WATER USE, PROJECTED WATER REQUIREMENTS, AND RELATED DATA AND INFORMATION FOR THE STANDARD METROPOLITAN STATISTICAL AREAS IN TEXAS

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WATER USE, PROJECTED WATER REQUIREMENTS, AND RELATED DATA AND INFORMATION FOR THE STANDARD METROPOLITAN STATISTICAL AREAS IN TEXAS

Introduction

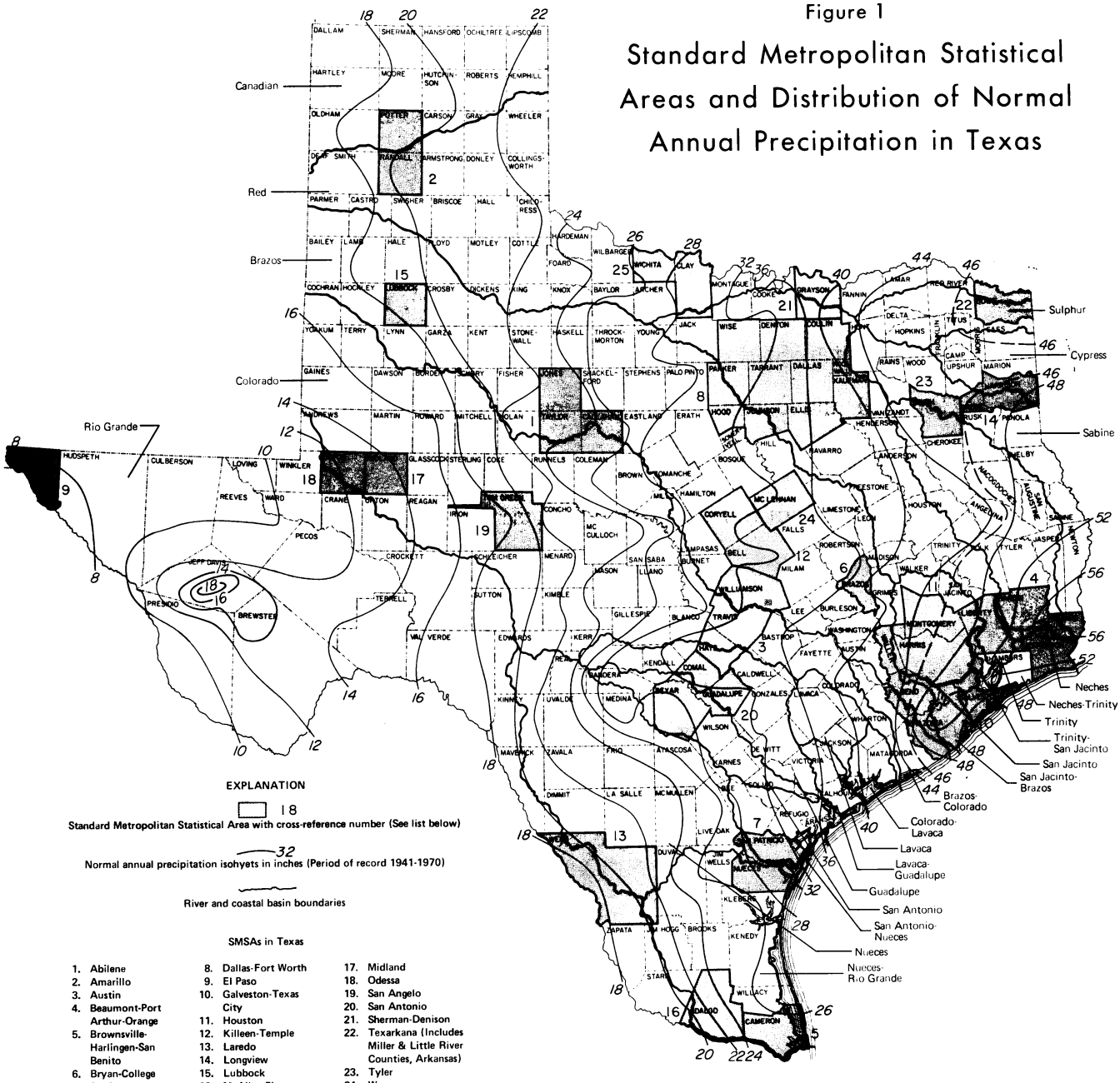
The purpose of this report is to present current and projected water resources data and related information for Texas and for each of the twenty-five (25) Standard Metropolitan Statistical Areas (SMSAs) in Texas. The twenty-five (25) SMSAs are located and cross-referenced on Figure 1 which also shows the location of the SMSAs in relation to the State's twenty-three (23) river and coastal basins and the distribution of normal annual precipitation within the State. The twenty-five (25) SMSAs consist of fifty-three (53) counties, thirty-six (36) of the State's largest cities, and about 49.5 thousand square miles or about 18.5 percent of the land and water area of the State (267.3 thousand square miles). The following discussion presents a statewide perspective on water resources, their development and use, water quality planning, floodplain management, information about each of the SMSAs, and the State, and water supply outlook and problems in Texas and in each of the SMSAs.

Statewide Perspective

Texas has fifteen (15) major river basins and eight (8) coastal basins (Figures 1 and 2) which have approximately 3,700 designated streams and tributaries and more than 80,000 miles of streambed. Average annual runoff or streamflow is about 49 million acre-feet (one acre-foot of water is 325,851 gallons). Runoff ranges from about 1,100 acre-feet per square mile at the Texas-Louisiana border to practically zero (0) in parts of the Trans-Pecos Region of far West Texas. From 1940 through 1970, statewide runoff averaged 57 million acre-feet during the

Figure 1

Standard Metropolitan Statistical Areas and Distribution of Normal Annual Precipitation in Texas



EXPLANATION

18 — Standard Metropolitan Statistical Area with cross-reference number (See list below)

32 — Normal annual precipitation isohyets in inches (Period of record 1941-1970)

River and coastal basin boundaries

SMSAs in Texas

1. Abilene
2. Amarillo
3. Austin
4. Beaumont-Port Arthur-Orange
5. Brownsville-Harlingen-San Benito
6. Bryan-College Station
7. Corpus Christi
8. Dallas-Fort Worth
9. El Paso
10. Galveston-Texas City
11. Houston
12. Killeen-Temple
13. Laredo
14. Longview
15. Lubbock
16. McAllen-Pharr-Edinburg
17. Midland
18. Odessa
19. San Angelo
20. San Antonio
21. Sherman-Denison
22. Texarkana (Includes Miller & Little River Counties, Arkansas)
23. Tyler
24. Waco
25. Wichita Falls

wettest period (1940-1950), and 23 million acre-feet during the severe drought of the early and mid-1950's.

Surface Water Resource Development and Use

Currently, Texas has 174 major reservoirs (27-Federal and 147-non-Federal) with 5,000 acre-feet or greater total capacity (Figure 2, reservoirs in and stippled solid blue). In addition, there are 10 reservoirs presently under construction (7-Federal and 3-non-Federal) (Figure 2, reservoirs outlined in blue). Conservation storage capacity in major reservoirs and reservoirs under construction totals about 32.3 million acre-feet. Flood control storage capacity totals about 17.5 million acre-feet. The dependable (firm) water supply from major reservoirs is about 11 million acre-feet annually; i.e., the uniform yield which can be withdrawn annually through extended drought period.
Currently, Texas has 65 potential reservo
Currently, Texas has 65 potential reservoir projects of which 19 are authorized Federal Projects (Figure 2, reservoirs in red), seven are planned State/local projects (Figure 2, reservoirs in orange), six are planned Federal/State/local projects to meet projected year 2000 water requirements in areas near the locations of these projects (Figure 2, reservoirs in solid green), and 33 are potential Federal/State/local projects to meet the projected water requirements beyond the year 2000 (Figure 2, reservoirs outlined in green). Included in the 33 potential projects are reservoir enlargements of Lakes Wright Patman (Sulphur River Basin) and Caddo (Cypress Creek Basin). About 4.3 million acre-feet per year of additional dependable surface water yield can be developed with construction of these 65 potential reservoir projects.

Currently, Texans use about 6.2 million acre-feet or 56 percent of the 11 million acre-feet of dependable surface water supply available. Of the 6.2

million acre-feet of surface water used, about 27.2 percent is for municipal uses, 20.2 percent is for manufacturing purposes, 5.3 percent is for steam-electric power generation, 0.9 percent is for mining, 2.9 percent is for livestock watering, and 43.5 percent is for irrigation.

A large portion of the remaining 4.8 million acre-feet of dependable surface water supply is committed or planned for municipalities and industries to meet growing municipal and industrial needs of major metropolitan areas of the State during the foreseeable 20 to 30 year period of time. However, this quantity of supply will not meet all of the municipal and industrial needs in the foreseeable future; i.e., many cities in the central, south, north central, and west Texas areas have practically no dependable surface water supplies that are unused at the present time, and projections show that many cities in eastern portions of the State will need additional surface water supplies in the immediate future.

In the central, south, north central, and west Texas areas, annual precipitation is low, in comparison to precipitation rates in eastern portions of the State. Thus, surface water flows are relatively low per square mile of land area, total surface water supplies are smaller, and the supply is less reliable on an annual basis. In addition, the quality of available supplies is lowered due to natural sources of salt and minerals. However, additional supply can be developed locally in some of these areas through construction of the few remaining undeveloped reservoir sites, through construction of chloride control structures to keep saline flows from entering streams, and perhaps through desalting of brackish surface and ground waters of some of these areas.

Ground-Water Resource Development and Use

More than fifty (50) percent of Texas is underlain by seven (7) major aquifers (Figure 3) and seventeen (17) minor aquifers (Figure 4. The seven (7) major aquifers, plus the seventeen (17) minor aquifers, have a total average annual natural recharge of about 5.1 million acre-feet and a total recoverable reserve or storage of about 328 million acre-feet, of which about 86 percent or 282 million are in the Ogallala Aquifer in the High Plains.

Currently, Texans use about 19.2 million acre-feet of water annually, of which about 13.08 million acre-feet are from ground-water sources. Of the 13.08 million acre-feet of ground water used, 12.9 percent or 1.68 million acre-feet are for municipal uses, 4.2 percent or 544 thousand acre-feet are for manufacturing purposes, 0.9 percent or 11.7 thousand acre-feet are for steam-electric power generation, 1.5 percent or 200 thousand acre-feet are for mining, 1.0 percent or 136 thousand acre-feet are for livestock watering, and 79.5 percent or 10.40 million acre-feet are for irrigation. According to water use statistics obtained from annual water use surveys of the municipalities of Texas, about 50 percent of municipal water is obtained from ground water sources. Ground water is used for municipal purposes in all areas of Texas and in practically every county. However, in many areas, the long terms use of well fields is lowering the water tables to an extent that major water supply problems are occurring or are projected to occur in the foreseeable future. Thus, there is a need to develop surface-water supplies to supplement ground-water supplies.

