OPERATIONS ON THE UPPER RIO GRANDE

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Introduction/Background

U.S. Bureau of Reclamation operations on the Upper Rio Grande in 1985 and 1986 have been very challenging and stimulating. This has resulted from an abundant water supply and new requirements coming into play. Each of these years featured far above normal runoffs and water supplies. Further, they have followed a sequence of almost unprecedented years of abundant water supply. Beginning in 1979, with the exception of 1981, each year has furnished an above-normal water supply.

Authorizations

Three projects are managed by the reclamation's Albuquerque office. These are the Middle Rio Grande Project, the San Juan-Chama Project, the Platoro Dam, and part of the San Luis Valley Project. The Middle Rio Grande Project was authorized by Congress through the Flood Control Acts of 1950 and 1960.

El Vado Dam and Reservoir, a feature of the Middle Rio Grande Project, was built by the Middle Rio Grande Conservancy District in the middle 1930s. Recently, it

celebrated its 50th birthday, and was recognized by the American Society of Civil Engineers as a civil engineering landmark because of the unique characteristics of its construction, which featured a large amount of steel face plate on the upstream face of the dam and in the spillway chute.

Other features of the Middle Rio Grande Project include the three diversion dams at Angustora, Isleta, and San Acacia. At these three locations, and also at Cochiti Dam, water is diverted from the main stem of the Rio Grande into the conveyance and distribution system of the Middle Rio Grande Conservancy District. The Middle Rio Grande Project is a partnership arrangement between the U.S. Bureau of Reclamation, the U.S. Army Corps of Engineers, and the Middle Rio Grande Conservancy District. The U.S. Bureau of Reclamation at Albuquerque has retained operation and maintenance responsibility for the river channel between Velarde, New Mexico, in the north, and the headwaters of Caballo Reservoir in the south, excluding Elephant Butte Reservoir. Also, water salvage projects of up to about $1 million each year are executed by reclamation for the New Mexico Interstate Stream Commission. This maintenance responsibility and work of reclamation in the channel will be the subject of most of this paper.

The San Juan-Chama Project diverts water from three

locations in southern Colorado. The water flows through some 26 miles of tunnel, passes under the Continental Divide and discharges at Azotea Creek. The water then flows downstream into Heron Dam and Reservoir, which has a capacity of about 400,000 acre-feet. Here the water is stored for release for use by contractors downstream in the state of New Mexico.

The authorization for the San Juan-Chama Project requires very close accounting of this transbasin water, which is brought into the Rio Grande system. As a result, the reclamation office in Albuquerque does most of the water accounting for the Upper Rio Grande. The San Juan-Chama Project was authorized with the Navajo Indian irrigation project in June of 1962.

A participating project within the San Juan-Chama Project is Nambe Falls Dam. This is located approximately 30 miles north of Santa Fe. This facility provides supplemental irrigation water to the Pojoaque Valley Irrigation District, which serves non-Indian lands and the pueblos of Nambe, Pojoaque, and San Ildefonso.

Platoro Dam was authorized as part of the San Luis Valley project under Secretary of the Interior authorization pursuant to the Reclamation Act of 1939 with a reauthorization in 1949. Platoro is located at approximately 10,000 feet elevation, about 35 miles

southwest of Alamosa, Colorado. While this 60,000 acre-foot reservoir is not large in comparison with other features in the system, it has been the subject of many interesting discussions, particularly relating to the storage of water for flood control and the release of water as a result of the Rio Grande Compact requirements.

Dry Period, 1950 - 1978

Next, let us examine what has transpired over the period of historical record on the Rio Grande system. Two gaging stations, the Otowi gage to the north and the San Marcial gage to the south, are very important because of the delivery requirements contained in the Rio Grande Compact. Figure 1 is entitled "Rio Grande at Otowi Recorded Flow" and shows the annual discharge at that location. The wide range of annual discharge is further emphasized by the lack of lengthy unbroken periods of below or above average discharge. With few exceptions, one or two high or low years have been followed by opposing low or high years. Thus, the sawtooth pattern results which appears to have a strong random component. The recorded flow data at the Otowi station on the Rio Grande can be compiled into a ten-year moving average as shown on figure 2, entitled similarly to the previous with "Ten Year Moving Average." This figure demonstrates quite vividly the abundance of water before 1950, the dry period, beginning in 1950 and extending nearly for three decades.

