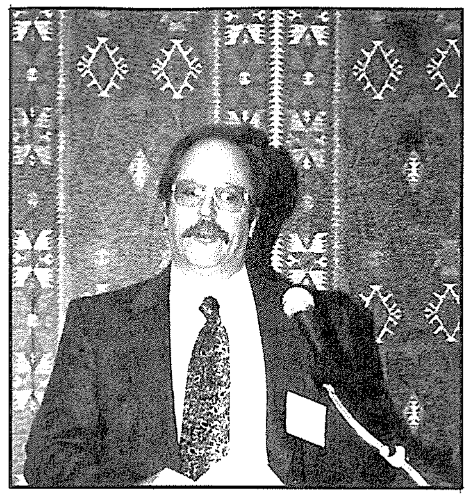
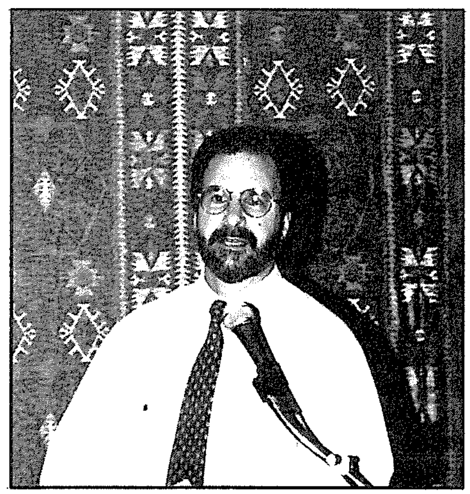
James Davis, *over-educated, DWM, received a bachelor's degree from the University of New Mexico, a master's from University of Utah at Salt Lake City, and Ph.D. from New Mexico State University, all in biology. Jim claims to be Responsible, having held only two jobs in the last 19 years: New Mexico Department of Agriculture for 18 years and Chief of the Surface Water Quality Bureau of the New Mexico Environment Department for the past 10 months. He Enjoys public meetings and stimulating discussions on water quality criteria, especially Hg and Se; he's ISO interested audience to hear short talk on* H_2O *quality issues.*



Water Quality on the Lower Rio Grande

Rodger Ferreira *is the Associate District Chief for the New Mexico District, Water Resources Division of the U.S. Geological Survey (USGS). He received a B.S. degree in fisheries and wildlife from the University of California/Davis in 1971 and an M.S. degree in fisheries from Humboldt State University in 1976. Since 1972, Rodger has worked for the USGS in the California, Montana and Texas districts before moving to New Mexico in 1990. Hydrologic studies have included work in the areas of limnology, aquatic entomology, and surface-water quality.*



Mark Jordan *received his law degree from the Lewis and Clark Law School in Portland, Oregon in 1984. While at law school, he received a certificate in environmental and natural resources law. He received his B.A. in 1976 from Austin College in Sherman, Texas. Mark has been with the Texas Natural Resource Conservation Commission since 1988, starting as a staff attorney in the Legal Division. In 1989, he was promoted to Senior Attorney for Water Rights. In 1992, he was promoted to Assistant Division Director of the Legal Division. Mark assumed his present duties as Director of the Water Policy and Regulations Division in December 1992.*

James Davis
Surface Water Quality Bureau
New Mexico Environment Department

For today's presentation on surface water quality, I have put together overheads with some water quality parameters for what we call the Lower Rio Grande. I'm fond of an astute Will Rogers' quote, "The Rio Grande is the only river I ever saw that needed irrigation."

Figure 1 is a map of the area I will talk about, specifically from San Marcial in the north to Fort Quitman in the south. I will make reference to the three stations of San Marcial, El Paso and Fort Quitman. There are 160 river miles from the San Marcial station to the El Paso station and 80 river miles from El Paso to Fort Quitman.

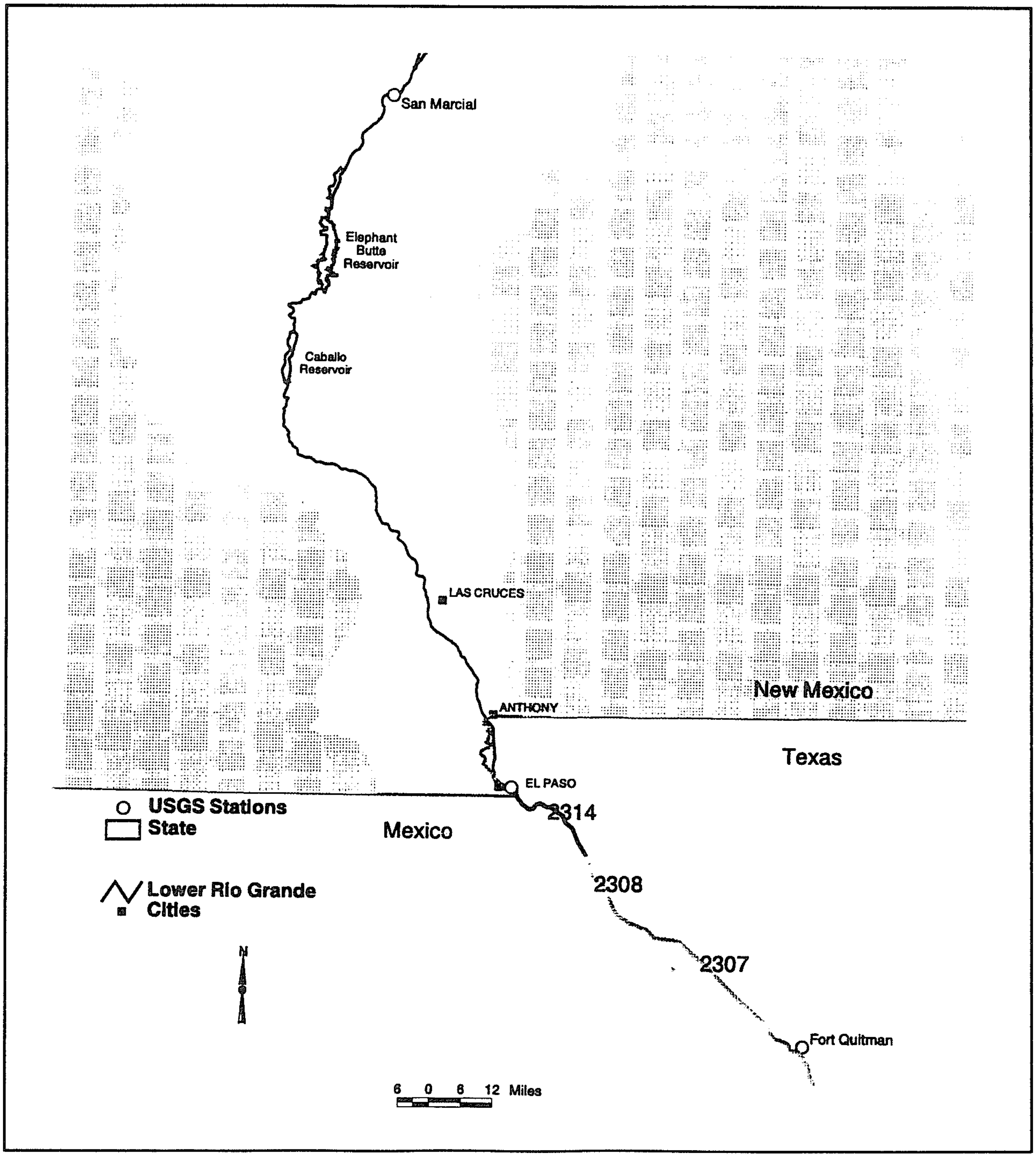


Figure 1. Lower Rio Grande Sampling Sites

In figures 2-4, we looked at three constituents of water quality–chloride, sulfate and total dissolved solids (TDS). Recently there have been discussions about these three constituents and that is why we chose to present them here. All the data we are presenting came from the STORET database. Approximately 180 sites along the Lower Rio Grande from Elephant Butte to Fort Quitman have data in STORET. However, something important to note and the main reason we are only referring to three stations–San Marcial, El Paso and Fort Quitman–is because only these three stations provide enough data for long-term trend analysis. Other stations had no substantial period of record, some having had just a one-time sample. Significant amounts of data are needed to provide confidence in your data and helps to establish a trend. Quite a bit of data have been collected over the years in a somewhat haphazard manner. To have confidence in your data, evaluation of the methodology, frequency and consistency of data collection is quite important. Therefore I will restrict my comments to the three stations where we have a considerable amount of data collected consistently over the years. Figure 2 depicts decade averages and the concentration of chloride. The bar furthest back on the graph is the instream water quality standard as it exists at each of the three locations. The standard does not change depending on the designated use of the river segment. You will notice two things from the graph. First, over time, from 1970, 1980 and 1990 decade averages, the trend is that water quality is improving. The geographic trend as you move down from San Marcial to El Paso and then to Fort Quitman is that water quality decreases and that is not unexpected.

