	0.1	10.8	8.5	7.4	18.8	24.8	19.3	21.8	27.4	25.2	16.3	12.8	12.0	14.5	12.9	22.3	24.9	19.0	15.1	14.2	432.1	857.1
June	13.0	9.7	10.3	7.7	8.2	6.8	6.4	4.1	5.4	5.5	7.9	8.5	9.5	10.2	6.1	5.4	28.4	90.7	85.8	89.7	74.3	59.3	58.2	64.8	65.8	83.3	83.7	71.8	57.8	51.2	X	1,089.5	2,161.0
July	58.7	22.7	19.1	15.1	2.4	2.8	0	0	0.4	0	1.8	6.0	0.3	10.6	7.7	11.0	22.4	22.0	12.2	8.1	10.5	23.5	34.3	31.9	30.3	34.6	37.8	29.0	48.9	39.3	37.0	580.4	1,151.2
August	37.6	40.0	35.9	27.7	31.0	36.2	31.3	33.3	32.9	28.1	23.3	28.9	31.1	33.4	39.5	33.0	34.1	26.7	35.0	34.4	25.5	24.6	23.1	17.2	11.4	13.8	23.2	31.4	31.5	7.4	8.8	871.3	1,728.2
September	14.7	20.0	21.8	16.5	26.6	39.8	26.3	13.8	29.4	32.2	32.0	33.1	28.2	20.0	14.4	19.0	20.9	19.5	16.0	19.2	16.5	6.7	19.4	23.2	20.4	20.3	19.3	14.2	9.4	18.9	X	631.7	1,253.0
October	16.7	9.3	13.3	16.4	5.8	4.2	10.1	7.3	5.7	4.5	4.0	1.8	0.1	0.1	2.4	4.9	7.7	11.6	12.4	4.8	12.0	7.5	9.5	11.0	9.5	7.4	0	8.2	15.8	12.9	15.9	252.8	501.4
November	18.5	15.5	10.4	19.6	18.7	13.3	12.6	2.3	0.4	0.4	3.0	3.1	5.5	2.9	4.2	4.6	2.3	4.7	5.0	0.3	1.9	1.8	0.3	0.3	0.3	0.3	0.3	0.2	0.2	0.2	X	153.1	303.7
December	0.2	0.2	0.2	0.2	0.3	0.4	0.4	0.5	0.5	0.4	0.5	0.4	2.0	2.1	0.4	3.7	0.6	0.2	0.4	0.4	0.1	0.1	2.0	1.1	0.3	0.6	0.4	1.4	1.7	1.7	1.5	24.9	49.4
																															ANNUAL TOTAL	5,900.2	11,703.1

Table 1.--Daily pumpage from Pecos River between the Acme and Artesia stream-gaging stations, in cubic feet per second [1/] - Continued