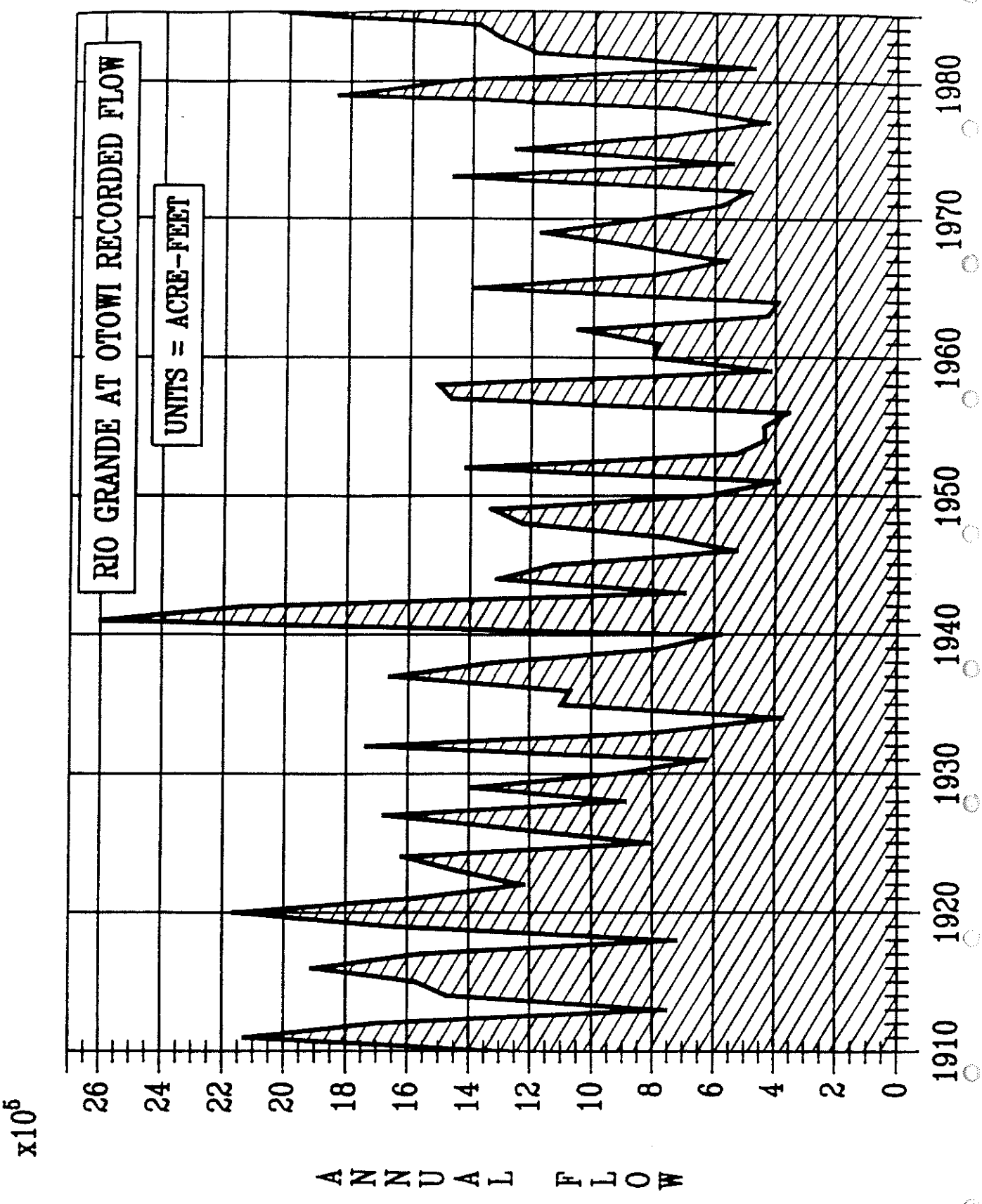

Figure 1. Rio Grande at Otowi. Recorded flow.