Figure 3 was built similar to Figure 2 but for a different constituent, sulfate. As for chloride, the sulfate results hold both in time and geographic trend. Figure 4 presents the results for TDS. Again, the overall trend shows a decrease in water quality as the water flows south to Fort Quitman.

Figure 5 is derived from the El Paso water quality station, again presenting the same three constituents. The solid line on this graph represents flow in cubic feet per second (cfs) for the years 1987 through 1997. Right now, since we are at the end of October, you can see the flow trend is about 300-350 cfs. Those of us who participated on the field trip on Wednesday that was hosted by Gary Esslinger discussed what the flow would be at this time of the year and I think Gary's estimate was right at 300-350 cfs. This graph shows an inverse relationship for these particular parameters between water quality and flow. During the May-July time frame when flow is around 1,000 cfs, you can see how these various constituents decrease in their concentrations. The dotted lines that have the same pattern as the patterned solid lines are the standards for these constituents. The standard for TDS is right at the top of the graph at 1,800 mg/l. This graph provides the inverse relationship between flow and quality. At this conference so far, we have been talking about water quantity issues. I think these graphs point out very clearly how water quality and quantity are linked to each other, and I believe it is important to recognize that linkage.

While on the conference field trip on Wednesday, we stopped at Robert Faubion's farm and looked at his drip irrigation system. One thing he mentioned of particular interest to me was that when he first put in the system, he sited the filtering system at a lateral. He was using surface water that he was pulling directly out of the ditch and into his drip system and that worked. That worked until he and everyone else experienced the typical monsoon season here in southern New Mexico. The rainfall in July and August, nonpoint source events if you will, put water into the system and basically increased the suspended sediments in the system such that the filtration system he was using could not handle it, forcing him to use well water. That is a very good example of why we need to be concerned about surface water quality. It is a concrete, economic example of an agricultural producer who had put in a very nice irrigation system but later had to move it so it could continue to operate. The reason he moved it was due to water quality issues.

Thank you.