Month	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	Monthly Total cfs-days	Monthly Total ac-ft
1969																																	
January	1.1	1.3	1.2	2.5	1.8	0	0	2.2	3.8	4.1	0	0	0	0	0	0	1.7	1.8	0	1.3	1.9	0.2	1.0	0	1.1	0	3.3	3.6	0.7	1.5	2.3	38.4	76.2
February	0	0	3.6	6.1	4.3	4.1	3.9	3.9	0.8	6.3	6.0	11.8	7.1	7.0	6.9	5.9	1.7	0.9	0.8	0	2.3	4.3	3.5	2.3	0.9	4.9	1.4	2.2	X	X	X	102.9	204.1
March	2.9	0	4.2	1.3	0	6.2	6.9	5.3	4.8	5.6	1.8	7.2	10.9	9.7	0	0	25.4	61.3	71.4	78.2	80.9	76.0	74.4	57.5	78.8	83.6	87.4	84.1	74.3	61.6	59.9	1,121.6	2,224.7
April	67.1	66.7	60.0	56.8	34.9	17.7	48.6	56.8	50.0	42.4	38.9	26.3	16.3	9.6	18.1	32.4	33.5	15.0	5.6	1.6	16.0	16.5	17.4	27.2	28.3	23.4	12.0	17.9	18.7	20.5	X	896.2	1,777.6
May	17.4	10.3	8.8	4.0	7.3	11.8	10.5	15.2	18.8	25.2	18.4	20.0	22.7	15.9	13.9	11.4	11.9	5.7	18.8	21.6	16.8	19.1	19.8	17.8	6.2	13.6	21.7	18.0	16.2	20.1	13.6	472.5	937.2
June	11.1	17.1	22.0	25.2	25.1	23.8	21.6	22.2	36.2	52.0	54.9	74.9	65.1	45.6	34.5	47.9	45.2	47.2	52.9	60.1	58.9	51.6	68.0	49.7	57.4	37.8	47.5	34.0	33.3	47.4	X	1,270.2	2,519.4
July	44.2	52.2	50.9	40.5	44.8	36.7	49.4	42.2	43.2	38.2	34.6	29.5	28.3	56.1	40.0	34.8	46.5	46.5	48.4	34.0	34.6	39.3	44.0	48.2	30.9	26.1	21.9	22.4	28.8	24.3	28.2	1,189.7	2,359.8
August	22.3	16.8	15.8	21.1	16.6	32.3	48.3	41.8	38.7	47.7	55.1	48.2	56.8	56.9	52.4	41.2	23.1	42.8	50.2	45.5	37.2	48.6	42.6	36.4	47.2	42.3	40.8	35.3	29.2	18.2	5.3	1,156.7	2,294.3
September	8.4	8.3	7.1	5.2	12.6	14.9	3.7	8.0	11.6	9.1	10.4	8.6	5.6	2.2	6.3	11.1	20.1	25.6	12.4	12.0	12.9	15.9	10.0	22.2	22.3	19.2	11.8	11.7	12.1	20.6	X	361.9	717.8
October	21.4	19.4	18.5	9.4	8.6	10.7	16.4	19.3	17.6	18.7	17.6	11.2	15.6	22.0	16.3	10.4	14.9	11.2	1.2	11.9	2.2	0	0	0	0	0	0	0	0.4	12.8	12.2	319.9	634.5
November	6.4	0	0	0	0	0	0	0	0	1.6	0	0	0	0	0	0	0	0.9	0.8	0	0	0	0	0	0	0	0	0	0	0	X	9.7	19.2
December	0	0	0	0	0	0	0	0	0.2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.2	0.4
																															ANNUAL TOTAL	6,939.9	13,765.2
1970																																	
January	0	0	0	0	0	0	0	0	0	0	0	0.2	0	0	0	0	1.9	5.7	1.4	0	0	0	0	0	0	0	0	0	0	0	0	9.2	18.2
February	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.7	2.9	1.8	13.6	8.8	3.6	6.9	13.0	17.1	16.0	12.2	9.6	9.3	X	X	X	115.5	229.1
March	1.5	2.0	3.8	6.1	6.5	1.7	3.2	8.0	12.4	13.8	13.8	17.6	20.0	24.6	24.1	34.4	35.5	38.8	36.5	26.8	29.5	26.9	45.4	48.0	40.6	41.6	32.3	19.7	6.3	32.5	37.4	691.3	1,371.2
April	40.2	39.1	33.3	23.2	29.2	33.7	31.5	27.0	26.5	25.3	14.9	10.1	8.8	13.0	19.2	16.3	14.2	10.7	8.3	28.1	57.5	65.8	71.7	60.3	52.4	29.9	45.5	47.5	48.0	40.1	X	971.3	1,926.6
May	29.0	26.9	26.6	15.3	5.0	0.6	0	9.4	15.1	13.1	17.1	19.8	15.7	17.1	13.6	14.6	10.3	17.0	16.2	17.5	19.0	19.7	12.2	2.6	27.2	51.5	35.1	38.7	43.5	41.5	37.5	628.4	1,246.4
June	49.3	67.3	56.9	46.5	52.6	41.9	39.9	43.6	41.0	41.8	43.6	44.3	45.6	48.5	59.5	61.3	65.7	60.3	59.6	40.5	22.9	35.7	37.8	41.3	41.7	33.9	20.6	9.9	23.7	24.1	X	1,301.3	2,581.1
July	31.1	34.7	39.3	31.3	35.4	38.4	42.6	30.5	26.1	20.2	14.4	11.8	12.2	12.2	13.7	13.8	12.7	27.8	17.4	17.3	35.5	61.8	67.6	43.5	29.5	20.3	52.4	54.4	51.7	69.1	61.6	1,030.3	2,043.6
August	54.4	54.4	64.0	55.7	40.6	44.1	48.9	39.1	41.0	57.7	57.4	57.3	56.5	53.4	46.4	40.5	43.2	63.7	65.6	67.6	55.6	47.4	33.1	39.4	32.7	33.5	46.2	47.3	38.7	29.6	34.2	1,489.2	2,953.8
September	35.1	37.4	33.6	29.4	24.2	17.1	20.8	24.8	17.1	13.7	16.0	11.6	9.3	15.9	12.5	3.4	15.2	24.6	22.5	15.9	22.7	28.1	24.3	34.8	33.0	34.2	27.1	25.2	13.9	10.6	X	654.0	1,297.2
October	11.8	8.6	0.6	0.6	2.3	3.7	3.3	0.4	0.4	0.4	0.4	2.4	2.5	4.1	0.4	0.5	0.5	2.1	5.6	5.1	5.7	6.2	5.0	3.3	0.4	2.4	4.1	11.1	14.0	13.4	11.2	132.5	262.8
November	7.8	5.1	4.9	7.1	10.0	7.7	7.9	6.1	15.7	19.3	20.6	24.9	19.8	16.8	10.2	11.5	15.9	12.1	13.2	7.5	3.8	3.7	6.3	8.0	2.6	0	2.7	4.0	1.6	2.5	X	279.3	554.0
December	3.7	1.7	1.5	1.5	1.6	0	0	0.7	2.2	3.9	4.1	2.6	0.1	0.8	0.1	1.4	2.3	2.8	2.7	2.6	7.6	3.8	2.9	1.2	1.0	1.7	0.5	7.2	12.7	9.5	8.3	92.7	183.9
																															ANNUAL TOTAL	7,395.0	14,667.9