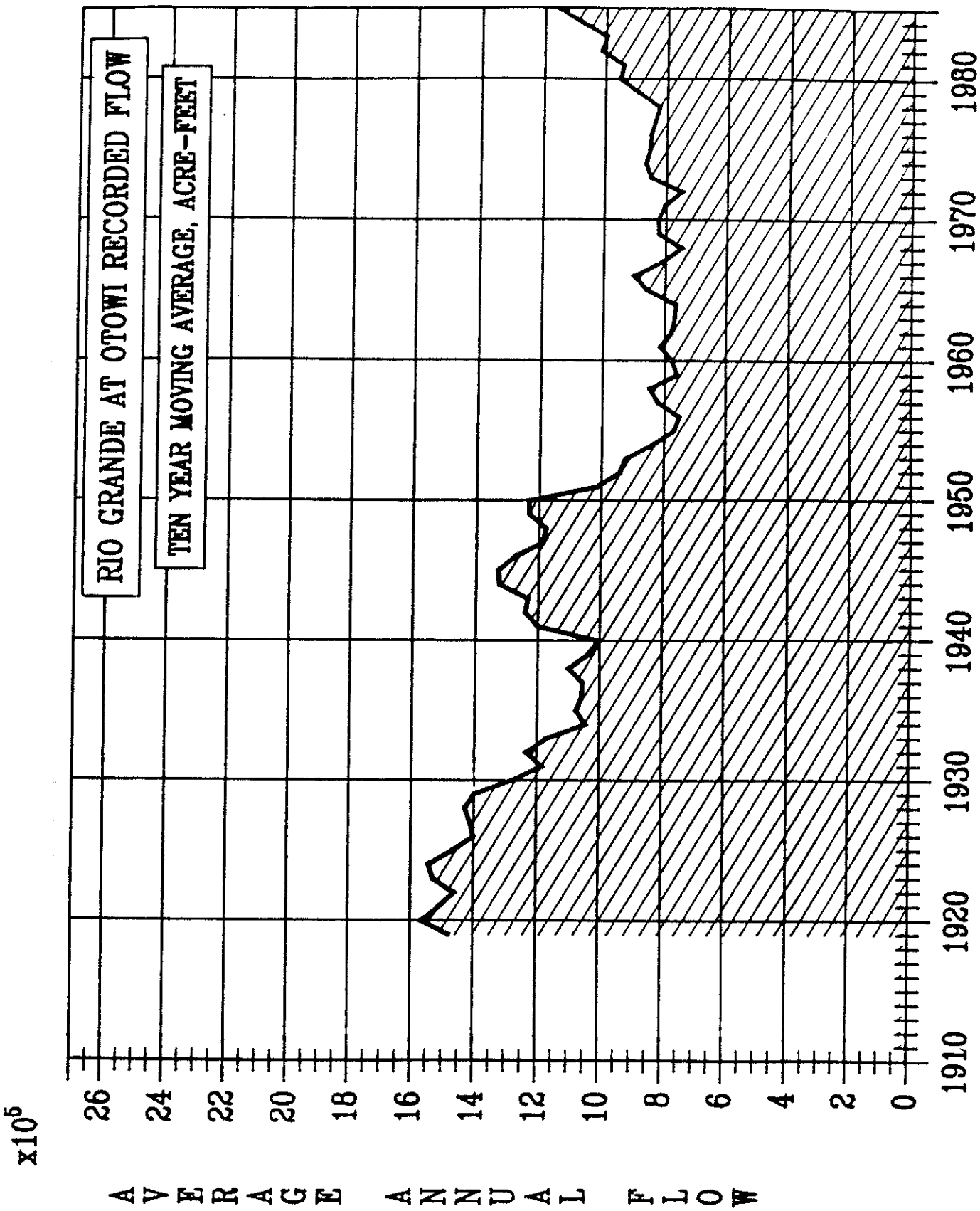

Figure 2. Rio Grande at Otowi. Recorded flow. Ten-year moving average.

A comparison of both annual and ten-year moving average data at San Marcial as shown on figure 3 shows a similar conclusion at that location. The San Marcial gage is just upstream of Elephant Butte Reservoir and reflects depletions of the Middle Rio Grande Valley not shown on the Otowi figure.

Wet Period, 1979 to Present

Further study of these hydrographs shows a reversal of the dry period of the 1950s, '60s, and '70s beginning in 1978. Good runoff was reported in 1979 and 1980 but 1981 was a very low year. Since then, however, an unbroken string of wet years have followed. You can conclude that we are in a wet period but that we are overdue for a low runoff year.