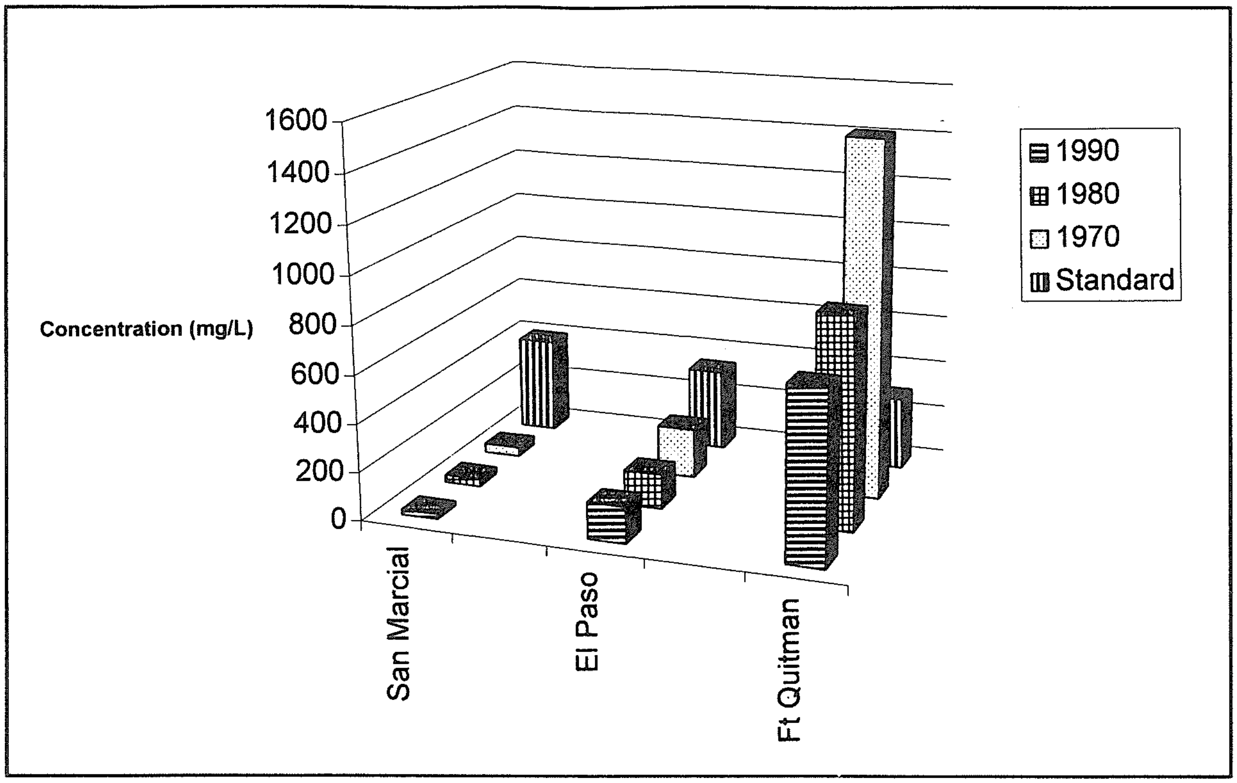


Figure 2. Lower Rio Grande Chloride Trend

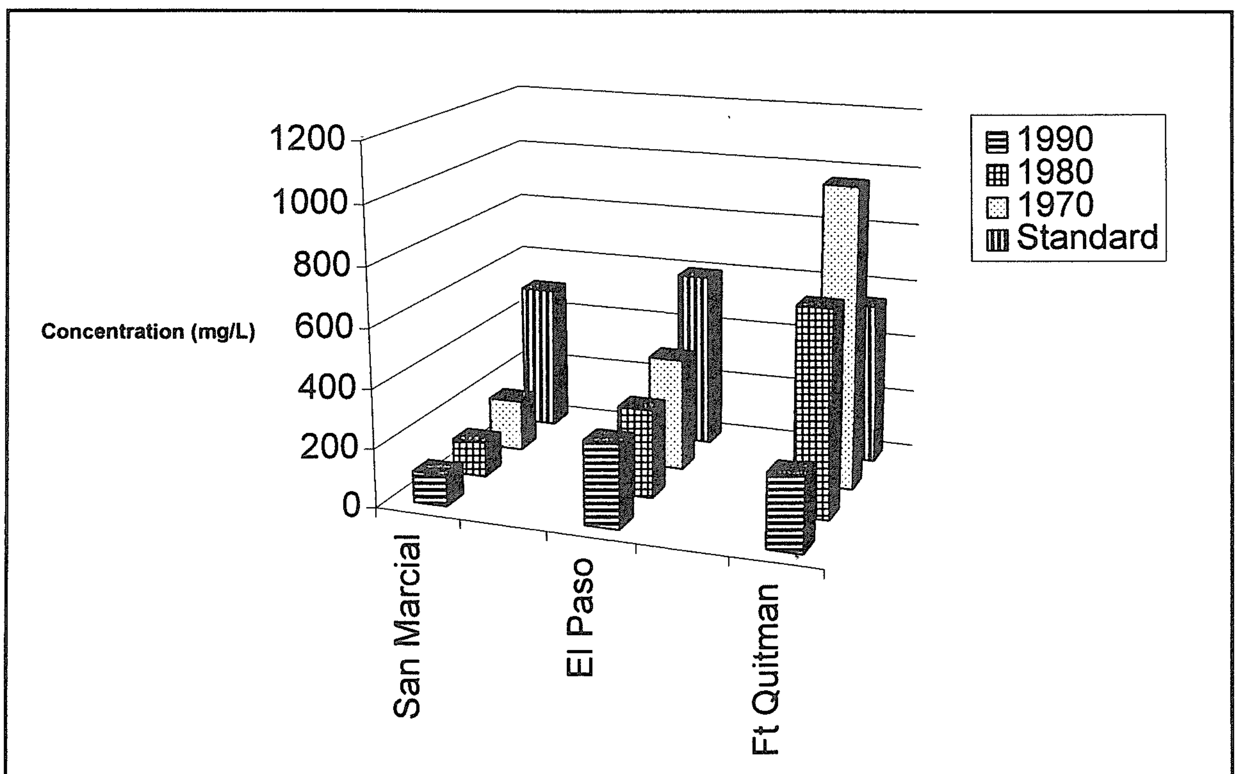


Figure 3. Lower Rio Grande Sulfate Trend

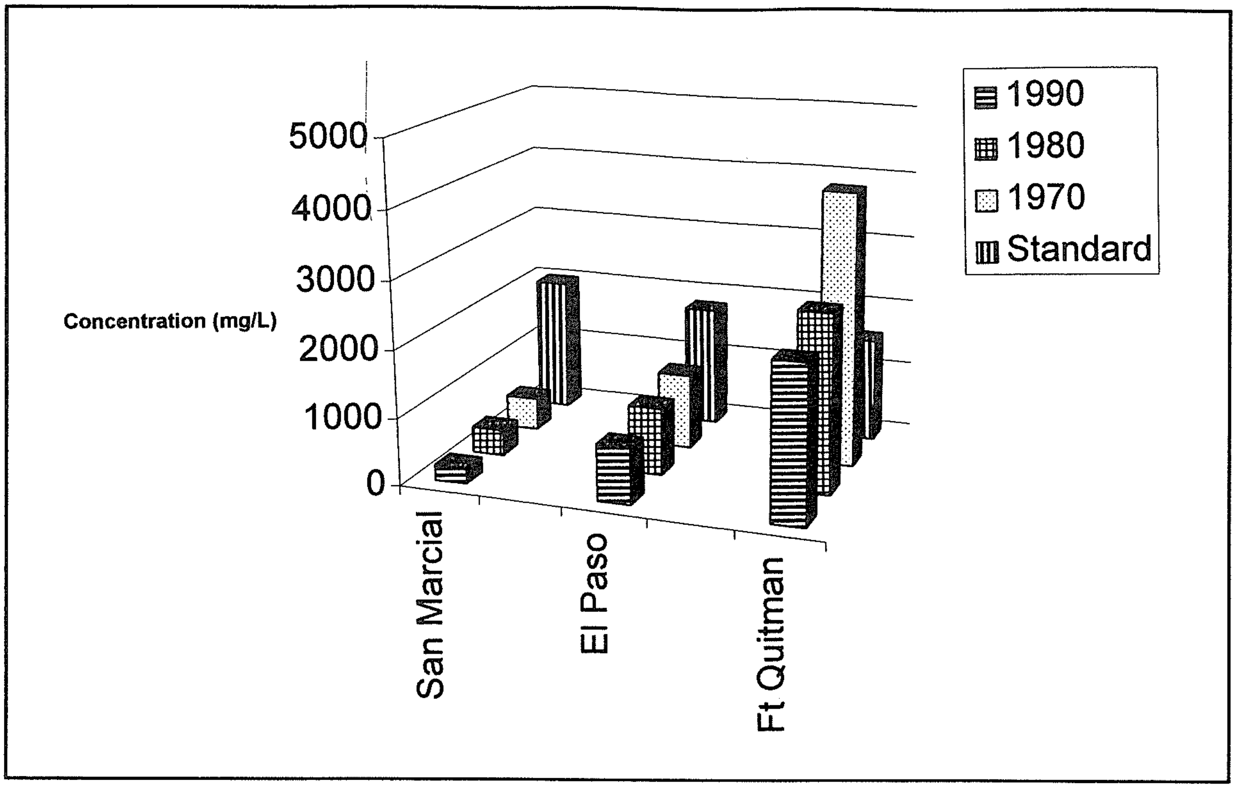


Figure 4. Lower Rio Grande Total Dissolved Solids (TDS) Trend

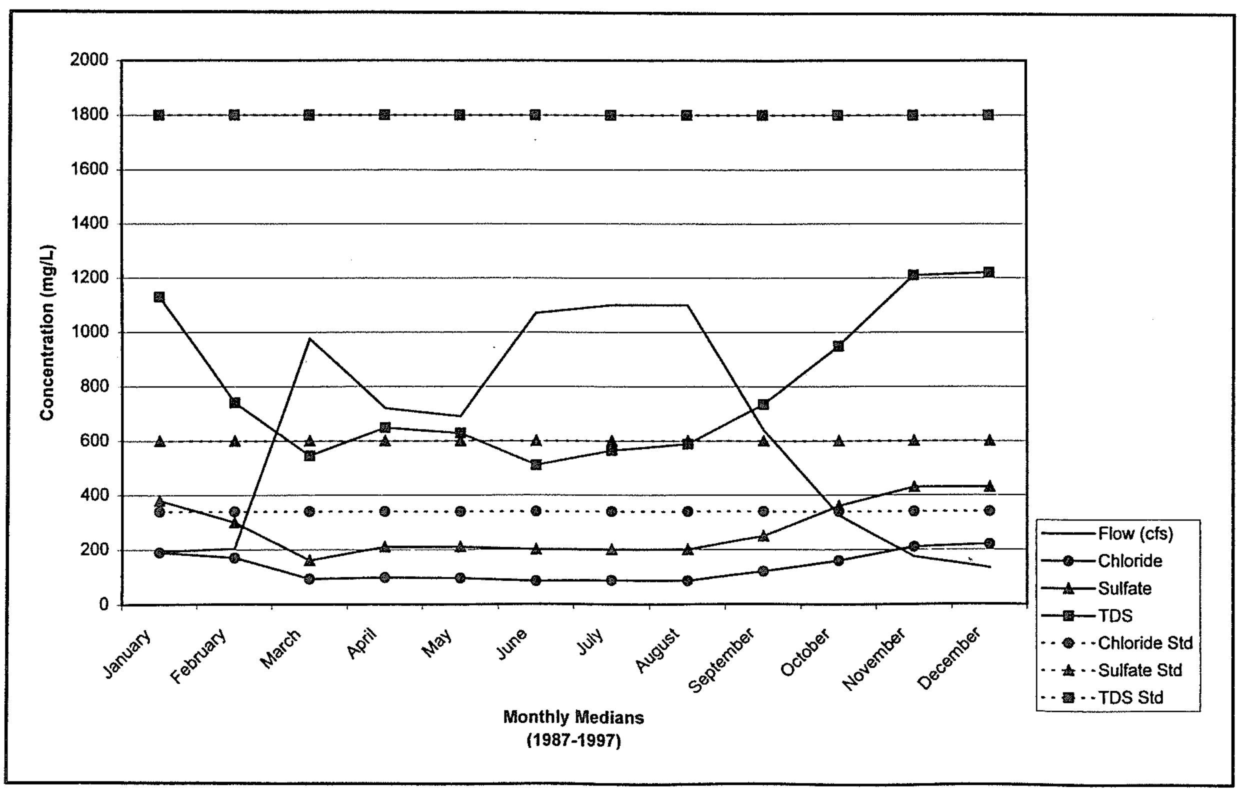


Figure 5. Lower Rio Grande trend for chloride, sulfate, and TDS as derived from the El Paso water quality station

Water Quality on the Lower Rio Grande

Rodger Ferreira
Water Resources Division
U.S. Geological Survey

The U.S. Geological Survey (USGS) provides hydrologic data as well as data analysis to local, state, and federal agencies to assist in the management of the Nation's water resources. Since the 1930s, the USGS has been involved with other agencies in several data-collection programs and hydrologic studies in the Lower Rio Grande. These activities have provided much of the information referred to by other conference speakers who have presented some of their own interpretations and studies here today. The attached bibliography lists publications of the New Mexico District that describe water-quality studies in the Lower Rio Grande. The USGS has collected surface-water and groundwater-quality data at many sites in the Lower Rio Grande Valley. The location of water-quality data-collection sites and the variability in water quality in the Lower Rio Grande are presented in this paper.