Table 1.--Daily pumpage from Pecos River between the Acme and Artesia stream-gaging stations, in cubic feet per second [1/] - Concluded

Month	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	Monthly Total cfs-days	Monthly Total ac-ft
1971																																	
January	7.8	1.7	0	0	0	1.2	0	0	3.0	4.2	1.3	0	1.2	1.9	2.1	2.1	0	1.2	0	0.3	1.7	1.8	0.5	0	2.2	4.1	2.8	2.2	3.0	4.6	1.9	52.8	104.7
February	10.5	14.8	12.4	12.9	7.9	8.3	5.5	5.5	14.8	13.2	12.5	12.7	10.4	4.3	5.1	12.2	13.7	13.6	14.0	18.0	10.4	5.6	16.5	23.3	26.7	25.2	24.4	15.6	X	X	X	370.0	733.9
March	20.2	9.7	12.5	15.7	20.4	16.1	9.3	13.8	13.8	10.3	10.8	14.0	16.4	7.7	21.9	23.5	20.5	22.2	13.9	20.3	18.2	19.7	32.1	29.0	28.8	30.7	36.5	26.4	31.3	29.1	26.0	620.8	1,231.4
April	22.4	22.4	15.0	7.8	27.1	20.1	24.8	17.3	14.8	3.4	0.6	4.5	45.8	77.0	79.6	72.8	69.0	57.9	72.0	75.8	77.4	66.3	56.0	50.8	46.6	69.4	76.0	72.2	59.9	58.2	X	1,362.9	2,703.3
May	43.6	45.3	45.3	51.1	52.0	48.1	42.0	23.4	18.7	36.6	37.5	51.5	55.8	68.8	66.1	59.5	80.6	67.8	45.8	50.8	56.7	50.4	50.5	64.6	69.7	64.4	57.1	37.4	34.2	34.9	38.6	1,548.8	3,072.0
June	34.3	35.6	31.6	25.2	22.9	20.5	26.1	19.4	18.8	14.5	10.0	7.4	4.1	13.1	8.1	13.7	12.1	12.1	9.3	9.0	8.8	50.1	77.6	42.9	17.8	9.4	8.2	7.6	9.0	7.8	X	587.0	1,164.3
July	8.6	6.0	3.4	3.1	4.6	9.2	7.0	7.7	6.2	7.4	11.3	6.2	1.5	2.4	2.8	2.7	3.9	5.2	6.9	7.5	4.2	4.1	6.7	4.0	3.9	7.2	13.6	8.6	6.6	16.7	35.3	224.5	445.3
August	47.6	79.2	89.2	76.1	63.4	28.9	16.5	3.0	14.6	34.1	34.2	30.8	29.9	30.7	24.0	18.3	5.8	11.7	11.8	13.6	19.8	25.6	43.9	50.4	44.3	40.3	26.8	28.7	24.4	38.8	41.2	1,047.6	2,077.9
September	46.1	35.2	13.8	18.3	18.7	28.8	42.0	37.8	39.9	37.6	33.6	25.8	25.6	25.7	27.6	30.8	22.7	13.0	8.9	13.7	31.7	24.4	0	2.5	3.8	5.7	14.0	21.3	16.9	14.4	X	680.3	1,349.4
October	8.0	8.3	16.1	17.8	20.9	15.5	17.1	15.5	12.4	1.9	3.9	7.0	10.5	0.6	2.9	3.3	0	3.4	2.8	5.3	2.9	0	2.9	4.7	4.6	5.9	4.6	1.4	0	0	2.4	202.6	401.9
November	6.0	5.6	8.1	10.5	13.6	14.6	13.5	14.7	14.7	4.9	3.6	10.3	12.3	11.7	8.4	6.0	6.5	5.5	4.9	4.8	4.6	4.9	4.8	5.0	4.9	4.9	4.7	3.9	3.9	3.9	X	225.7	447.7
December	3.9	1.1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5.0	9.9
																															ANNUAL TOTAL	6,928.0	13,741.7