Water Quality and Water Quality Planning

Since many areas of Texas are water-short, the maintenance or recovery of the quality of our limited water supplies is absolutely essential. Recognition

Figure 3

MAJOR AQUIFERS

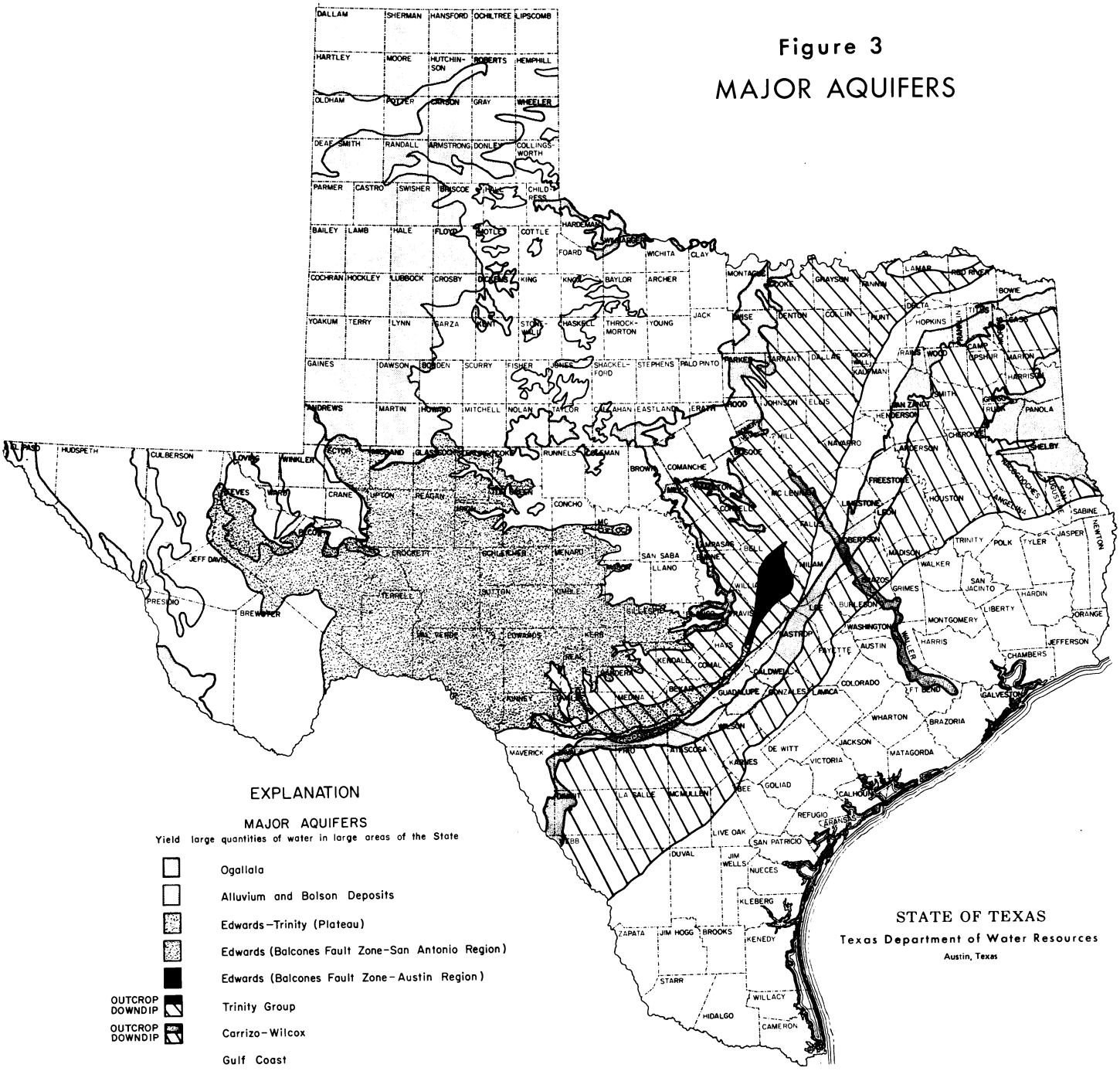
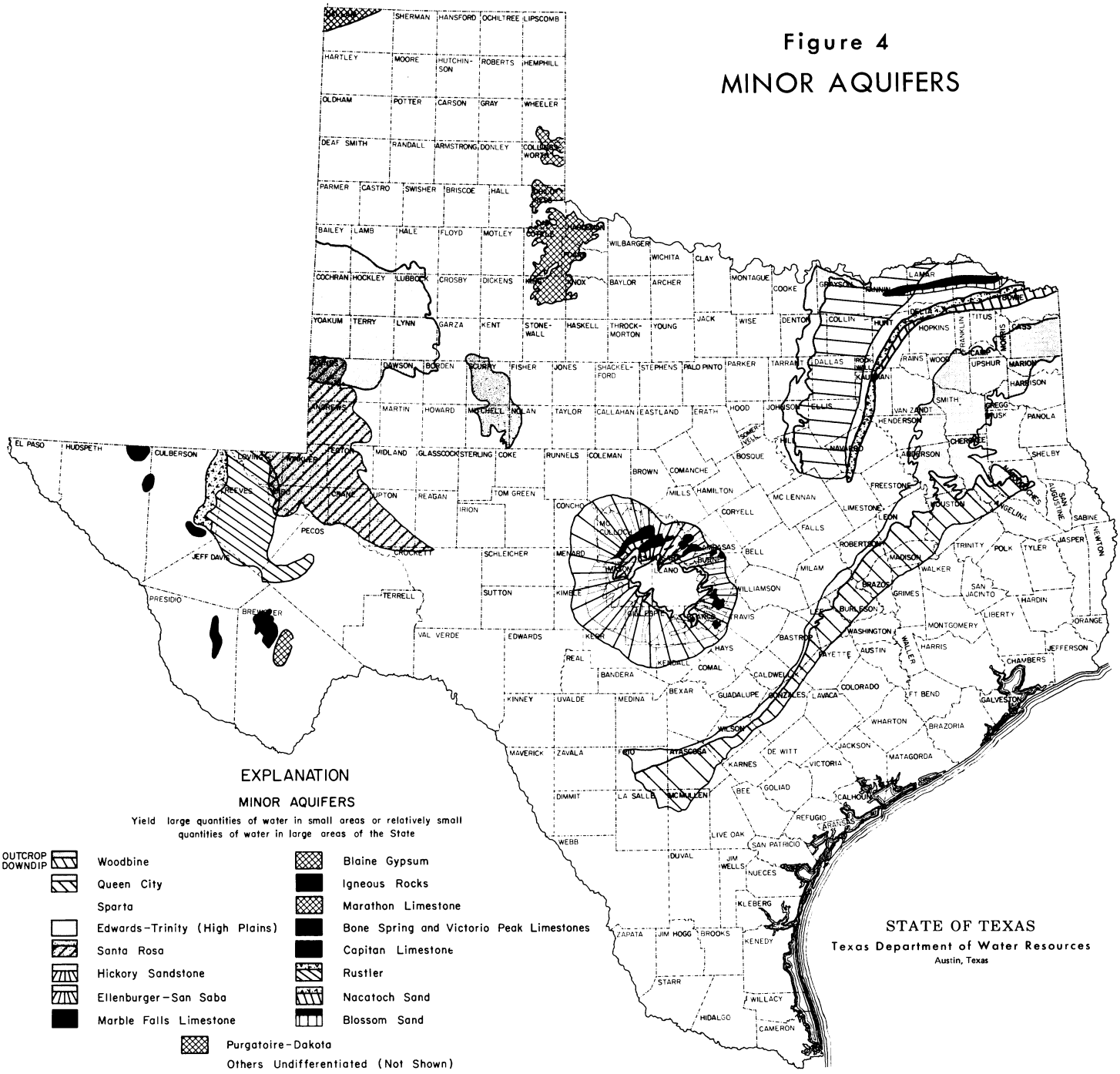


Figure 4
MINOR AQUIFERS



of this fact occurred years ago and led to the passage of the Texas Water Quality Act in 1967 which resulted in a water quality management program that contained the basic elements included in the Federal Water Quality Program.