As an indicator of variability in surface-water quality, dissolved-solids and pesticide data were used from the Rio Grande Valley study unit of the National Water Quality Assessment (NAWQA) program. As part of the NAWQA program, a surface-water-quality synoptic study of the Lower Rio Grande was conducted in April 1994 and January 1995. This paper uses data from four sites that were included in the synoptic.

Variability in groundwater quality is exemplified using data from the report *Water resources of the Rincon and Mesilla Valleys and adjacent areas, New Mexico* (Wilson et al. 1981). The USGS conducted the study in cooperation with the New Mexico Office of the State Engineer, who published the results in Technical Report 43. The figures from that report are used here to show horizontal and vertical variation of groundwater quality.

Figure 1 shows the locations of surface-water sites from Caballo Reservoir to El Paso, Texas, where the USGS has collected one or more water-quality samples. Water-quality samples have been collected from about 50 sites on the Rio Grande and on inflows to the Rio Grande. Samples have been analyzed for a wide variety of different constituents. The four sites with the longest period of sampling and largest number of samples are Rio Grande below Caballo Dam, 1966-68; Rio Grande at Leasburg Dam, 1975-79; Tortugas Arroyo near Las Cruces, 1963-74; and Rio Grande at El Paso, 1930- present.

Data from four surface-water sites (Healy 1996; USGS Annual Water-Data Reports for New Mexico) demonstrate the variability of water quality in the Lower Rio Grande. These sites, in downstream order (Figure 2), are Rio Grande below Caballo Dam, Rio Grande below Leasburg Dam near Las Cruces, Rio Grande above New Mexico Highway 359 bridge at Mesilla, and Rio Grande at El Paso. The bar graphs for April 1994 and January 1995 show that dissolved-solids concentrations increased in a downstream direction. In April, dissolved-solids concentrations increased from about 400 to about 650 milligrams per liter (mg/L) between Caballo Reservoir and El Paso. Streamflow decreased from about 1,400 to 850 cubic feet per second (cfs). The increase in dissolved solids probably was due to groundwater discharge and drain flow to the Rio Grande, and the decrease in streamflow probably was due to evapotranspiration and irrigation diversions (Wilson et al. 1981). In January, dissolved-solids concentrations in the Rio Grande increased from about 600 to 1,100 mg/L between Caballo Reservoir and El Paso. Streamflow increased from about 4 to 180 cfs. The increase in dissolved solids and flow probably was due to groundwater discharge and drain flow to the Rio Grande along this reach (Wilson et al. 1981). The increase in dissolved solids was larger in January than in April most likely because of the proportion of groundwater discharge and drain flow relative to total streamflow at El Paso (Wilson et al. 1981), which was larger in January than in April.

The sum of concentrations of pesticides detected in surface water (Figure 3) generally increased between Caballo Reservoir and El Paso; however, the concentration did not increase downstream between each site as dissolved solids did. In April and January at each site, the sum of pesticide concentrations increased between Caballo Reservoir and Radium Springs, decreased between Radium Springs and Las Cruces, and increased between Las Cruces and El Paso. In April 1994, one herbicide and one insecticide were detected. The pesticides detected in January 1995 included four herbicides and one insecticide, a metabolite of DDT. None of the concentrations detected during the synoptic were above U.S. Environmental Protection Agency drinking-water limits.

The USGS has conducted several studies involving water-quality data collection at groundwater sites. Figure 4 indicates the locations of groundwater sampling sites where at least one water-quality sample has been collected. The number of constituents for which samples were analyzed at each location varies from several to more than 100. Cross section A-A' (Figure 5) shows the variability in dissolved-solids concentration with depth in the Rio Grande Valley. In most of the valley, water with a larger dissolved-solids concentration (slightly saline

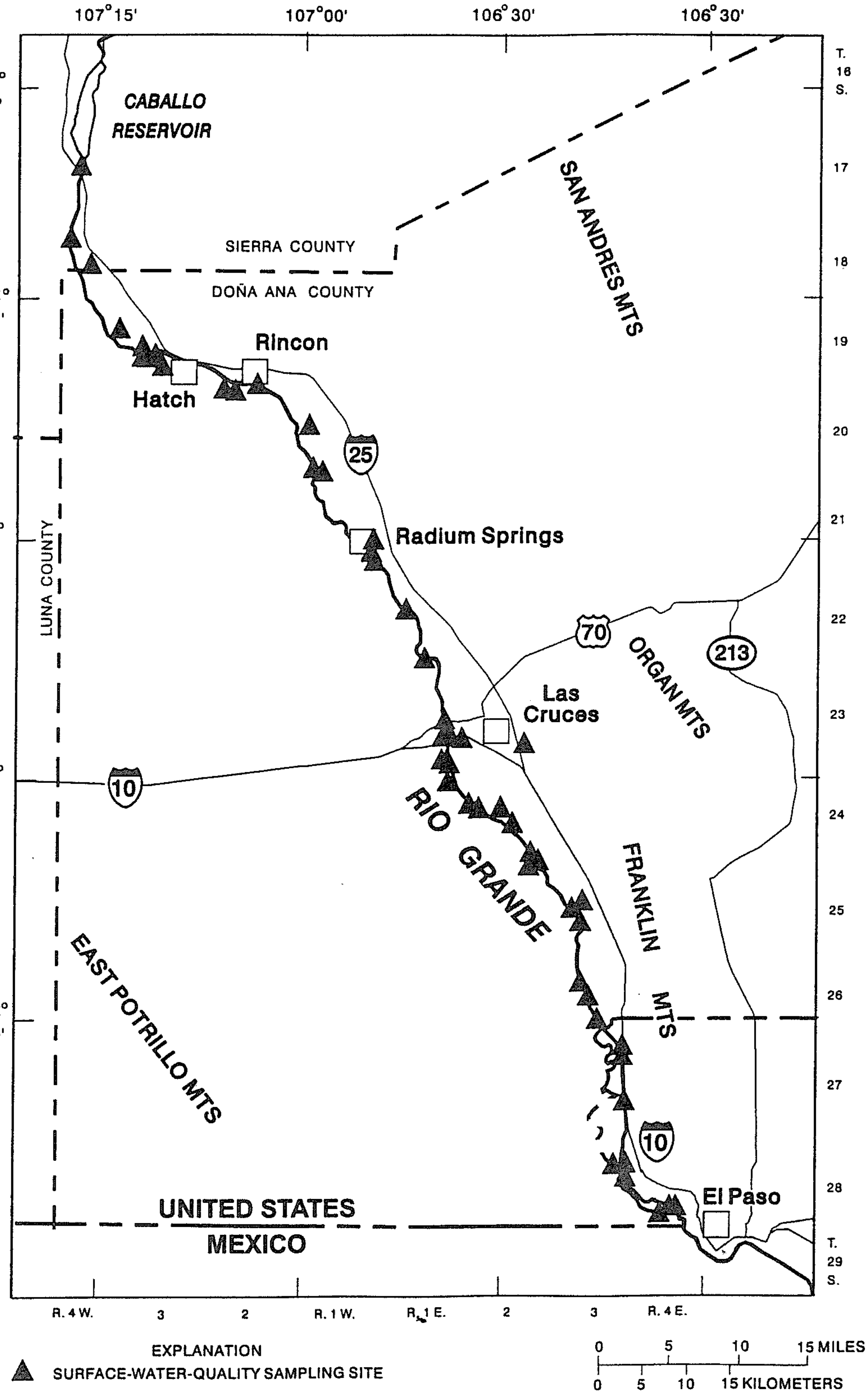


Figure 1. Location of surface-water sites in the Lower Rio Grande Valley where at least one sample has been collected for water-quality analysis.