CRITICAL PROBLEMS IDENTIFIED

River Maintenance Responsibility

Several critical problems were identified during this wet period. Before the filling of Elephant Butte Reservoir, a severe channel restriction problem was recognized downstream of Elephant Butte through the city of Truth or Consequences, New Mexico. This reach of the river had an authorized capacity of 5,000 cfs. However, as a result of arroyo inflows, sediment plugs, and other factors, only a little more than 2,000 cfs could pass through this reach. So it became imperative that this reach be restored and

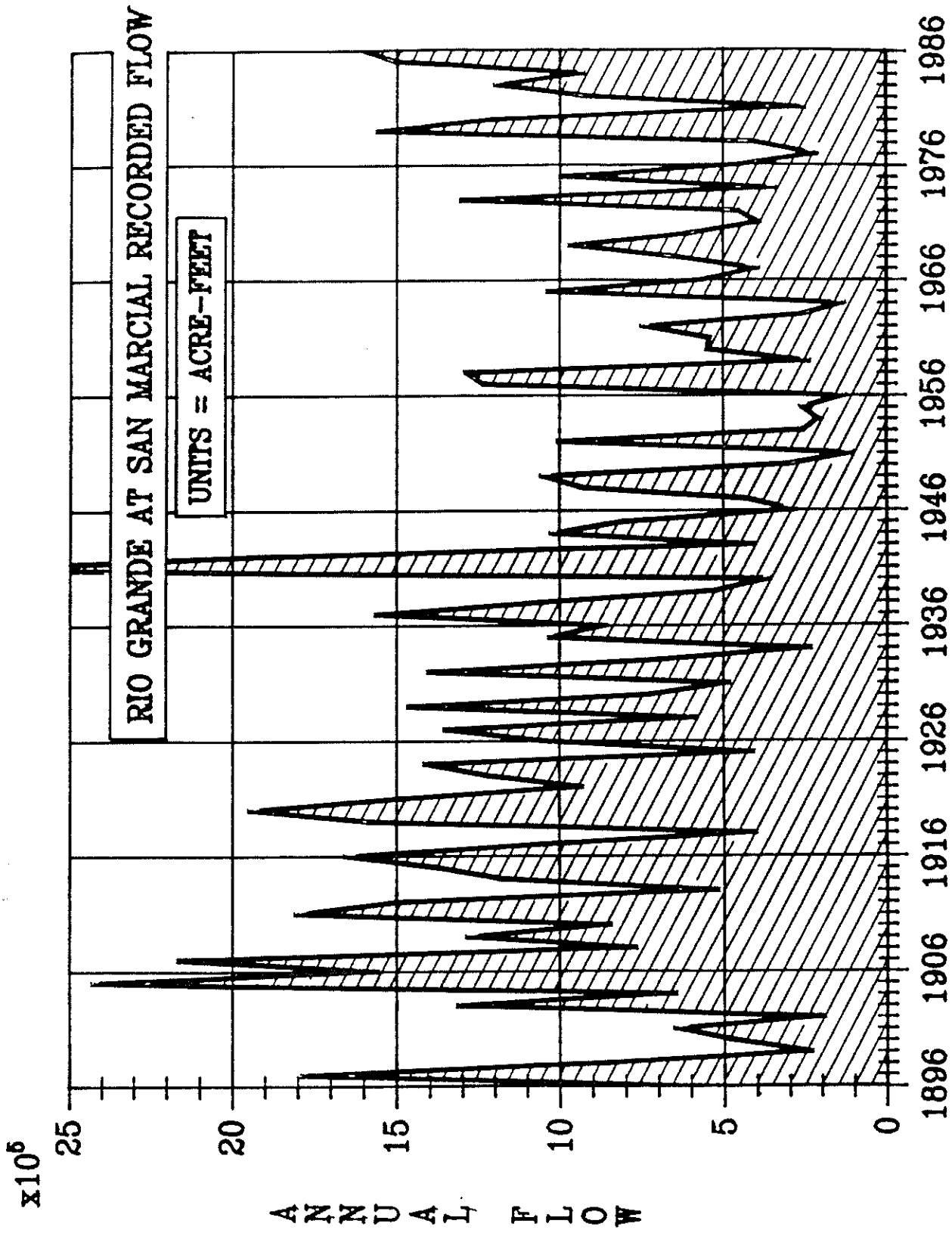

Figure 3. Rio Grande at San Marcial. Recorded flow.

maintained to make large discharges, up to 5,000 cfs, possible from Elephant Butte Dam.

Other problem areas recognized include the reach immediately upstream of Elephant Butte. Here, a meandering river with sediment deposition is taking place. A well-defined, deep, narrow channel is now filled with sediment, plugged over, and the river is spreading out and more or less going off cross country with some velocity of water against the spoil levee. Near the San Marcial railroad bridge the river was seeking to establish a new channel by flowing back to the north and northwest. That situation was watched with a great deal of concern earlier this summer. Fortunately, the river does not seem to be pursuing that track now. Nevertheless, the entire reach upstream of Elephant Butte does provide some very serious challenges, both from the standpoint of management of the river and sediment depositions.