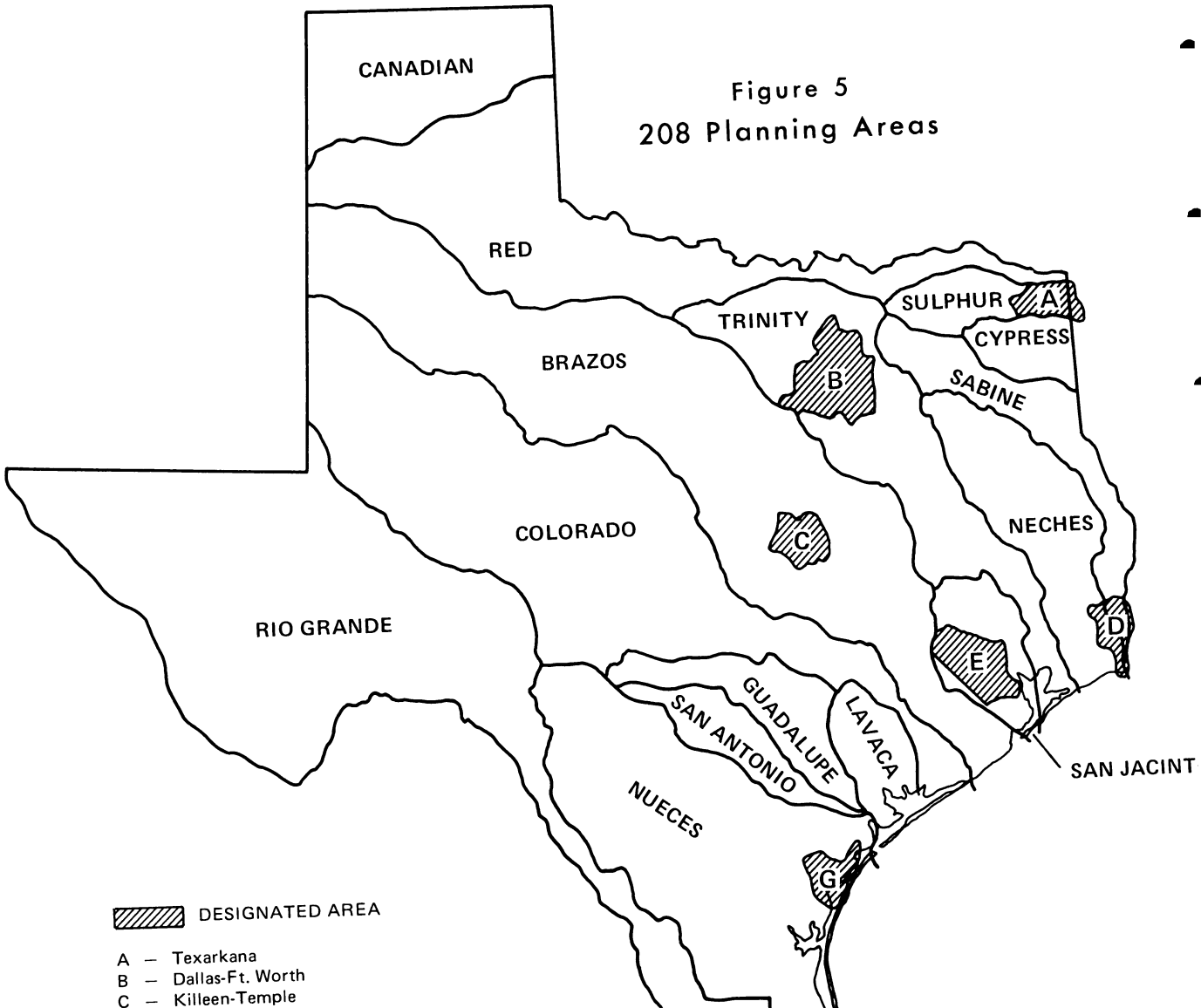
Texas has had an instream water quality monitoring program since 1956 and water quality standards (stream standards) since 1967. These water quality standards define the quality of water necessary in each stream to provide for all the beneficial uses that stream should yield.

Of the nearly 16,000 stream miles subject to quality standards, over 87 percent currently meet the 1983 fishable and swimmable goals of Federal legislation, with another 4.5 percent to 5.0 percent projected to be in compliance by 1983. About two percent will not be compliant due to natural conditions, leaving about five percent of the 16,000 miles of streams needing further work on both non-point and point pollution sources.

Basic water quality planning and areawide waste treatment and management studies were begun in 1967 and were basically complete when the Federal Water Pollution Control Act of 1972 was passed. Following passage of the Federal Act, basin planning and waste load evaluation studies were accelerated. When additional funding was made available through Section 208 of the Federal Clean Water Act, (Appendix A), Texas' planning process was reoriented to meet the requirements of the Federal Act and to provide the information and framework to insure that the national goals stated in the Act were met.

In mid-1975, the Governor designated eight urban areas of the State as areas in which intensive planning was to be done and selection of the designated planning entity for each area was made (Figure 5). The Department of Water Resources was

Figure 5
208 Planning Areas



assigned the responsibility for insuring statewide consistency and acceptability of the plans developed by the local entities. The Department was also assigned the responsibility for developing updated water quality plans for the remaining or nondesignated areas of the State.

The water quality (208) management plans for the designated areas have been completed, certified by the State, and forwarded to the Environmental Protection Agency (EPA) for approval. 1/ The water quality 208 plans for all of the non-designated areas have received conditional EPA approval with additional information being developed through the annual update process currently underway. These water quality management plans define the actions that will be taken by the State, public/private wastewater dischargers, and local agencies in order to attain water quality goals and protect the State's streams, rivers, lakes and estuaries from degradation. Significant portions of these plans are already being implemented at this time through the construction grants program and the permits program and will, with annual updating to reflect changing conditions, be relied upon to allow economic growth while simultaneously protecting Texas' valuable water resources.

Floodplain Management

All of the 254 counties in Texas have been designated by the Federal Emergency Management Agency to have some flood prone areas. Flood hazard boundry maps which indentify flood-prone areas have been published for most of the counties and many of the cities within the twenty-five (25) SMSAs (Appendix B). Also, many of the

1/ As of this writing, all but two of the 208 plans for the seven designated areas have been approved by the EPA. The Houston area plan is in EPA final review stage. The Texarkana area plan has EPA's conditional approval and is subject to revisions currently underway.

counties and cities within the SMSAs have adopted local floodplain management programs (Appendix B) in compliance with the requirements regarding participation in the National Flood Insurance Program (NFIP). Participation in the NFIP makes flood insurance available to SMSA residents presently in the floodplains, and will afford some degree of protection against monetary losses due to flooding. Enforcement of the local floodplain management programs would perhaps help to assure that future developments will be located so as to eliminate damage from the 100-year flood. Detailed Flood Insurance Rate Studies presently in various stages of completion within the SMSA's will supply detailed 10-year, 50-year, 100-year, and 500-year flood event data (Appendix B).

Population and Employment Data for Texas

Population and economic growth are the fundamental factors underlying water use and projected future water requirements of our limited water supplies is absolutely essential. Recognition of this fact nationally, Texas is third in population, first in petroleum and petrochemical production, and third in agricultural production. Since 1900, Texas has shifted from 83 percent rural population to about 80 percent urban population. Since 1950, Texas has expanded from a ranching, farming and energy based economy, to a complex, interdependent agricultural, energy, manufacturing, national defense, and services economy.

Table 1. Texas Population

Area	1960	1970	1980	1990	2000
	(Millions)				
SMSA Counties	7.1	8.7	11.3	13.9	16.4
Other Counties	2.5	2.5	2.9	3.4	4.0
State	9.6	11.2	14.2	17.3	20.4

Source: U.S. Bureau of the Census, with projections for 1990, and 2000 by the Texas Department of Water Resources.

Table 2. Texas Employment

Area	1960	1970	1980	1990	2000
	(Millions)				
SMSA Counties	2.5	3.3	5.0	6.0	7.4
Other Counties	0.8	0.8	0.9	1.1	1.5
State	3.3	4.1	5.9	7.1	8.9

Source: Texas Employment Commission, with projections for 1990 and 2000 by the Texas Department of Water Resources.

Estimated Water Use, Projected Water Requirements, and Water Supply Outlook and Water Problems

Projections for municipal water requirements in 1990 and 2000 are based upon projected population and projected per capita water use and incorporate estimated variances to take into account variations in climatic factors which affect per capita water requirements. Therefore, in the following discussion of water requirements, and in the presentation of water requirement data for each SMSA, water requirements for urban needs in 1990 and 2000 will be presented in terms of quantities needed annually under drought conditions. Projections for manufacturing, steam-electric power generation, mining, and municipal uses are based upon the best available estimates of population and economic growth and upon the assumption that water quality goals of the Federal Water Pollution Control (Clean Water) Act, as amended, will be met according to schedule. The latter affects water use per unit product, in that, in order to meet water quality goals of the Act, waste water treatment costs are increasing and water users are responding by reducing the quantity of water used per unit product produced. Agricultural water

requirements projections are based on the assumption that water use efficiency in irrigation will improve by about 10 percent per acre during the next 20 years; i.e., by the year 2000 irrigation water requirements per acre will be 10 percent less than in 1980.

In 1990, statewide water requirements for municipal, manufacturing, and other needs in urban areas have been projected at about 7.1 million acre-feet under drought conditions (Table 3). Projections for each of the SMSAs are presented later in the discussion. The 2000 statewide water requirements under drought conditions are projected at about 9.2 million acre-feet (Table 3).

During the 1980s and 1990s, available local ground water supplies in Texas for food and fiber production are projected to decrease from about 10.4 million acre-feet per year to about 4.8 million acre-feet in the year 2000, due to exhaustion of ground water reserves that supply irrigation water. By the year 2000, approximately 10.8 million acre-feet per year of additional water will be needed for irrigation to meet the needs of the growing Texas population and expanding Texas markets. Of this total, 5.5 million acre-feet are needed to maintain current irrigated acreage, and 5.3 million acre-feet are needed to support the projected agricultural growth needed. Statewide estimated 1980 water use for livestock was about 314 thousand acre-feet. Water requirements for livestock watering purposes throughout the State are projected to be 345 and 375 thousand acre-feet per year in 1990 and 2000, respectively.

In the two decades ahead, under drought conditions, water requirements for municipal, manufacturing, steam-electric power generation, and mining purposes

Table 3. Estimated Water Use and Projected Water Requirements For Urban Needs in the SMSAs and the State 1/

Area Categories	Estimated Use 1980	Projected for 1990	Projected for 2000
	(Thousands of Acre-Feet)		
SMSAs			
Municipal 2/	2,645.5	3,277.9	3,968.2
Manufacturing 3/	1,426.8	1,571.7	2,314.0
Steam-Electric 4/	182.4	247.9	288.4
Mining 5/	82.0	86.4	97.4
SMSAs Totals	4,315.7	5,183.9	6,668.4
State			
Municipal 2/	3,359.8	4,145.0	5,038.4
Manufacturing 3/	1,788.6	1,893.2	2,755.4
Steam-Electric 4/	444.8	779.3	1,053.7
Mining 5/	254.2	274.4	310.7
State Totals	5,847.4	7,091.9	9,158.2

Source: Texas Department of Water Resources projections of water required under drought conditions. One acre-foot of water is 325,851 gallons.

1/ Additional water for agriculture (irrigation and livestock watering) will be required within the SMSAs and State. Total statewide agricultural use was estimated to be 13.4 million acre-feet in 1980. Total statewide agricultural requirements are projected to be 16.0 million acre-feet per year in 1990, and 18.8 million acre-feet per year in 2000.

2/ Includes water used in cities for household purposes, fire protection, drinking and sanitation in public and commercial establishments, lawn watering, car washes, and other uses.

3/ Includes water used in the production processes and for cooling and heat exchange in manufacturing establishments.

4/ Estimated evaporation of cooling water used in stream-electric power plants. Additional water will be required for steam-electric power generation at plants outside the SMSAs which supply electrical energy to users within the SMSAs. These additional projected requirements are included in the "Steam-Electric" requirements given for the "State" in the table.