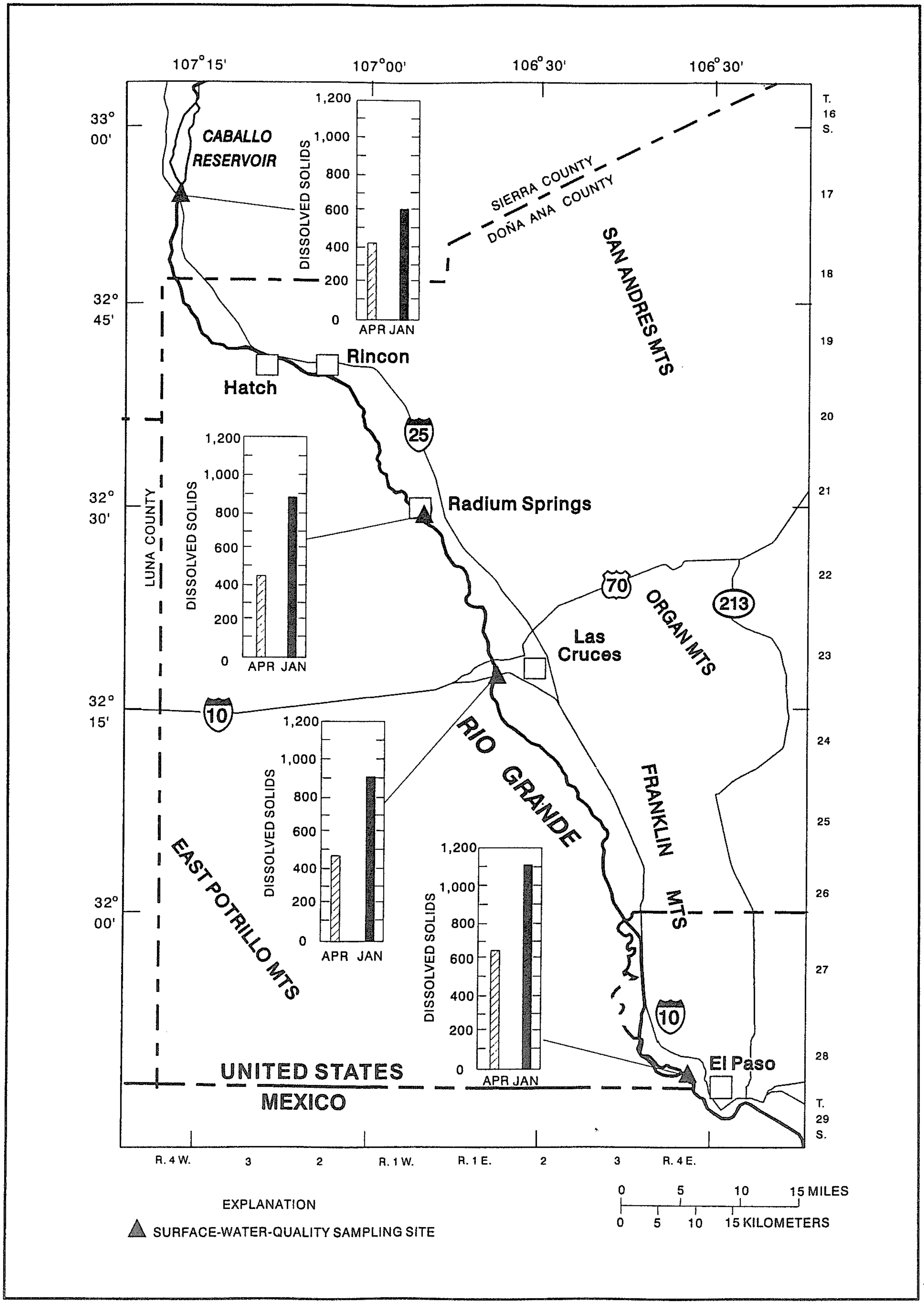


Figure 2. Selected dissolved-solids concentration, in milligrams per liter, at four sites in the Rio Grande between Caballo Reservoir, New Mexico, El Paso, Texas, April 1994 and January 1995.

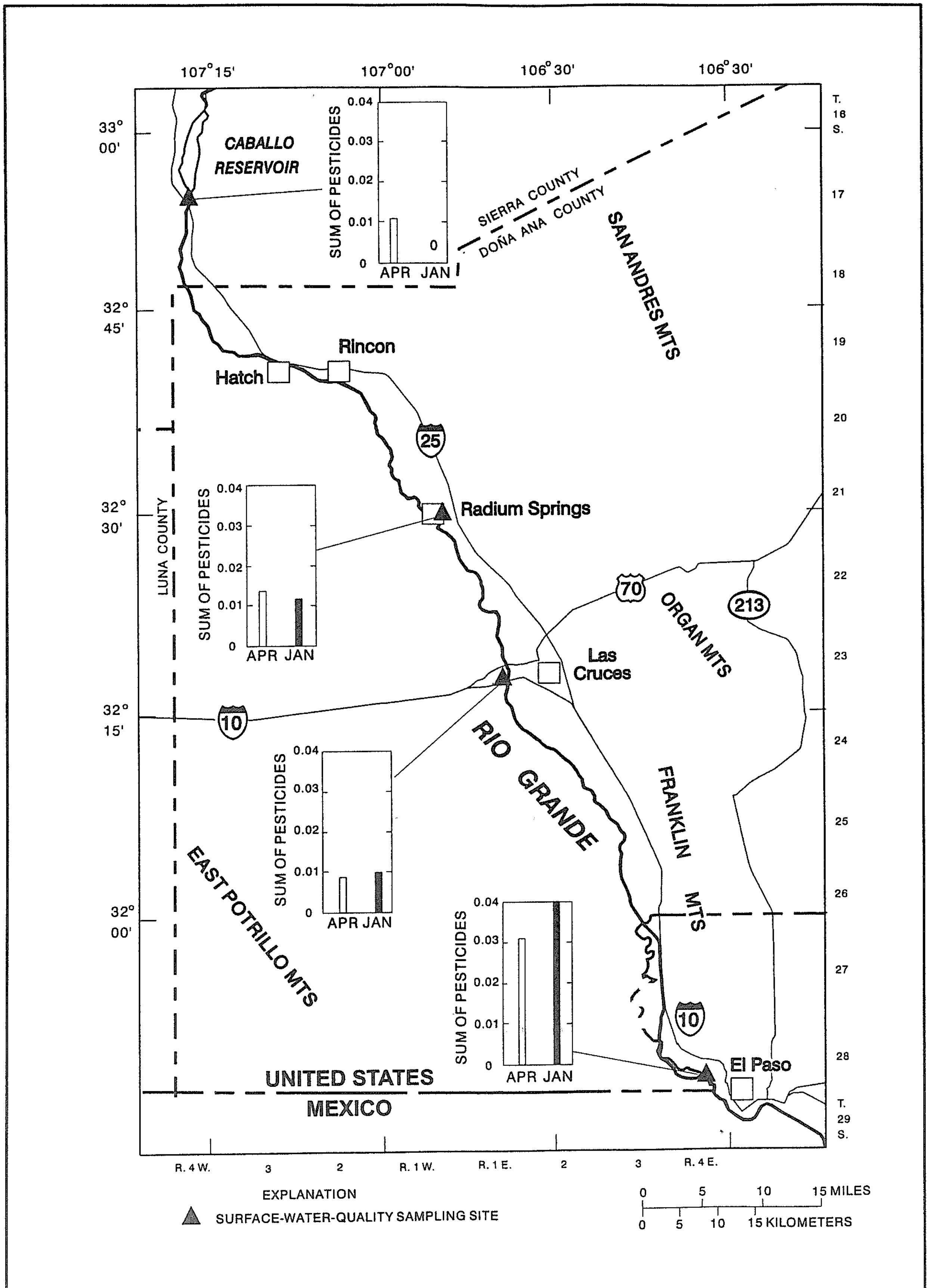


Figure 3. Selected sum of concentrations of detected pesticides, in micrograms per liter, at four sites on the Rio Grande between Caballo Reservoir, New Mexico and El Paso, Texas, April 1994 and January 1995.