[1/] Pumpage figures are from individual river pumper records collected by the Watermaster of the New Mexico Pecos Valley Surface Water District. These figures are the total amount of water pumped from the Pecos River and lower reaches of the tributaries of Rio Hondo below the Hagerman Canal, Zuber Draw, Rio Felix, and Cottonwood Creek. Drain flow to the river is considered to be ground water and part of the Pecos River base flow.

Annual pumpage from the Pecos River, Cottonwood Creek, Rio Felix, Zuber Draw, and the Rio Hondo below the Hagerman Canal has ranged from a high of about 19,400 acre-feet in 1959 to a low of 10,700 acre-feet in 1964 during the 15-year period, 1957-71. The average annual pumpage for 1957-71 is about 14,400 acre-feet (table 1). Ground-water pumpage from the Roswell basin is considerably more than the surface-water pumpage. The Office of the New Mexico State Engineer determined that 391,200 acre-feet of ground water was pumped in 1971 from the basin (written commun., G. W. Brim and F. H. Henninghausen, 2-25-72).

Evaporation

Mower and others (1964, p. 52) estimated that the average evaporation from the surfaces of lakes, ponds, streams, and wet sandbars, which totaled 2,250 acres in the Acme-Artesia reach, was 13,000 acre-feet per year for 1956, 1957, and 1958. About one-half of the area, 1,140 acres, consisted of streams and wet sandbars. Therefore, one might assume that the evaporation from these surfaces was about 6,500 acre-feet per year. The base-flow estimates for the Acme-Artesia reach shown in table 2 do not include the amount of base flow that was evaporated from the river in the reach.

Base flow

Method of calculation

The base-flow accretion to the Pecos River in the Acme-Artesia reach was determined by a graphical method. Mean-daily discharge records from the Acme and Artesia stations were plotted on the same graph (in cubic feet per second) for each of the 15 years from 1957-71. The daily pumpage from the river and the pertinent tributaries (table 1) was then added to the Artesia station hydrographs. Next, lines separating base flow from high flow were drawn for both the Acme and Artesia station hydrographs (fig. 3), and the areas between the lines were planimetered for each month. Table 2 is a tabulation of the monthly and annual base-flow accretion (in acre-feet) along the Acme-Artesia reach as determined by this method.