5/ Includes water used in the flooding of petroleum bearing formations to increase oil and gas production plus water used in sand and gravel and other mining activities.

in the State will increase from about 5.8 million acre-feet per year to approximately 9.2 million acre-feet per year. Of the 9.2 million acre-feet, approximately 73 percent or 6.7 million acre-feet per year will be required in the twenty-five (25) SMSAs. Of the estimated current water use in the SMSAs for urban needs, approximately 38 percent or 1.6 million acre-feet are from ground-water resources and about 62 percent or 2.7 million acre-feet are from developed surface-water resources. By the year 2000, because of physical and economic problems related to overdraft or mining of ground water, this relationship is expected to change, i.e., approximately 83 percent of the 6.7 million acre-feet of the water requirements for urban needs will have to be supplied from developed surface-water resources in or adjacent to the SMSA's.

Of the estimated 19.2 million acre-feet of water used currently in Texas, 68 percent or 13.08 million acre-feet are from ground-water resources and 32 percent or 6.16 million acre-feet are from developed surface-water resources. By the year 2000, if current water use trends continue, the State's ground water aquifers are projected to be capable of supplying about 6.8 million acre-feet annually or about 52 percent of the present level.

In most areas of the State, ground water is being withdrawn more rapidly than recharge is taking place. Currently, on a net statewide basis, approximately 7 to 8 million acre-feet per year of ground water is withdrawn from reserves or storage. This net withdrawal from reserves is causing water level declines, decreasing well yields, land subsidence, movement of geologic faults, and saline-water encroachment. Serious water-level declines are currently evident on a local and regional basis in the El Paso, High Plains, north-central, and east Texas areas. Land subsidence and fault movement are serious

problems related to overdrafts of ground water from the Gulf Coast Aquifer in the Houston region. Saline-water encroachment has caused abandonment and relocation of municipal well fields in Galveston, Brazoria and Calhoun counties. Overdrafts of ground water are causing deterioration of ground-water quality in the Lufkin, Kingsville and El Paso areas. During the drought of the 1950's, withdrawals of ground water in the San Antonio Region increased to such an extent that Comal Springs stopped flowing for several months in 1956.

Currently, without extracting ground water reserves, the total annual dependable statewide water supply is about 16.1 million acre-feet; approximately 5.1 million acre-feet of ground water from natural recharge and approximately 11.0 million acre-feet of dependable yield from surface water projects. The surface-water yield is from those reservoirs shown in blue on Figure 2 as those "existing" plus those "under construction." About 4.3 million acre-feet per year of additional dependable surface-water yield can be developed with construction of reservoirs that have been authorized by Congress plus those that are being planned by the State and local units of governments (those reservoirs in red, orange and green on Figure 2). This construction would bring the total dependable annual supply of ground and surface waters to about 20.4 million acre-feet. By the year 2000, total statewide annual projected water requirements, under drought conditions are 27.9 million acre-feet.

In several urban areas there is strong potential for serious water supply shortages in the immediate future, especially under moderate to severe drought conditions; i.e., the San Antonio, Lower Rio Grande Valley, North Central Texas, West Texas, and some cities in North and East Texas areas. During the

next two decades, overdrafts of ground water in urban areas will need to be eliminated or significantly controlled through additional, well planned, and implemented surface-water developments, and through conjunctive use of the dependable yield of surface-water projects and the sustained ground-water yields available to the areas. Cooperative local, State, and Federal planning and development programs are in progress that can, if fully implemented, effectively meet municipal, manufacturing, steam-electric power generation, and mining water requirements related to urban needs in the 1980s and 1990s. Texas is participating in Congressionally authorized efforts to find and implement solutions to meet irrigation requirements by the year 2000 and beyond, which cannot be met with intra-state water resources.

Description of Abilene SMSA - The SMSA is area No. 1 on Figure 1, and is composed of Callahan, Jones, and Taylor counties which cover about 2,724 square miles in parts of the Brazos and Colorado River basins. Normal annual precipitation of the area ranges from 22 to 26 inches. The mean annual temperatures range from about 62°F to 65°F. The principal city is Abilene.

Economy of Abilene SMSA - The area economy is characterized by higher-than-average concentrations in the agricultural, mining, and military sectors. The electrical components manufacturing industry is the most important source of manufacturing employment. Manufacturing contributes 9.1 percent to the total personal income of the SMSA. The regional economic outlook is for continuing dependence on agriculture and trade with increasing employment opportunities in manufacturing and oil production.

Water Quality Planning in Abilene SMSA - A background discussion of the purpose, scope, goals, status, etc. of Section 208 (P.L. 92-500) water quality planning in Texas is given in the "Statewide Perspective" section of this report. The majority of the Abilene SMSA is located in the Brazos Basin State Planning Area with the remainder being located in the Colorado Basin State Planning Area. The Brazos River Authority, through contract with the TDWR, serves as the basin water quality planning agency. The most important activity performed during the initial planning was the identification of those entities which potentially

had wastewater treatment needs within five years. For those areas so identified, the sewage treatment needs were determined for a 20 year period. With respect to continuing planning, the SMSA has not been identified for special studies. Therefore, the major planning activity will be the continued assessment of sewage treatment needs within a 20 year time frame, and the designation of sewage collection and treatment management agencies. Intensive public participation activities were carried out during the initial planning and will be continued during the continuing planning process. A water quality advisory committee has been established in the Brazos Basin State Planning Area. The committee has representation from four groups: public officials, economic interests, public interests, and private citizens. The committee will review and make recommendations on planning outputs.

Floodplain Management Program in the Abilene SMSA - The Federal Emergency Management Agency has designated all three counties and 17 incorporated cities in the Abilene SMSA as being subject to potential flooding problems from a 100-year flood event (Appendix B). Flood hazard boundary maps identifying flood-prone areas have been published for one of the three counties and for 13 of the incorporated cities in the SMSA (Appendix B). Presently, only six cities in the SMSA (Appendix B) have adopted local floodplain management programs in compliance with the requirements regarding participation in the National Flood Insurance Program (NFIP). Participation in the NFIP makes flood insurance available to SMSA residents presently in the floodplain and will afford some degree of protection against monetary losses due to flooding. Enforcement of the local floodplain management programs would assure that future developments will be located so as to eliminate damage from the 100-year flood. As of March 17, 1980, the City of Buffalo Gap is the only entity

within the SMSA which has had a Detailed Flood Insurance Rate Study completed to supply detailed 10-year, 50-year, 100-year, and 500-year flood event data (Appendix B).

Population and Employment in Abilene SMSA

Item	1960	1970	1980	1990	2000
	(thousands)				
Total Population	128.3	122.2	139.1	154.8	171.3
Urban Population	108.5	106.6	118.1	129.3	144.3
Other Population	19.8	15.6	21.0	25.5	27.0
Employment	44.3	44.6	63.3	70.0	80.7

Estimated Water Use and Projected Water Requirements Within the Abilene SMSA 1/

Demand Categories	Estimated Use	Projected Requirements	
	1980	1990	2000
	(Thousands of Acre-feet)		
Municipal 2/	34.2	38.8	43.8
Manufacturing 3/	2.2	2.3	2.8
Steam-Electric 4/	0.8	0.8	0.8
Mining 5/	0.8	0.7	0.7
SMSA Totals	38.0	42.6	48.1

Source: Texas Department of Water Resources projections of water required under drought conditions. One acre-foot of water is 325,851 gallons.

1/ Additional water for agriculture (irrigation and livestock watering) will be required within the SMSA. Total SMSA agricultural uses were estimated at 14.0 thousand acre-feet in 1980. Projected future irrigation water requirements for 1990 and 2000 are not presented because urban growth within the SMSA and the resulting potential for this growth to impinge on irrigation in the area has not been predicted. (See footnote 1/, Table 1 for estimated total statewide irrigation water requirements for 1980, 1990 and 2000).

2/ Includes water used in cities for household purposes, fire protection, drinking and sanitation in public and commercial establishments, lawn watering, car washes, and other uses.

3/ Includes water used in the production processes and for cooling and heat exchange in manufacturing establishments.

4/ Estimated evaporation of cooling water used in steam-electric power plants. Additional water will be required for steam-electric power generation at plants outside the SMSA which supply electrical energy to users within the SMSA.

5/ Includes water used in the flooding of petroleum bearing formations to increase oil and gas production plus water used in sand and gravel and other mining activities.

Water Supply Outlook and Problems in the Abilene SMSA - Currently within the SMSA, approximately 88 percent of the water used for urban needs (municipal, manufacturing, steam-electric power generation, and mining) is supplied by developed surface-water resources. The remaining 12 percent is supplied by ground-water resources. In the year 2000, approximately 94 percent of the area's projected urban water requirements are expected to be supplied by developed surface-water resources, and approximately six percent by the very limited ground-water resources, available in and adjacent to the SMSA for urban needs.

Many of the smaller yet growing urban water systems within the SMSA have been and will continue to be faced with problems related to physical conditions, facility costs, and water rights. Many of the smaller, growing systems are located in areas distant from reliable sources of supply. Under this condition, the cost of required delivery and treatment facilities to develop a reliable supply may be relatively high in relation to costs for other cities within the SMSA. Also, sufficient surface or ground-water rights to adequately fulfill the water needs of the smaller urban systems may not be readily available or may not be accessible through a larger system having water rights.