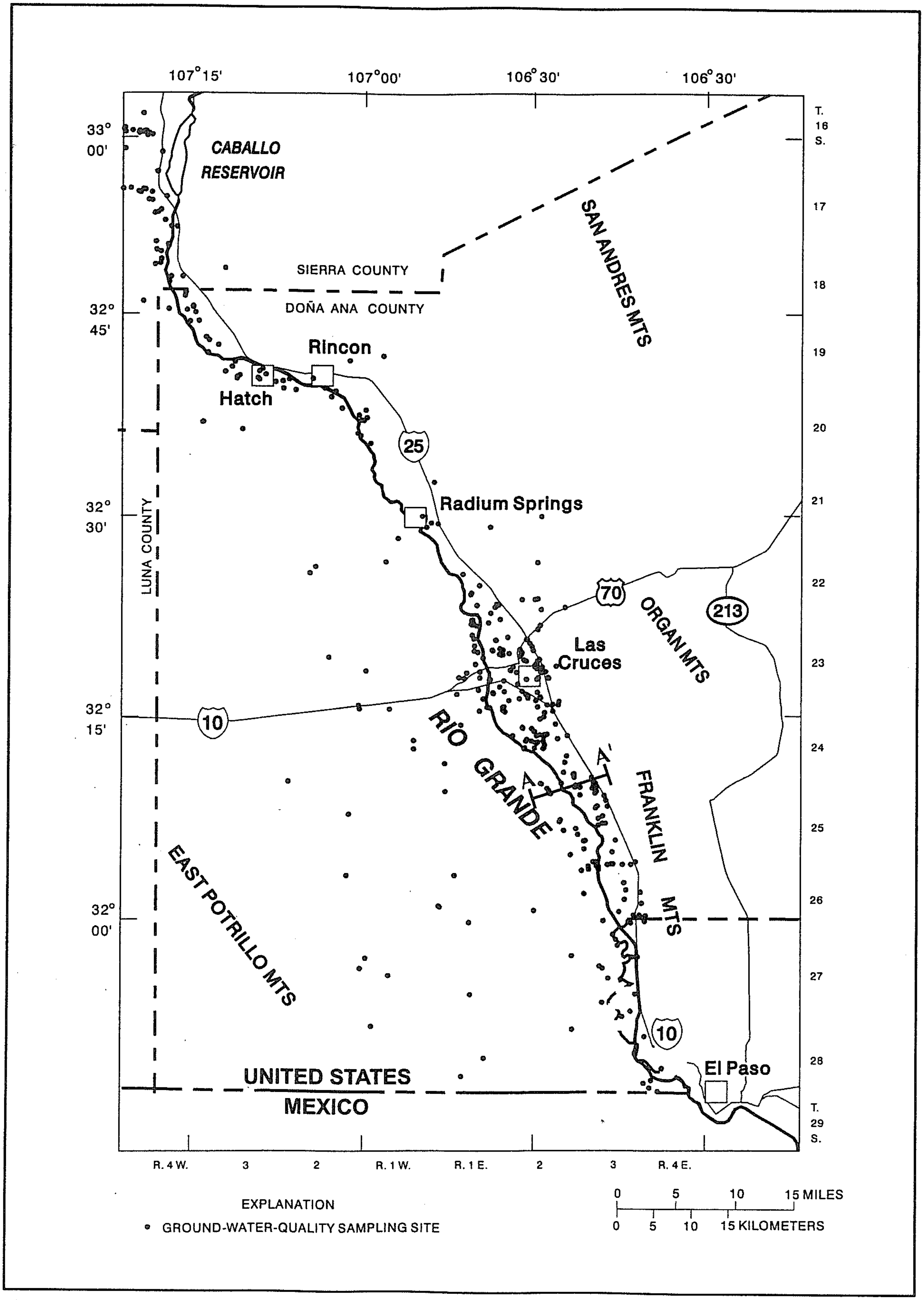


Figure 4. Location of groundwater sites in the Lower Rio Grande Valley where at least one sample has been collected for water-quality analysis.

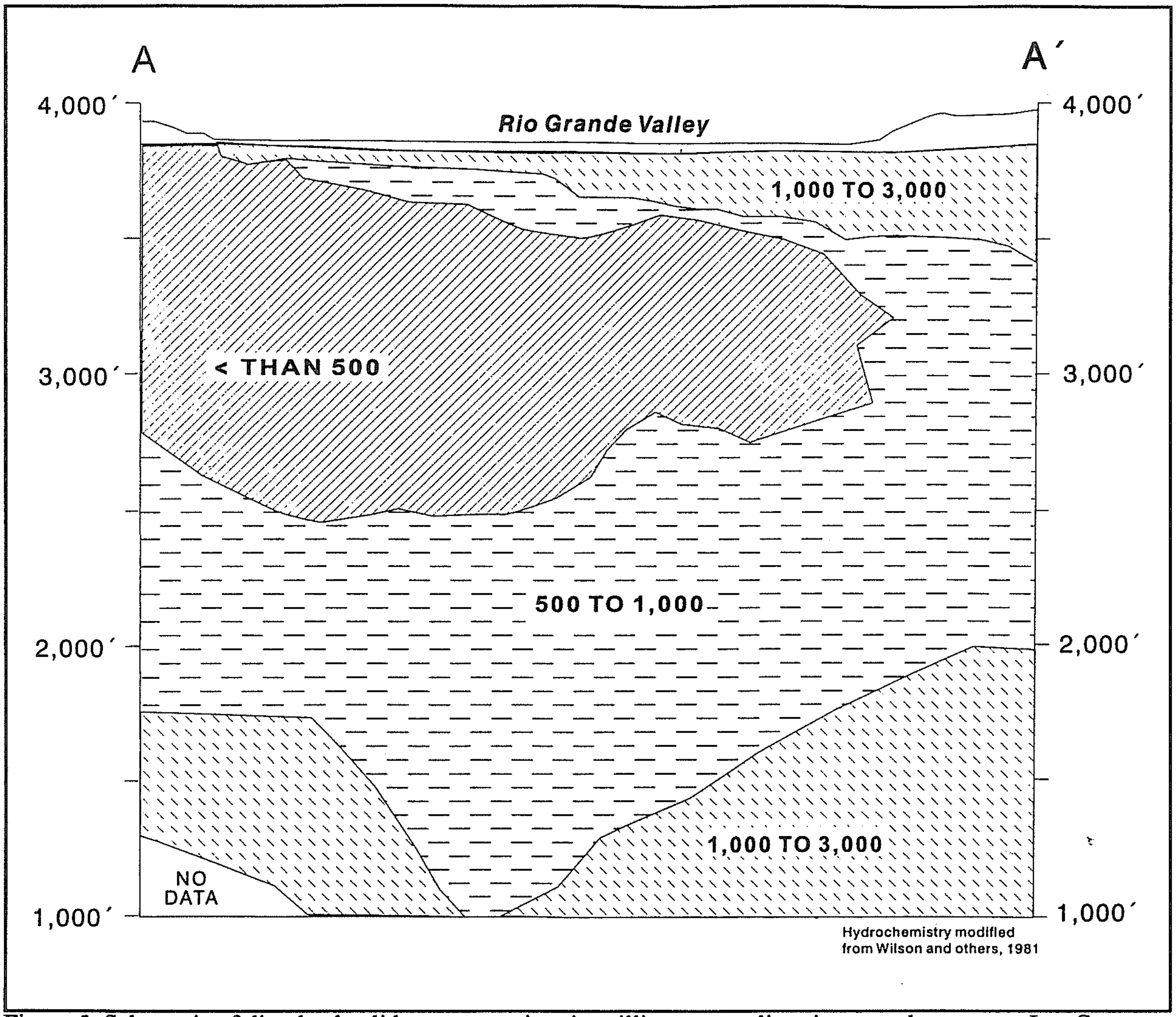


Figure 5. Schematic of dissolved-solids concentration, in milligrams per liter, in groundwater near Las Cruces, New Mexico, for cross section A-A' (section trace shown in Figure 4).

water) overlies water with a smaller dissolved-solids concentration (freshwater). The freshwater is also underlain by slightly saline water. The thickness of the upper, slightly saline water and freshwater varies throughout the valley.

Figure 6 shows the approximate thickness of the freshwater zone where the dissolved-solids concentration is less than 1,000 mg/L. North and south of Las Cruces, the thickness of freshwater is less than 400 feet. In the central valley near Las Cruces the thickness of freshwater is about 2,400 feet. Factors affecting the distribution of dissolved solids and other water-quality constituents are not fully understood. However, as additional studies continue, more information will be available to more fully manage water resources for the benefit of those living in the Lower Rio Grande Valley.

Bibliography for New Mexico District Hydrologic Data-Collection Programs and Studies on Water Quality in the Lower Rio Grande Valley

Anderholm, S.K. 1992. Water quality and geochemistry, In Frenzel, P.F., and Kaehler, C.A., Geohydrology and simulation of ground-water flow in the Mesilla Basin, Doña Ana County, New Mexico, and El Paso County, Texas: U.S. Geological Survey Professional Paper 1407-C, p. C64-C105.