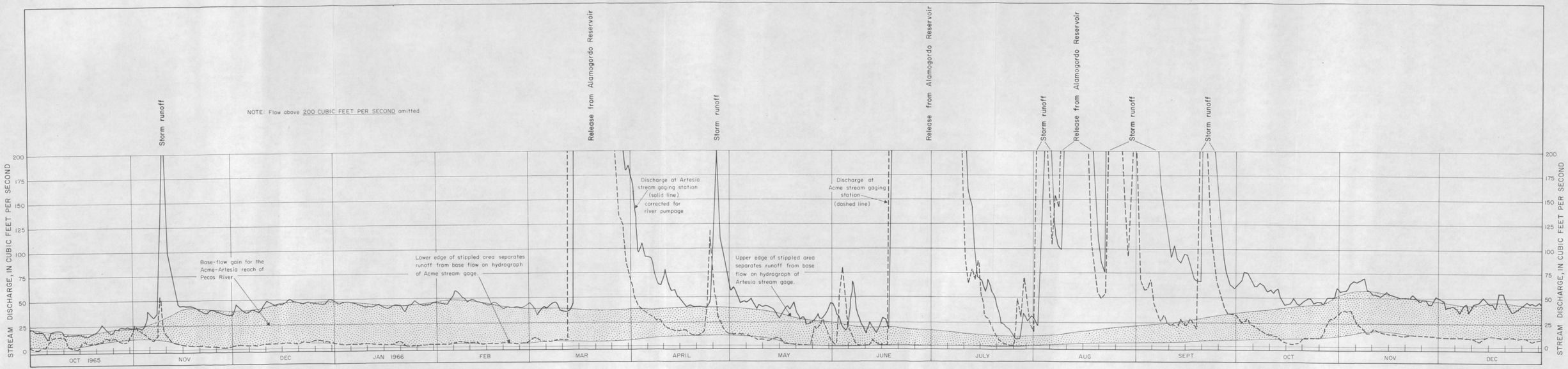

Figure 3.-- Method of separating base flow on the steamflow hydrographs of the Acme and Artesia stream-gaging stations.

Table 2.--Base-flow gain in the Acme-Artesia reach of the Pecos River, 1957-71, in acre-feet

Year	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Annual
1957	3,740	2,980	3,120	3,300	3,010	2,010	1,360	1,540	1,410	1,830	3,560	3,970	31,830
58	3,860	3,430	3,490	3,060	2,700	1,890	1,700	1,740	2,740	3,940	4,320	3,770	36,640
59	3,270	2,950	3,980	3,130	2,740	2,240	1,880	1,340	790	1,330	2,310	3,000	28,960
60	4,150	3,440	2,850	2,280	1,980	1,700	1,720	1,610	1,740	2,980	4,060	5,470	33,980
61	5,490	3,790	4,200	3,430	1,750	1,990	1,970	1,600	1,390	1,460	2,730	3,670	33,470
1962	3,330	2,920	2,260	2,080	1,870	1,380	1,290	1,080	1,200	2,800	3,130	3,070	26,410
63	3,220	2,860	2,820	2,000	1,930	1,230	930	910	960	1,150	2,150	2,620	22,780
64	2,420	2,390	2,240	1,420	1,150	760	520	280	270	550	1,190	2,060	15,250
65	2,030	1,700	1,640	1,270	1,150	920	750	910	1,060	780	1,700	2,420	16,330
66	2,540	2,240	1,980	1,770	1,660	1,090	670	880	1,390	1,940	2,340	2,090	20,590
1967	2,620	2,280	1,920	1,240	1,040	1,070	810	670	850	780	1,340	2,000	16,620
68	2,540	2,640	2,210	1,460	1,190	810	950	1,130	1,010	950	1,730	2,310	18,930
69	2,340	1,850	1,910	1,800	1,720	1,300	880	780	1,130	1,640	2,240	3,120	20,710
70	3,150	2,120	1,950	1,340	1,030	1,040	1,120	1,060	1,090	1,610	1,670	2,030	19,210
71	2,280	1,830	1,660	910	880	750	390	660	1,060	1,360	2,040	2,250	16,070

The method used does not employ a time-lag correction between the Acme and Artesia stations, which varies from 1 to 5 days depending on the volume and shape of a high-water pulse. Lag corrections are not applied as it is unlikely that such corrections would be significant for a month of base-flow data. Generally the base flow is not greatly affected by high water unless the river overflows its banks. The position of the base-flow separation lines before, during, and after the release from Alamogordo Reservoir in March and April 1966 would not be significantly different if the hydrographs for the Artesia station were corrected for the time lag (fig. 3).