Further upstream in the vicinity of the Santa Domingo Pueblo, the river is attacking the levee. Erosion has been limited with the installation of a line of jetty jacks and dumped rip-rap. This area is upstream of Albuquerque and downstream of Cochiti Dam.

Another problem encountered is the sediment plug that occurs when arroyos, such as Tonque Arroyo at San Felipe Pueblo, flow. Arroyos tend to drop large amounts of

sediment into the river, and then this sediment must be removed or transported further downstream.

Water Accounting

The complexity of the water accounting was made a part of the San Juan-Chama Project Authorization. The inflow into El Vado Reservoir for 1983-1985 included both the Rio Chama natural flows and the imported San Juan-Chama flows. Basically, this reflects the natural runoff with the added discharges from Heron into El Vado, which is now at capacity.

Reservoir Operations

The reservoir operations associated with these wet years have changed from what was experienced during the dry years. For the most part, storage reservoirs are full, and new problems of trying to account for water and to accommodate the requirements of the full reservoir system have resulted. One particular case in point was the transfer of the Elephant Butte recreation pool from Elephant Butte upstream to Abiquiu and then to Cochiti, and finally the loss of this recreation pool for lack of a location for further storage.

Possible Solutions

Let's consider solutions. Certainly, one of the solutions that has been used extensively along the Rio Grande system is the installation of steel jacks. An

installation within the city limits of Albuquerque is protecting the east bank of the Rio Grande from further erosion. Jetties have been and continue to be effective at a number of locations. They do have limitations in that they require a high sediment concentration and trash or debris to be caught in the wires to form an effective barrier to erosion and removal of material.

The necessity of restoration of the channel from Elephant Butte to Caballo was described earlier. This was accomplished from September 1985 to February 1986, under a $2 million construction contract with Ed Logan Contracting Company from Arizona. The Logan Company was able to get in the river channel with double-engine scrapers and the river bed was removed to restore the channel capacity to the 5,000 cfs authorized discharge.

Not all the excavation went smoothly. An example of one of the incidents is when the equipment became stuck. When a scraper was submerged it usually ruined the transmission at a cost of more than $12,000. Nevertheless, the contract went quite well, and the contractor was able to perform this excavation with the scrapers, whereas before the contract it was assumed by many that drag lines would be required to remove a great deal of this material.

The area at Truth or Consequences is environmentally and politically sensitive. Many people live adjacent to the

river. They were concerned about the work that was going on in their back yards. They wanted to be assured that not only would the channel restoration take place, but it would be done in a manner that protected their environment and protected their property. As part of the channelization, two grade control structures were installed.

Certainly, many problems and challenges lie ahead for us. One of the biggest is at the headwaters of Elephant Butte Reservoir with the very difficult problem of sediment deposition and high discharges during a high reservoir state. Other problems include the erosion and other difficulties in the Cochiti Division, and similar problems in the Espanola Valley.

Conclusions

Water accounting remains a day-to-day activity and concern, as does reservoir operations. We work very closely with the U.S. Bureau of Reclamation office in El Paso, the U.S. Army Corps of Engineers office in Albuquerque, the three state commissioners to the Rio Grande Compact, and with a number of other entities.

There are gray areas and a number of serious limitations to project management. Certainly, one problem at many locations is that the public feels we should not only maintain the river but that we should protect their private property from erosion. To the extent that this work

can be accomplished within our authorizations, we try to accommodate it. However, many times it just comes down to the fact that work cannot be accomplished outside the authorization, and it would be improper for any agency to do so.

Priorities for river maintenance work are addressed to a large degree through the river assessment, which is performed each year. All of the work that needs to be done on the river is prioritized into three broad categories. Priority one is the most urgent and work that has to be done in the near future. It's very difficult to accomplish some of this work with the high flows and the large amount of water recently experienced. We do have to be flexible. There are many other entities that we share our concerns and priorities with.

The projects are working well to serve the public. The public's needs and priorities change and our operations change within the authorized limits to meet those needs.

In closing, please consider the flooding at Albuquerque at the time of the disastrous 1941 floods. Certainly, we all want to prevent this sort of thing from happening in our valley again. We're working together towards the goal of assuring that it does not.