Anderholm, S.K., M.J. Radell, and S.F. Richey. 1995. Water-quality assessment of the Rio Grande Valley study unit, Colorado, New Mexico, and Texas —Analysis of selected nutrient, suspended-sediment, and pesticide data: U.S. Geological Survey Water-Resources Investigations Report 94-4061, 203 p.

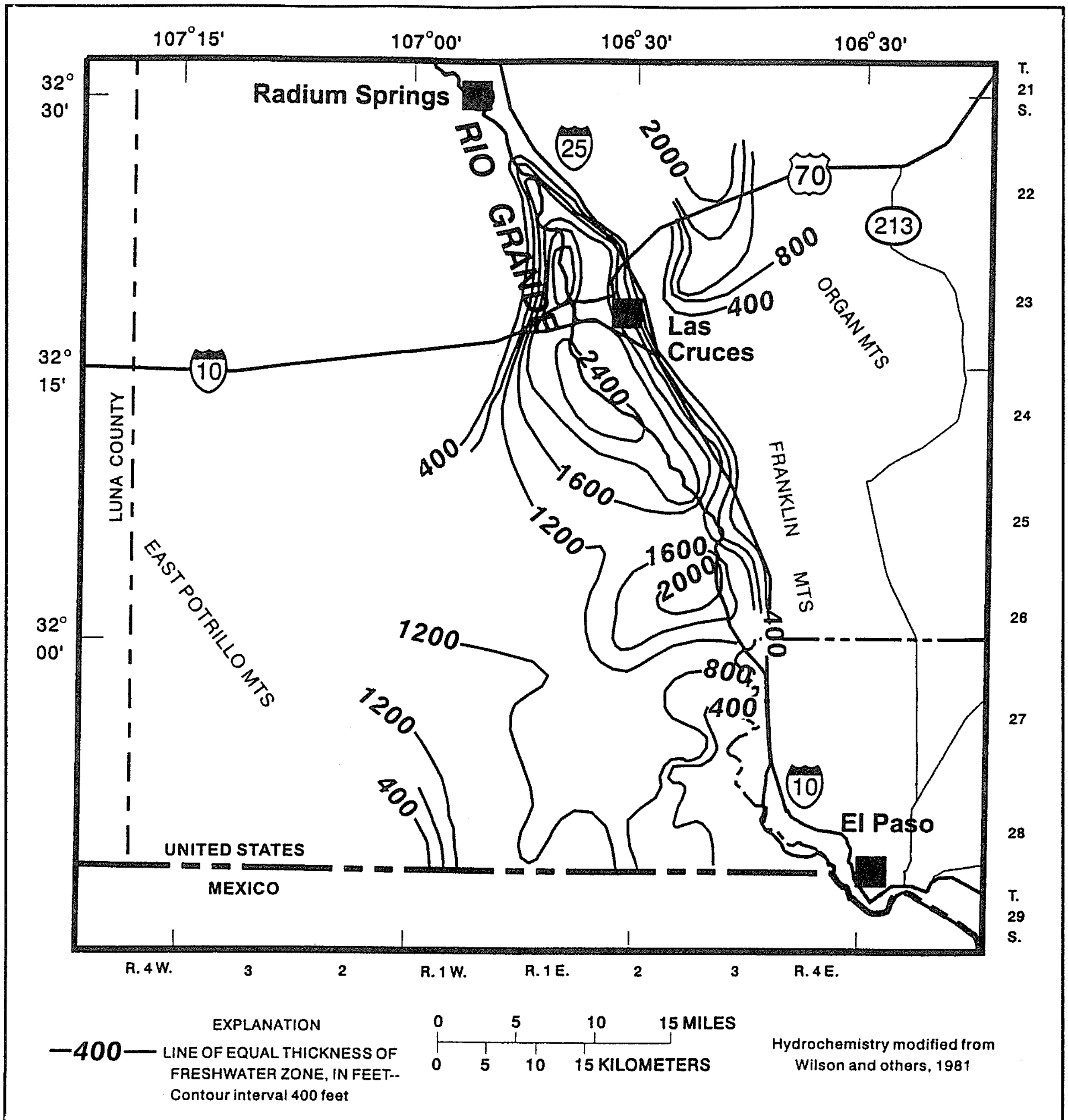


Figure 6. Approximate thickness of freshwater zone, in feet, where the dissolved-solids concentration is less than 1,000 milligrams per liter.

Bexfield, L.M., and S.K. Anderholm. 1997. Water-quality assessment of the Rio Grande Valley, Colorado, New Mexico, and Texas—Ground-water quality in the Rio Grande flood plain, Cochiti Lake, New Mexico, to El Paso, Texas, 1995: U.S. Geological Survey Water-Resources Investigations Report 96-4249, 93 p.

Carter, L.F. 1997. Water-quality assessment of the Rio Grande Valley, Colorado, New Mexico, and Texas—Fish communities at selected sites, 1993-95: U.S. Geological Survey Water-Resources Investigations Report 97-4017, 27 p.

_____1997. Water-quality assessment of the Rio Grande Valley, Colorado, New Mexico, and Texas—Organic compounds and trace elements in bed sediment and fish tissue, 1992-93: U.S. Geological Survey Water-Resources Investigations Report 97-4002, 23 p.

Healy, D.F. 1996. Water-quality assessment of the Rio Grande Valley, Colorado, New Mexico, and Texas—Occurrence and distribution of selected pesticides and nutrients at selected surface-water sites in the Mesilla Valley, 1994-95: U.S. Geological Survey Water-Resources Investigations Report 96-4069, 85 p.

_____1997. Water-quality assessment of the Rio Grande Valley, Colorado, New Mexico, and Texas—Summary and analysis of water-quality data for the basic-fixed-site network, 1993-95: U.S. Geological Survey Water-Resources Investigations Report 97-4212, 82 p.

Huff, G.F. 1998. Water-quality data for the Rio Grande between Picacho Bridge near Las Cruces and Calle del Norte Bridge near Mesilla, New Mexico, 1996-97: U.S. Geological Survey Open-File Report 98-66, 58 p.

Levings, G.W., D.F. Healy, S.F. Richey, and L.F. Carter. 1998. Water quality in the Rio Grande Valley, Colorado, New Mexico, and Texas, 1992-95: U.S. Geological Survey Circular 1162, 39 p.

Nickerson, E.L., and R.G. Myers. 1993. Geohydrology of the Mesilla ground-water basin, Doña Ana County, New Mexico, and El Paso County, Texas: U.S. Geological Water-Resources Investigations Report 92-4156, 89 p.

Myers, R.G., and B.R. Orr. 1985. Geohydrology of the aquifer in the Santa Fe Group, northern West Mesa of the Mesilla Basin near Las Cruces, New Mexico: U.S. Geological Survey Water-Resources Investigations Report 84-4190, 37 p.

Nickerson, E.L. 1986. Selected geohydrologic data for the Mesilla Basin, Doña Ana County, New Mexico, and El Paso County, Texas: U.S. Geological Survey Open-File Report 86-75, 59 p.

U.S. Geological Survey, Water resources data for New Mexico: U.S. Geological Survey Water-Data Reports (published annually).

Wilson, C.A., and R.R. White. 1984. Geohydrology of the central Mesilla Valley, Doña Ana County, New Mexico: U.S. Geological Survey Water-Resources Investigations Report 82-555, 144 p.

Wilson, C.A., R.R. White, B.R. Orr, and R.G. Roybal. 1981. Water resources of the Rincon and Mesilla Valleys and adjacent areas, New Mexico: New Mexico State Engineer Office Technical Report 43, 514 p.

Mark Jordan
Texas Natural Resource Conservation Commission

Thank you very much for inviting me to speak to you today on an issue that is very important to Texas users of the Rio Grande. As some of you know, Commissioner Baker was originally scheduled to speak to you today but had to address a little matter of an application for the disposal of low-level radioactive wastes. You may have heard of it . . . Commissioner Baker sends his sincere regrets that he is not here and I hope I can be an adequate substitute.