Surface-water facilities currently serving the Abilene SMSA (Stamford Lake, Clyde Lake, Abilene Lake, Kirby Lake, Fort Phantom Hill Lake and diversions from the Clear Fork Brazos River - Figure 6), plus additional supplies available to the SMSA from Hubbard Creek Lake (Figure 6) in Stephens County (outside the SMSA) are expected to be adequate to meet projected municipal and manufacturing water requirements of the SMSA through the 1980s. These surface water facilities, the Clear Fork Brazos diversion, and associated return flows are expected to be capable of providing about 47.0 thousand acre-feet per year

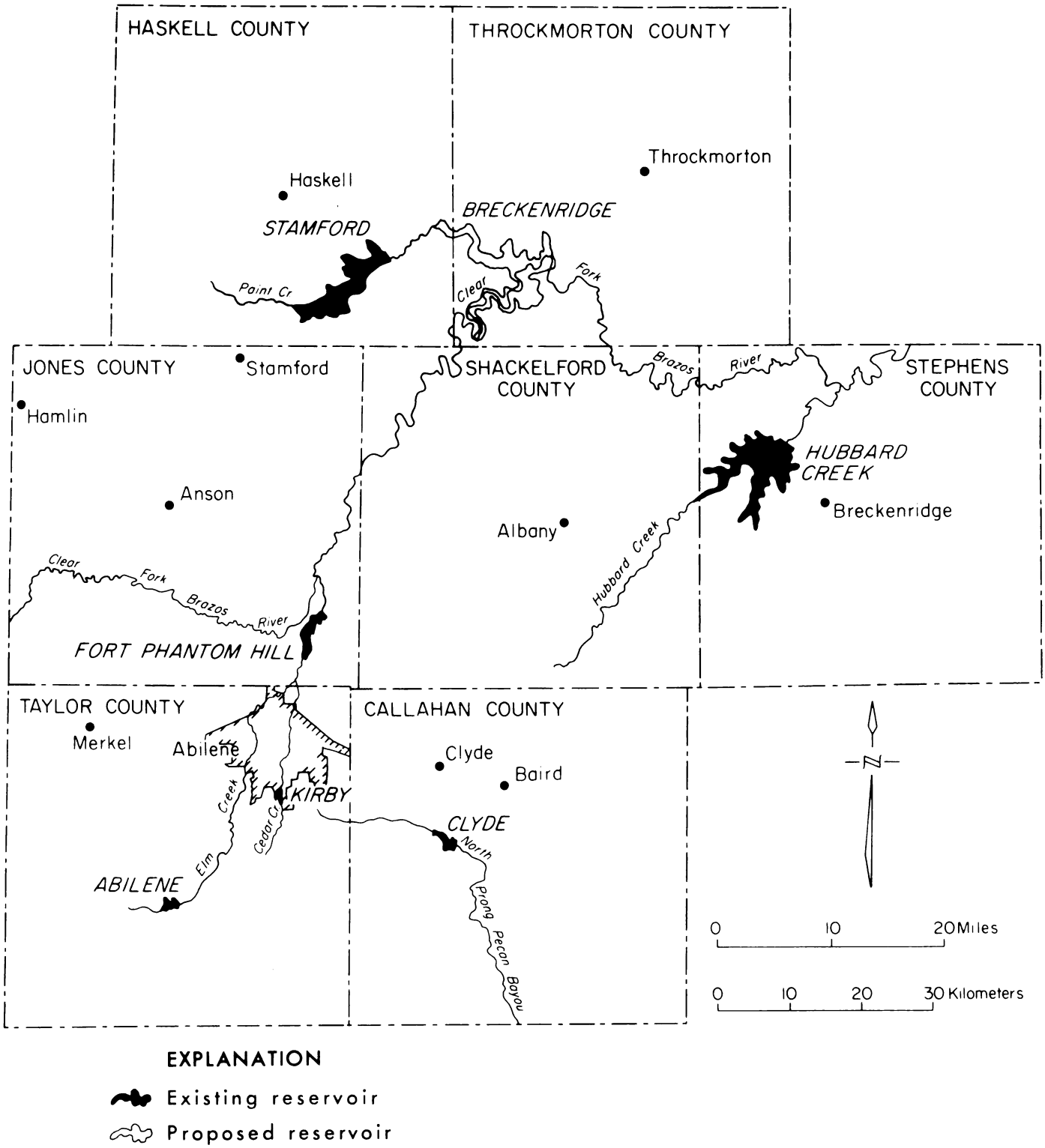


Figure 6

Abilene SMSA Water Supply Projects

of dependable supply through the year 2000 under drought conditions. However, any further significant increases in the salinity of water stored in Hubbard Creek Lake over current levels, and further degradation of the Clear Fork Brazos River diversion into Fort Phantom Hill Lake, under specified river-flow conditions, could result in severe water supply problems in the SMSA. Also in the 1990's, water requirements of the municipal water systems at Stamford and Hamlin (Jones County within the SMSA) are expected to exceed the dependable yield of Lake Stamford, which also must support the operation of a steam-electric power plant located at the lake in Haskell County (outside the SMSA).

The long-term projected municipal and manufacturing water needs of the SMSA are expected to exceed the supplies currently available to the area in about the year 2015. Possible solutions to this problem include 1) construction of the potential Breckenridge Reservoir on the Clear Fork Brazos River in southwestern Throckmorton County (Figure 6), or 2) diversions from Possum Kingdom Lake which is located in Palo Pinto County a considerable distance east of the SMSA. (Figure 2). Water from Possum Kingdom Lake, which has high salinity, would be used for oil field secondary recovery purposes releasing current secondary recovery demands on Lake Hubbard Creek for municipal urban water needs.

High concentrations of fluoride, nitrate, sulfate, chloride, and total dissolved solids are often encountered in ground-water supplies from the Alluvium and Trinity Group Aquifers (See Figure 3). Salinity coupled with the low permeability of the aquifers and low recharge rates do not permit adequate amounts of ground water to be developed for moderate to large municipal and manufacturing supplies.

Description of Amarillo SMSA - The SMSA is area No. 2 on Figure 1, and is composed of Potter and Randall counties which cover about 1,812 square miles in parts of the Canadian and Red River basins. Normal annual precipitation is about 20 inches. Mean annual temperatures range from about 56°F to 58°F. The principal city is Amarillo.

Economy of Amarillo SMSA - The area economy is characterized by high concentrations of employment in agriculture, trade, transportation, communication, and public utilities. The agricultural products and processing industries are important sources of manufacturing employment. Manufacturing contributes 7.6 percent to the total personal income of the SMSA. The regional economic outlook is for continuing dependence on agriculture with increasing employment opportunities caused by a rapid recent industrial expansion.

Water Quality Planning in Amarillo SMSA - A background discussion of the purpose, scope, goals, status, etc. of Section 208 (P.L. 92-500) water quality planning in Texas is given in the "Statewide perspective" section of this report. The City of Amarillo is located in both Potter and Randall counties and on the basin divide between the Canadian and the Red River basins (Canadian and Red River Basin State Planning Areas). For planning purposes, the City of Amarillo was assigned to the Canadian River basin. The Texas Department of Water Resources contracted with the Panhandle Regional Planning Commission for water quality planning work in the Canadian Basin State Planning Area and with the Red River Authority for water quality planning work in the Red River Basin State Planning Area.

It appears that most of the projected population growth in the Canadian River basin will occur in Amarillo and the surrounding area. Necessary improvements to the two Amarillo wastewater treatment plans were previously identified through a Section 201, P.L. 92-500 construction grants facility plan and documented in the Section 208 plan. A number of communities and subdivisions having septic tanks surround the Amarillo area. These are regulated by the Amarillo Bi-City County Health Department, a joint agency of Amarillo, Canyon, Potter County, and Randall County. Long-term needs for wastewater facilities for these communities were identified as part of the planning process. Some sampling to determine the effects of urban runoff in the Amarillo area was carried out as part of the Canadian Basin Plan. The conclusion of the study was that pollutants from urban runoff was not a serious problem warranting additional study. In continuing planning, needs for wastewater facilities for those communities not addressed in the initial plan will be considered both in the Red and Canadian River basins. All planning recommendations will be considered by local committees having representation from four groups: public officials, economic interests, public interests, and private citizens. Similar committees were active in the initial planning process.

Floodplain Management Program in the Amarillo SMSA - The Federal Emergency Management Agency has designated both counties and three incorporated cities in the SMSA as being subject to potential flooding problems from a 100-year flood event (Appendix B). Flood hazard boundary maps identifying flood-prone areas have been published for both counties and the incorporated cities in the SMSA (Appendix B). Presently, one of the counties and all three cities (Appendix B) have adopted local floodplain management programs in compliance with the requirements regarding participation in the National Flood Insurance Program (NFIP). Participation in the NFIP makes flood insurance available to SMSA residents presently in the floodplain and will afford some degree of

protection against monetary losses due to flooding. Enforcement of the local floodplain management programs would assure that future developments will be located so as to eliminate damage from the 100-year flood. Detailed Flood Insurance Rate Studies presently in various stages of completion will supply detailed 10-year, 50-year, 100-year, and 500-year flood event data for one county and three cities in the SMSA (Appendix B).

Population and Employment in Amarillo SMSA

Item	1960	1970	1980	1990	2000
			(thousands)		
Total Population	149.5	144.4	173.6	202.1	227.3
Urban Population	143.8	135.3	159.9	183.6	204.3
Other Population	5.7	9.1	13.7	18.5	23.0
Employment	53.9	59.2	84.3	97.1	107.6

Estimated Water Use and Projected Water Requirements Within the Amarillo SMSA 1/

Demand Categories	Estimated Use 1980	Projected Requirements 1990	2000
	(Thousands of Acre-feet)		
Municipal 2/	46.2	54.5	61.9
Manufacturing 3/	3.5	3.5	4.8
Steam-Electric 4/	15.0	20.0	20.0
Mining 5/	0.3	0.3	0.4
SMSA Totals	65.0	78.3	87.1

Source: Texas Department of Water Resources projections of water required under drought conditions. One acre-foot of water is 325,851 gallons.

1/ Additional water for agriculture (irrigation and livestock watering) will be required within the SMSA. Total SMSA agricultural uses were estimated at 14.0 thousand acre-feet in 1980. Projected future irrigation water requirements for 1990 and 2000 are not presented because urban growth within the SMSA and the resulting potential for this growth to impinge on irrigation in the area has not been predicted. (See footnote 1/, Table 1 for estimated total statewide irrigation water requirements for 1980, 1990 and 2000).

2/ Includes water used in cities for household purposes, fire protection, drinking and sanitation in public and commercial establishments, lawn watering, car washes, and other uses.

3/ Includes water used in the production processes and for cooling and heat exchange in manufacturing establishments.

4/ Estimated evaporation of cooling water used in steam-electric power plants. Additional water will be required for steam-electric power generation at plants outside the SMSA which supply electrical energy to users within the SMSA.

5/ Includes water used in the flooding of petroleum bearing formations to increase oil and gas production plus water used in sand and gravel and other mining activities.

Water Supply Outlook and Problems in the Amarillo SMSA - Through the year 2000, the City of Amarillo water system plus steam-electric power generation plants within the SMSA are expected to continue to obtain most of their water supplies from Lake Meredith (Canadian River basin - See Figure 7) through the Canadian River Municipal Water Authority, and various City of Amarillo well fields completed in the Ogallala Aquifer in Deaf Smith, Randall and Carson counties (Figure 7). Currently within the SMSA, approximately 52 percent of the water used for urban needs (municipal, manufacturing, steam-electric power generation, and mining) is supplied by ground-water resources. The remaining 48 percent is supplied by Lake Meredith. In the year 2000, approximately 58 percent of the area's projected urban water requirements are expected to be supplied by ground-water resources of the Ogallala Aquifer, and approximately 48 percent by the limited surface-water resources of Lake Meredith. However, during the next 20 years, water-level declines and related declines of well yields are expected to continue in the Ogallala Aquifer due to large overdrafts of ground water. If this situation should adversely effect the productivity and performance of the currently established well fields, then part of the Amarillo System's water requirements may have to be met by available treated return flows from the system. To increase their ground-water supply, the City of Amarillo uses Bivins Lake (Figure 7) to artifically recharge the Ogallala in the Randall County well fields south-west of the City.