Separation of storm runoff from the tributaries to the Pecos River between the Acme and Artesia stations is allowed for to a large extent by the method used. Storm peaks such as the one at the Artesia station in November 1965 (fig. 3), which obviously is due in part to tributary inflow below the Acme station, are easily separated from the base-flow component of the hydrograph.

High flows of several weeks' duration present a problem to base-flow separation. The complexity of flow in the Acme-Artesia reach, which is caused by variations in permeability of the "shallow" aquifer of the Roswell basin and the probable connection of the river with the "principal artesian" aquifer, prevents theoretical definition of the relation of ground-water movement and bank storage to high-flow events. For this reason, the base-flow separation line was drawn relatively straight through a high-water event, rather than asymmetrically to show a reduction in base flow at the first part of the flow and an increase in base flow at the latter part (Cooper and Rorabaugh, 1963, p. 361). The base-flow lines drawn through the high flows of August and September 1966 are straight lines connecting low flows in July and October (fig. 3) that represent base-flow conditions. This is an exceptionally long period in which several high flows are so closely spaced that normal base flow does not occur between the high-flows. In most cases the periods of normal base flow are not so widely separated.

Fluctuation

The base flow of the Acme-Artesia reach, which normally is low in late summer and early fall, increases substantially within a 4-week period almost every October or November. Hydrographs for 13 of the 15 years of stream discharge studied show this characteristic. During the other 2 years, 1966 and 1970, either storm runoff obscures the increase, or base flow is sustained through late summer and early fall by recharge from summer storms. Figure 3 shows the base-flow increase in November 1965, which is typical. (The small amount of storm runoff about November 10, 1965, has little effect on the general increase in base flow.) This relatively consistent increase in base flow each fall is caused by the cessation of evapotranspiration as the phreatophytes become dormant and daily temperatures lower, and by the reduction in pumping of wells in the Roswell basin. The base flow at the Artesia station increases more than the base flow at the Acme station (fig. 3) because the reach from Fort Sumner to the Acme station is little affected by ground-water pumpage.

The winter base flow remains about the same or increases slightly until March, when the well pumps are turned on, and April when temperature rises and transpiration begins. From April until September the base flow declines at various rates that are controlled by ground-water pumpage, runoff, recharge, evapotranspiration, and to a lesser extent by seepage from releases that is slow to return to the stream.

Certain types of storms can increase base flow by recharging the "artesian" aquifer along tributaries miles from the river, and by seepage to the "shallow" aquifer in distant parts of the flood plain when the river overflows its banks. Although precipitation was below average in 1954, runoff from a single storm in October of that year recharged the system sufficiently to sustain a high base flow for many months.

The monthly and annual base-flow accretion in the Acme-Artesia reach for 1957-71 is shown graphically on figure 4. Annual base flow for 1957-63 is probably the continuation of a long period of general decline that began in 1942. Estimates of base flow from Tipton and Kalmbach (unpub. eng. rept., Sept. 1958) for 1942-57 indicate this to be the case. From 1964 through 1971 the base flow was fairly stable (fig. 4). During 1957-63 and 1964-71 annual base flow averaged 30,600 and 17,950 acre-feet, respectively. Average annual base flow for the entire 15-year period was 23,850 acre-feet.