First, let me quickly say that I don't disagree with what the other two speakers have said as to what the water quality data indicates. But the fact that the Rio Grande is increasingly being looked to as a source of public drinking water may require a revision of the Water Quality Standards to meet more stringent public drinking water standards. If this happens, much more protection will be required than the previous speakers have indicated.

Texas water users are becoming increasingly concerned about the quality of water reaching the state line. Average total dissolved solids (TDS) concentration and sulfate in the Rio Grande increase on average by approximately one-third between Elephant Butte Reservoir and El Paso. High levels of these contaminants can make water treatment very expensive and affect crop production in Texas.

The surface water system in the Mesilla Valley includes a network of drains that capture ground-water resulting from agricultural and urban irrigation as well as urban and stormwater and wastewater treatment plants. While the drains are crucial to agricultural and municipal operations, they also return water to the river that contains higher concentrations of TDS and sulfate that exceed drinking water standards.

A stream segment listed as a source of public drinking water typically would be required to have TDS concentrations of less than 1,000 mg/l and sulfate concentrations of less than 300 mg/l. However, the current water quality standards for the segments below the state line in Texas are 1,800 mg/l for TDS just below the line and 1,400 for the next segment downstream. These less stringent standards were set before there was the current increased reliance on the Rio Grande as a source of public drinking water. In the recent New Mexico/Texas Water Commission report, analysis of TDS and sulfate data from surface water in the Mesilla Valley indicates that sulfate is the most critical problem–sulfate concentrations exceed the acceptable limits more frequently than do the TDS concentrations.

The results also show that both TDS and sulfate concentrations exceed acceptable public drinking water limits generally during the non-irrigation season when reservoir releases are not available to "sweeten" the water by dilution. The average monthly TDS/sulfate concentrations would generally meet acceptable water quality requirements for drinking water only in September through February, while **average monthly** values for March through August would most often meet these water quality requirements. However, there are periods during these months when the limits are exceeded. Recorded monthly averages indicate TDS levels well above the 1,000 mg/l mark during the nonirrigation winter months–sometimes up to 1,900 mg/l or almost twice the acceptable level. This study used all available water quality monitoring data, including that collected by New Mexico and the U.S. Geological Survey.

But the fact that the Rio Grande is increasingly being looked to as a source of public drinking water may require a revision of the Water Quality Standards to meet more stringent public drinking water standards. If this happens, much more protection will be required than the previous speakers have indicated.
Mark Jordan

Currently, the City of El Paso is the only municipal user of project water. By contract, the City also provides treated water to colonias through the Lower Valley Water Authority. The City's uses reflect a variety of contracts and institutional arrangements. For many decades, El Paso had a relatively small share of project rights. However, changes in use with increased growth in recent years have allowed the City to divert as much as 50,000 acre-feet per year. The City of El Paso continues to look more and more to the surface water of the Rio Grande to meet its growing water supply needs.

Historically, the cities of El Paso and Juárez have relied upon groundwater for their water supply. These groundwater supplies are being depleted. Both cities need additional water supplies. The City of El Paso, in the 1980s, applied to the State Engineer of New Mexico for permits to divert groundwater in New Mexico. The permit applications were denied and years of lengthy, expensive litigation ensued. The litigation was settled when the City of El Paso, New Mexico State University, and the Elephant Butte Irrigation District formed the New Mexico/Texas Water Commission to cooperate jointly on water resources planning between Texas and New Mexico entities. This group continues to meet and has commissioned several studies regarding water resources planning for the region, including strategies for drain mitigation. The State of Texas through the Texas Water Development Board helps fund these studies.

As the City of El Paso continues to use more and more water from the Rio Grande Project, it is becoming more and more critical to obtain a larger, more reliable year-round supply. Year-round reservoir releases to meet increased municipal demand would alleviate the TDS/sulfate problem, especially in nonirrigation months. However, some allege that changes to year-round release of water from Elephant Butte Reservoir might create concerns for the states of Colorado and New Mexico as it relates to their water delivery obligations under the Rio Grande Compact. Some feel that changing the water use from irrigation to municipal use also could make it less likely that there would be a spill from Elephant Butte Reservoir.

For now, it is likely that Juárez will develop additional groundwater supplies. But once these sources are depleted, Juárez also may be looking more to surface water from Mexico's share of the Rio Grande. When salinity concentrations in the Colorado River flowing into Mexico reached 2,700 parts per million in 1961, Mexico complained loudly about the degraded quality of the river. Salt loading and reduced volumes of water from consumptive uses and evaporation had caused lower basin states and Mexico to receive water of decreased quality with consequent degraded usefulness, increased treatment costs, decreased crop yields, and damage to soils. Irrigation increased salinity in two ways: agricultural return flows carried salts leached from cultivated fields; and the irrigation process caused a concentration of existing salts because about half the water applied was consumed by evapotranspiration. Salts were leached from cultivated soils and subsurface formations and entered the river as a part of the return flows.

The Mexican Treaty of 1944 regarding the Colorado River provided 1.5 million acre-feet of water per year to be delivered to Mexico but it was silent on the quality of water. The United States initially argued that it had no obligation to provide usable water, but later backed off that position and eventually agreed to deliver water of a specified quality. In 1974, Congress enacted the Colorado River Basin Salinity Control Act, authorizing an extensive program to reduce salinity in the river. Although the primary reason for the program was to fulfill the federal commitment to Mexico, the result also has been to protect the economics of the lower basin: it has been estimated that each part per million of salinity translates into $580,000 of lost benefits from agricultural production and municipal and industrial uses in the lower basins. The salinity control program has reduced salinity loading by 163,000 tons per year, according to Bureau of Reclamation figures.

Because of the increase in municipal use by El Paso for the Rio Grande, the Texas Natural Resource Conservation Commission currently is considering setting the water quality standard for TDS and sulfate at 1,000 mg/l and 300 mg/l, respectively, for the Rio Grande below the state line. If this occurs, the affected stream segments would be placed on the list of impaired water bodies not meeting water quality standards as required by Section 303 (d) of the Clean Water Act. The Act further requires states to develop and implement Total Daily Maximum Loads (TDMLs) for the pollutants of concern for the impaired stream segments with the goal of restoring the stream's water quality to meet applicable water quality standards. A part of the process includes identifying all point as well as nonpoint contributors of the targeted pollutants and making load allocations among these that would meet the water quality standards. In this process we would be looking for assistance and cooperation from New Mexico. As it has been previously pointed out by Jim Davis, irrigation return flows are specifically excluded from the definition of point sources under the Clean Water Act. However, control of agricultural nonpoint source pollution is addressed under sections 208 and 303 (e) of the Act requiring states to develop water quality management plans. The plans are to identify nonpoint sources of pollution and best management practices to reduce them, including annual milestones and the identification of funding sources.

A few months ago, representatives from the water agencies of Texas and New Mexico met here in Las Cruces to identify outstanding water issues between the two states and to figure out cooperative ways to address them. New Mexico officials indicated they needed Texas' help on groundwater management in the El Paso/Las Cruces region, the Lea and Gaines counties areas, and alternative ways to meet New Mexico's obligations under the Pecos River Compact. We mentioned our concerns about the water quality of the Rio Grande and the effect of groundwater pumping on Rio Grande flows. With respect to water quality, we discussed a joint water quality monitoring and assessment effort for the Rio Grande and support for continued congressional funding of USGS's monitoring efforts. With respect to groundwater pumping, there is a concern by Texas water users that groundwater pumping in New Mexico may be diminishing stream flow in the Rio Grande much like what was occurring in Colorado before the Rio Grande Water Conservation District was created in the San Luis Valley. The water district was formed in the 1970s after local farmers over pumped wells and sapped the Rio Grande. Texas and New Mexico threatened to sue to ensure their share of water. The solution was the federally funded Closed Basin Project which pumps water from Colorado state lands on the eastern edge of the Valley into a canal that pours into the Rio Grande. In this way, the farmers can continue to pump and Colorado still meets its delivery obligation.

> **Year-round reservoir releases to meet increased municipal demand would alleviate the TDS/sulfate problem, especially in nonirrigation months.**
> *Mark Jordan*

In the recent joint meeting here in Las Cruces, the two states agreed to work further on these issues. I look forward to working with my New Mexico colleagues in picking up where we left off to resolve these issues. Thank you.