Many of the smaller yet growing urban water systems within the SMSA have been and will continue to be faced with problems related to physical conditions, facility costs, and water rights. Many of the smaller, growing systems are located in areas distant from reliable sources of supply. Under this condition, the cost of required delivery and treatment facilities to develop a reliable

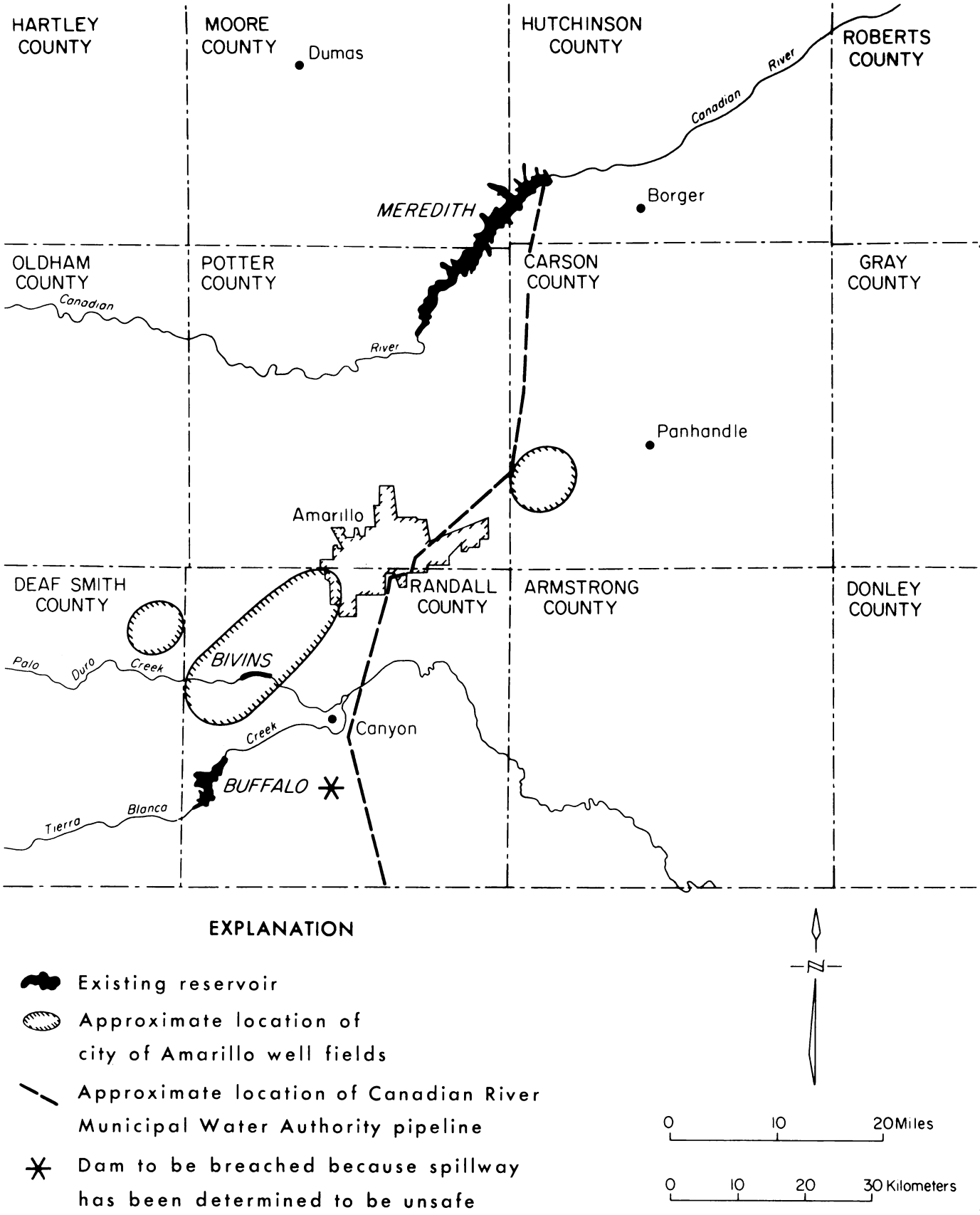


Figure 7

Amarillo SMSA Water Supply Projects

water supply may be relatively high in relation to costs for other cities within the SMSA. Also, sufficient surface or ground-water rights to adequately fulfill the water needs of the urban systems may not be readily available or may not be accessible through a larger system having water rights.

Exports from Lake Meredith to Amarillo and other member cities of the Canadian River Municipal Water Authority in the Canadian, Red, Brazos, and Colorado River basins will probably continue on a long-term basis. The dependable supply from Lake Meredith for urban needs within the Amarillo SMSA is about 38.2 thousand acre-feet annually under terms of the contract between Amarillo and the Canadian River Municipal Water Authority. It is anticipated that this supply can be supplemented by annual return flows which will produce a total surface-water supply of approximately 42.7 thousand acre-feet and 46.6 thousand acre-feet in 2000 and 2030 respectively. Projected long-term water requirements of the Amarillo SMSA will have to continue to be met through a combination of ground- and surface-water supplies, even though ground water in the Ogallala Aquifer will continue to be depleted. It is very likely that after the year 2000, the Amarillo system will have to develop additional Ogallala well fields; particularly in areas north of the Canadian River where sufficient saturated thickness is expected to be present to support such well fields. However, it is emphasized that new well fields in the Ogallala will ultimately be dewatered as is the case of present well fields, due to the fact that recharge to the Ogallala formation is quite low.

Salinity of water stored in Lake Meredith is expected to continue to present a problem until measures for alleviating this problem are implemented. The U.S. Water and Power Resources Service (formerly Bureau of Reclamation) is

conducting studies and preparing to implement salinity control measures in the upstream reaches of the Canadian Basin which would include the installation of a well field, pipeline, and brine disposal lake near and downstream of Conchas Lake. It is estimated that these measures would divert about 30 percent of the present salt load that now enters Lake Meredith into a salt lake, and thus would improve the quality of Lake Meredith water.

Description of Austin SMSA - The SMSA is area No. 3 on Figure 1, and is composed of Travis, Williamson, and Hays counties which cover about 2,766 square miles in parts of the Colorado, Brazos and Guadalupe River basins. Normal annual precipitation ranges from about 30 to 36 inches. Mean annual temperatures range from 66°F to 68°F. The principal city is Austin.

Economy of the Austin SMSA - The area's economy has experienced recent rapid expansion in the manufacturing, construction, and real estate sectors, but it remains concentrated in the sectors of government, wholesale and retail trade, and services. Electronics and other high-technology industries have become the most important source of manufacturing employment. Manufacturing which contributes 8.4 percent to the total personal income of the Austin SMSA. The regional economic outlook is for continuing dependence on state and local government earnings with increasing employment opportunities in the steadily growing industrial sector.

Water Quality Planning in Austin SMSA - A background discussion of the purpose, scope, goals, status, etc. of Section 208 (P.L. 92-500) water quality planning in Texas is given in the "Statewide Perspective" section of this report. Through contact with the TDWR, the Lower Colorado River Authority was the local planning agency responsible for the initial 208 water quality program. A primary concern of the 208 program in this area has been to study the effects of urban runoff on the lakes. A sampling program initiated in 1977 established a starting point to quantify loadings associated with urban runoff. This program is being expanded under the Nationwide Urban Runoff Program, Lake Austin Study, through the efforts

of the City of Austin, the TDWR, and the U.S. Environmental Protection Agency. An upgrading of wastewater treatment plants within the SMSA has resulted from past water quality management programs. The 208 program includes a public participation program which involves the general public. In the initial phase of the program a "208 Citizens Advisory Committee" contributed to the various aspects of the program for the lower portion of the Colorado Basin. This committee, and an advisory committee of the Austin Nationwide Urban Runoff Program contribute to the various aspects of the continuing planning program. The 208 Citizens Advisory Committee has representation from four categories of citizens: private citizens, public interest, public officials and economic interest. This committee reviews all documents developed under the program.

Floodplain Management Program in the Austin SMSA - The Federal Emergency Management Agency has designated all three counties and 18 incorporated cities in the SMSA as being subject to potential flooding problems from a 100-year flood event (Appendix B). Flood hazard boundary maps identifying flood-prone areas have been published for the three counties and for 16 of the incorporated cities in the SMSA (Appendix B). Presently, one county and 16 cities (Appendix B) have adopted local floodplain management programs in compliance with the requirements regarding participation in the National Flood Insurance Program (NFIP). Participation in the NFIP makes flood insurance available to SMSA residents presently in the floodplain and will afford some degree of protection against monetary losses due to flooding. Enforcement of the local floodplain management programs would assure that future developments will be located so as to eliminate damage from the 100-year flood. Detailed Flood Insurance Rate Studies presently in various stages of completion will

supply detailed 10-year, 50-year, 100-year, and 500-year flood event data for one county and 11 cities in the SMSA (Appendix B).

Population and Employment in Austin SMSA

Item	1960	1970	1980	1990	2000
	(thousands)				
Total Population	267.1	360.5	532.4	715.7	924.6
Urban Population	219.9	294.9	409.3	536.3	691.0
Other Population	47.2	65.6	123.1	179.4	233.6
Employment	96.2	142.0	241.9	239.4	310.9

Estimated Water Use and Projected Water Requirements Within the Austin SMSA 1/

Demand Categories	Estimated Use	Projected Requirements	
	1980	1990	2000
	(Thousands of Acre-feet)		
Municipal 2/	140.9	192.2	252.2
Manufacturing 3/	4.8	6.0	8.9
Steam-Electric 4/	15.9	12.0	12.0
Mining 5/	0.9	0.9	1.1
SMSA Totals	162.5	211.1	274.2

Source: Texas Department of Water Resources projections of water required under drought conditions. One acre-foot of water is 325,851 gallons.