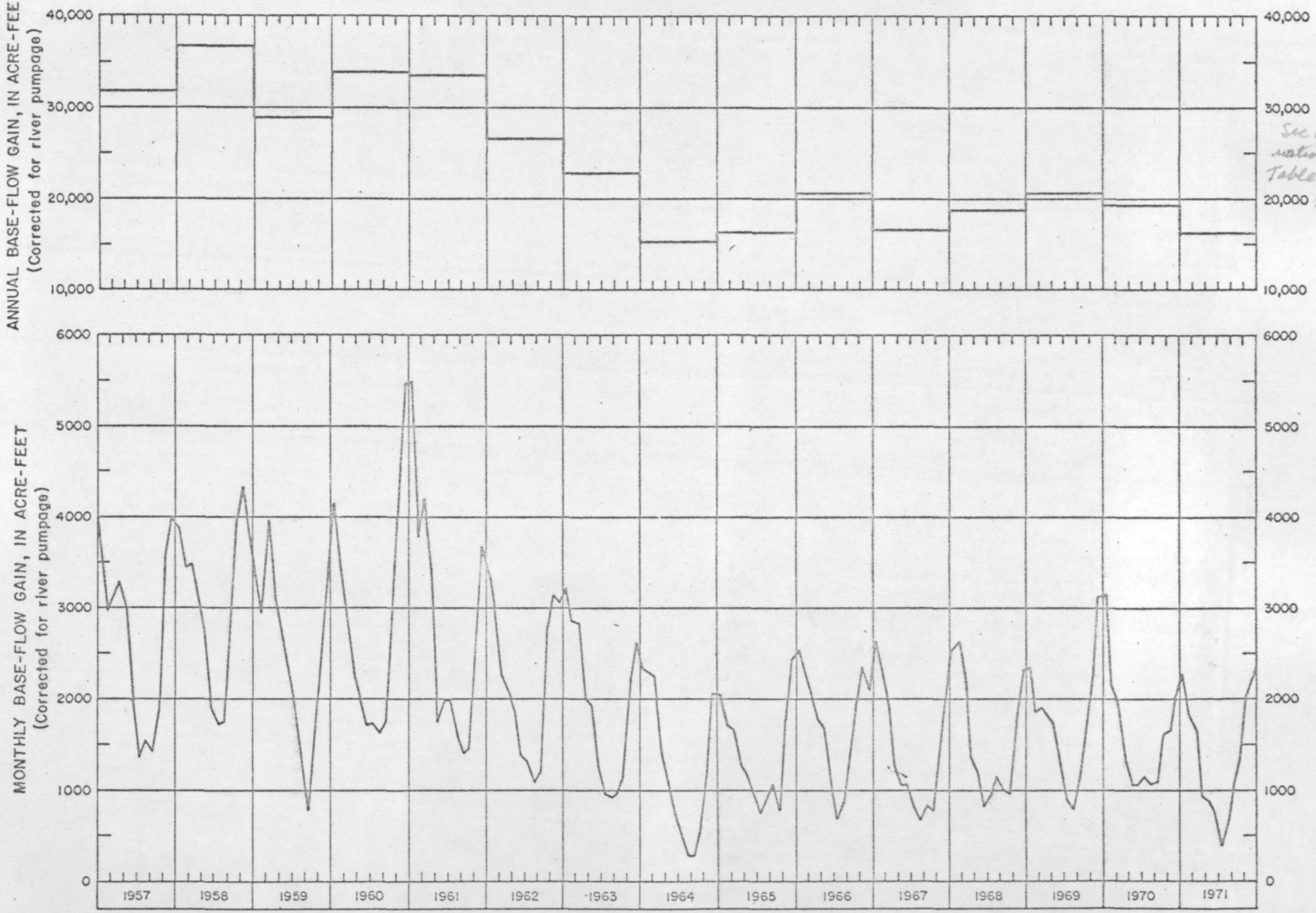

Figure 4.--Monthly and annual base-flow gain in the Acme-Artesia reach of the Pecos River, 1957-71.

Conclusions

The number of daily records of water pumped from the Acme-Artesia reach of the Pecos River and the main tributaries of the reach have gradually increased since 1957 and are more amenable for use on a daily basis than are the older records. The procedure of estimating the base-flow contribution to the reach by correcting for daily river pumpage prior to graphical separation of runoff is warranted when accurate river pumpage data are available. The accuracy of the method, however, can be improved if base flow during the runoff and release events could be better defined for a stream that is connected with both artesian and water-table aquifers.

The base-flow contribution to the Acme-Artesia reach decreased irregularly from 1957 to 1964 but was fairly stable from 1964 through 1971. The annual base flow from 1957 through 1971 averaged 23,850 acre-feet and ranged from a high of 36,640 acre-feet in 1958 to a low of 15,250 acre-feet in 1964. During 1957-63 and 1964-71 annual base flow averaged 30,600 and 17,950 acre-feet, respectively.

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Base flow in the Acme-Artesia reach of the Pecos River,

New Mexico, 1957-71

Figure 2.--Map showing points of surface-water diversion, area of former phreatophyte growth, and principal tributaries to the Acme-Artesia reach of the Pecos River.