1/ Additional water for agriculture (irrigation and livestock watering) will be required within the SMSA. Total SMSA agricultural uses were estimated at 6.4 thousand acre-feet in 1980. Projected future irrigation water requirements for 1990 and 2000 are not presented because urban growth within the SMSA and the resulting potential for this growth to impinge on irrigation in the area has not been predicted. (See footnote 1/, Table 1 for estimated total statewide irrigation water requirements for 1980, 1990 and 2000).

2/ Includes water used in cities for household purposes, fire protection, drinking and sanitation in public and commercial establishments, lawn watering, car washes, and other uses.

3/ Includes water used in the production processes and for cooling and heat exchange in manufacturing establishments.

4/ Estimated evaporation of cooling water used in steam-electric power plants. Additional water will be required for steam-electric power generation at plants outside the SMSA which supply electrical energy to users within the SMSA.

5/ Includes water used in the flooding of petroleum bearing formations to increase oil and gas production plus water used in sand and gravel and other mining activities.

Water Supply Outlook and Problems in the Austin SMSA - Currently within the SMSA, approximately 82 percent of the water used for urban needs (municipal, manufacturing, steam-electric power generation, and mining purposes) is supplied by developed surface-water resources in and adjacent to the SMSA. The remaining 18 percent is supplied by ground-water resources. In the year 2000, approximately 89 percent of the SMSA's projected urban water requirements are expected to be supplied by developed surface-water resources, and approximately 11 percent by ground-water resources.

Many of the smaller yet growing urban water systems within the SMSA have been and will continue to be faced with problems related to physical conditions, facility costs, and water rights. Many of the smaller, growing systems are located in areas distant from reliable sources of supply. Under this condition, the cost of required delivery and treatment facilities to develop a reliable supply may be relatively high in relation to costs for other cities with the SMSA. Also, sufficient surface or ground-water rights to adequately fulfill the water needs of the smaller urban systems may not be readily available or may not be accessible through a larger system having water rights.

The City of Austin water system and other large to moderate urban water systems within Travis and Hays counties in the Colorado River basin portion of the SMSA can be adequately supplied through the year 2030 by surface water from Lake Travis and Buchanan (Figure 8). City of Austin operated power plants in the SMSA are expected to continue to obtain their water supplies from Lake Walter E. Long and the Colorado River (Figure 8). Currently, Lakes Travis and Buchanan also supply water for urban and irrigation needs downstream in the lower Colorado River basin as well as portions of the adjacent Lavaca River basin, the Colorado-Lavaca Coastal basin, and and the Brazos-Colorado Coastal

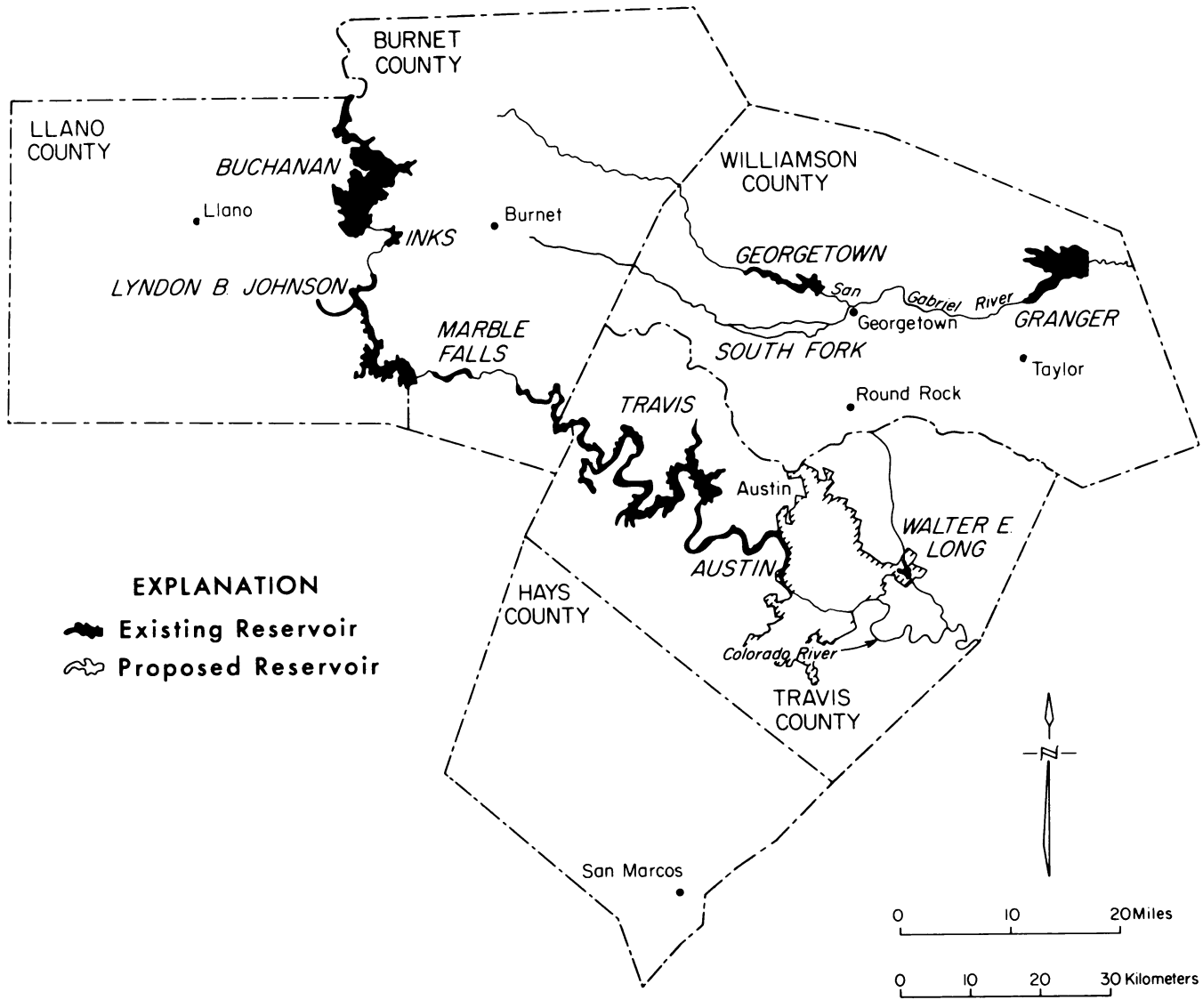


Figure 8

Austin SMSA Water Supply Projects

basin in Fayette, Colorado, Wharton, and Matagorda counties (Figure 2). Projected urban and irrigation requirements for these areas downstream from the SMSA indicate that surface-water supplies from Lake Travis and Buchanan will have to be supplemented with an additional surface-water supply between 1995 and the year 2000.

Municipal and manufacturing systems within the Guadalupe River basin portion of Hays County will continue through the year 2030 to obtain their water supply from the Edwards (Balcones Fault Zone) Aquifer (Figure 3).

In Williamson County, rapidly declining ground-water levels, and in some cases the inferior quality of ground-water supplies, dictate that future ground-water pumpage for municipal and manufacturing purposes not exceed the current level. In the early 1980's, the recently completed Lakes Georgetown and Granger (Figure 8) will contain water supplies for urban water systems in Williamson County. The dependable supplies of these reservoirs will be capable of meeting the projected urban water needs in Williamson County through about the year 2005, provided adequate conveyance and treatment facilities are installed. After the year 2005, the growing urban systems in Williamson County will have to seek additional supplies perhaps from South Fork Lake (proposed reservoir) on the south San Gabriel River in Williamson County, and from Stillhouse Hollow and Belton Lakes (existing reservoirs) in Bell County (Figure 2), if other arrangements can be made to meet the downstream needs in the lower Brazos River basin now being served by these reservoirs.

Description of the Beaumont-Port Arthur-Orange SMSA - The SMSA is area No. 4 on Figure 1, and is composed of Jefferson, Orange and Hardin counties which cover about 2,207 square miles in parts of the Neches, Sabine and Trinity River basins and the Neches-Trinity Coastal basin. Normal annual precipitation ranges from 50 to more than 56 inches. Mean annual temperatures range from about 67°F to 69°F. The principal cities are Beaumont, Port Arthur and Orange.

Economy of the Beaumont-Port Arthur-Orange SMSA - Manufacturing, contract construction, and port activity are the major economic sectors of the area. Petroleum refining, petrochemicals, shipbuilding and wood processing are the major sources of manufacturing employment. Manufacturing contributes 35.7 percent of the total personal income of the SMSA. The regional economic outlook is for continuing specialization in the processing of extractive materials.

Water Quality Planning in Beaumont-Port Arthur-Orange SMSA - A background discussion of the purpose, scope, goals, status, etc. of Section 208 (P.L. 92-500) water quality planning in Texas is given in the "Statewide Perspective" section of this report. In 1975, the Governor of Texas and the U.S. Environmental Protection Agency designated the South East Texas Regional Planning Commission (SETRPC) as the areawide water quality management planning agency for the Beaumont-Port Arthur area, under Section 208 of the Federal Water Pollution Control Act amendments of 1972 (P.L. 92-500). The designated planning area includes portions of Jefferson, Orange, and Hardin counties and includes most of the Beaumont-Port Arthur-Orange SMSA. The

goal of 208 planning in the southeast Texas area has been to formulate an areawide plan which protects the integrity of area waters without creating adverse economic impacts. To accomplish this goal, the SETRPC established a program which encompassed: stream quality modeling; inventories and projections of point and nonpoint sources of pollution; formulation of alternative technical plans capable of handling these sources of pollution; analyses of the effectiveness of plans in the improvement of water quality; and an evaluation of the environmental, socio-economic and political impacts of these alternative technical plans. The SETRPC will be assessing and evaluating nonpoint sources of pollution such as urban and agricultural runoff. This will be done by sampling and monitoring of the stream segments. SETRPC will analyze these studies and determine their significance in determining what control measures need to be implemented. Public participation is involved in all of the continuing planning programs. The "208 Citizens Advisory Committee" of SETRPC includes representation from four groups; private citizens, public interest, public officials, and economic interests. This committee reviews all documents released by SETRPC. The SETRPC is also assisting the Texas Department of Water Resources in the identification of Waste Treatment Management Agencies for the designated area and also identifying the waste treatment needed for communities through the year 2000 in five year increments. These needs are expressed in three categories: collection systems, interceptor lines, and sewage treatment plant construction or rehabilitation.

Floodplain Management Program in Beaumont-Port Arthur-Orange SMSA - The Federal Emergency Management Agency has designated all three counties and 23 incorporated cities in the Beaumont-Port Arthur-Orange SMSA as being subject to potential flooding problems from a 100-year flood event (Appendix B). Flood hazard boundary maps identifying flood-prone areas have been published for the three counties and for 20 of the incorporated cities in the SMSA

(Appendix B). Presently, the three counties and 19 of the cities in the SMSA (Appendix B) have adopted local floodplain management programs in compliance with the requirements regarding participation in the National Flood Insurance Program (NFIP). Participation in the NFIP makes flood insurance available to SMSA residents presently in the floodplain and will afford some degree of protection against monetary losses due to flooding. Enforcement of the local floodplain management programs would assure that future developments will be located so as to eliminate damage from the 100-year flood. Detailed Flood Insurance Rate Studies presently in various stages of completion will supply detailed 10-year, 50-year, 100-year, and 500-year flood event data for all three counties and 22 cities in the SMSA (Appendix B).

Population and Employment in Beaumont-Port Arthur-Orange SMSA

Item	1960	1970	1980	1990	2000
	(thousands)				
Total Population	330.6	347.6	372.4	414.1	469.7
Urban Population	280.0	290.0	296.4	320.4	357.5
Other Population	50.6	57.6	76.0	93.7	112.2
Employment	112.9	124.3	148.3	166.1	191.1

Estimated Water Use and Projected Water Requirements Within the Beaumont-Port Arthur-Orange SMSA 1/

Demand Categories	Estimated Use 1980	Projected Requirements 1990	2000
	(Thousands of Acre-feet)		
Municipal 2/	73.8	83.8	96.5
Manufacturing 3/	256.8	226.4	315.5
Steam-Electric 4/	16.0	22.5	22.5
Mining 5/	10.8	8.4	8.9
SMSA Totals	357.1	341.1	443.4

Source: Texas Department of Water Resources projections of water required under drought conditions. One acre-foot of water is 325,851 gallons.

1/ Additional water for agriculture (irrigation and livestock watering) will be required within the SMSA. Total SMSA agricultural uses were estimated at 190.7 thousand acre-feet in 1980. Projected future irrigation water requirements for 1990 and 2000 are not presented because urban growth within the SMSA and the resulting potential for this growth to impinge on irrigation in the area has not been predicted. (See footnote 1/, Table 1 for estimated total statewide irrigation water requirements for 1980, 1990 and 2000)

2/ Includes water used in cities for household purposes, fire protection, drinking and sanitation in public and commercial establishments, lawn watering, car washes, and other uses.

3/ Includes water used in the production processes and for cooling and heat exchange in manufacturing establishments.

4/ Estimated evaporation of cooling water used in steam-electric power plants. Additional water will be required for steam-electric power generation at plants outside the SMSA which supply electrical energy to users within the SMSA.

5/ Includes water used in the flooding of petroleum bearing formations to increase oil and gas production plus water used in sand and gravel and other mining activities.

Water Supply Outlook and Problems in the Beaumont-Port Arthur-Orange SMSA -

Currently within the SMSA, approximately 85 percent of the water used for urban needs (municipal, manufacturing, steam-electric power generation, and mining purposes) is supplied by developed surface-water resources in and adjacent to the SMSA. The remaining 15 percent is supplied by ground-water resources. In the year 2000, approximately 92 percent of the SMSA's projected urban water

requirements are expected to be supplied by developed surface-water resources, and approximately eight percent by ground-water resources.

As indicated in the "Projected Water Requirements" within the SMSA (see table above), the reduction of the projected manufacturing water requirements from 1980 to 1990 results from expected compliance with the clean water goals of P.L. 92-500, the Federal Water Pollution Control (Clean Water) Act. The cost of treatment methods and facilities needed to meet the effluent water quality standards required by the Act is expected to result in a reduction in the quantity of manufacturing water used within the SMSA; particularly in the petroleum refining, petrochemical, and wood processing industries. The reduction in projected water requirements for mining is expected because of improved technology in the use of water for mining purposes; particularly in the petroleum industry's enhanced recovery operations.

Many of the smaller yet growing urban water systems within the SMSA have been and will continue to be faced with problems related to physical conditions, facility costs, and water rights. Many of the smaller, growing systems are located in areas distant from reliable sources of supply. Under this condition, the cost of required delivery and treatment facilities to develop a reliable supply may be relatively high in relation to costs for other cities within the SMSA. Also, sufficient surface or ground-water rights to adequately fulfill the water needs of the smaller urban systems may not be readily available or may not be accessible through a larger system having water rights.

Through the year 2030, there will be more than enough dependable supply from Lakes Sam Rayburn, B.A. Steinhagen, (both in the lower Neches River basin), and Toledo Bend (lower Sabine River Basin) (Figure 9) to meet the surface-water requirements for all expected needs of the SMSA, and all of the remaining expected

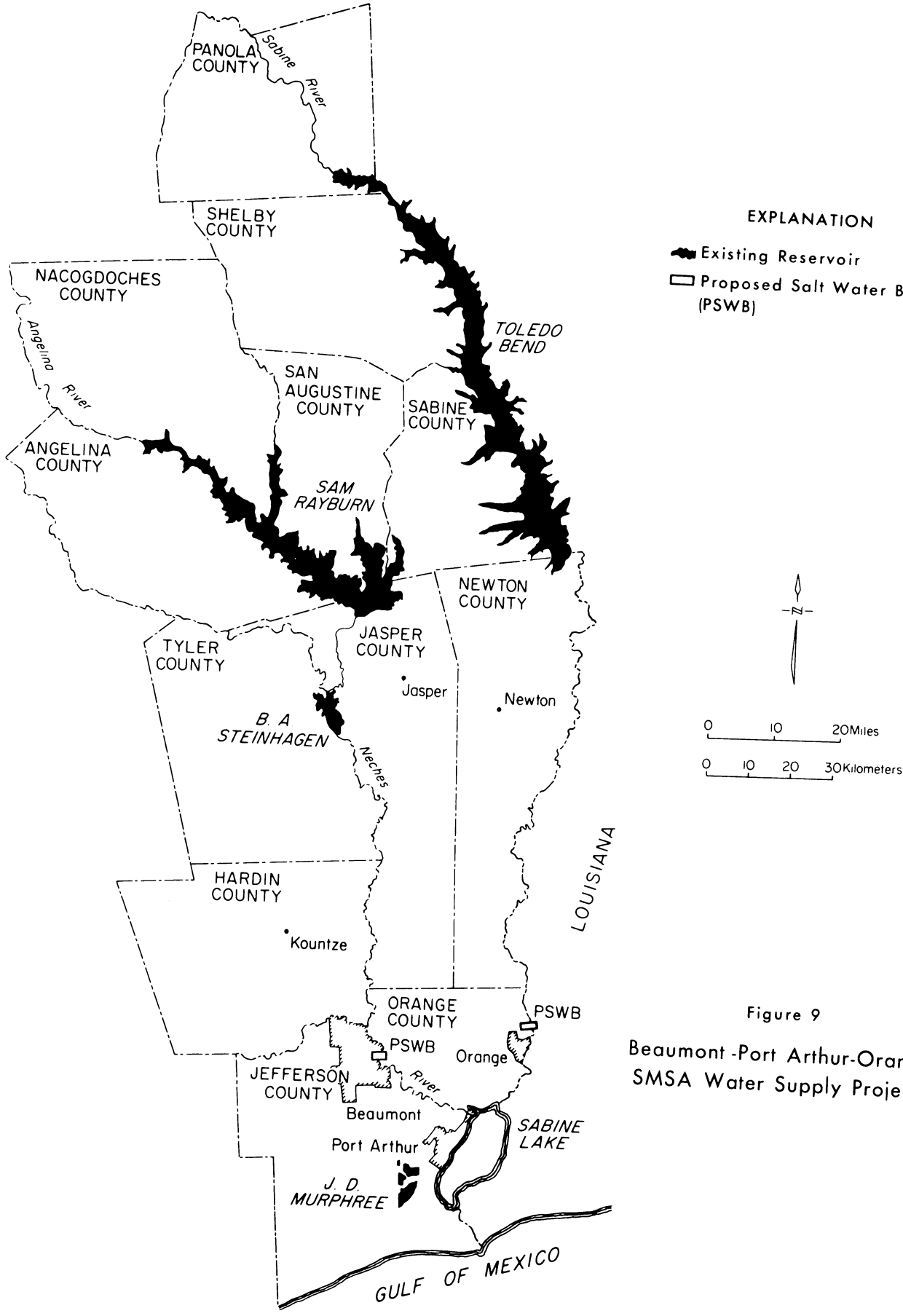


Figure 9

Beaumont-Port Arthur-Orange SMSA Water Supply Projects

needs (municipal, manufacturing, steam-electric power, and irrigation) of the lower Neches River basin, lower Sabine River basin (Texas), and the Jefferson County area of the Neches-Trinity Coastal Basin. The dependable supply of these reservoirs will be about 2.08 and 2.33 million acre-feet in the years 2000 and 2030, respectively. The total projected demand on these reservoirs for all uses (urban and agricultural in and adjacent to the SMSA) will be approximately 0.73 and 1.44 million acre-feet in 2000 and 2030 respectively.

With these reservoirs, both the lower Sabine and lower Neches River basins will have surface-water surpluses after meeting the projected in-basin needs; including the SMSA and the needs of the SMSA in Jefferson County within the Neches-Trinity Coastal basin. Except during recurrences of critical drought periods, surpluses in excess of both in-basin needs and the fresh-water requirements of the Sabine Lake estuarine system will be available for conveyance to water-deficient areas, such as part of the Houston SMSA, provided institutional arrangements can be made, and adequate conveyance facilities are constructed. Additional surface-water surpluses within the lower Sabine and lower Neches River basins could be obtained by the year 2030 with construction of Lakes Bon Wier, Big Cow Creek, and Rockland (Figure 2).

During periods of low flow and high water withdrawals, salt water from Sabine Lake and the Gulf of Mexico intrudes the Sabine and Neches Rivers in sufficient quantities to contaminate the fresh-water supplies for urban needs within the SMSA. To prevent contamination of these water supplies, permanent salt water barriers need to be constructed at the locations shown on Figure 9. The small amounts of water requirements for navigation facilities associated with these barriers can be met from the projected surpluses in the two river basins.

The J.D. Murphree Wildlife Management Area Impoundments (a group of shallow reservoirs - Figure 9) are owned and operated by the Texas Parks and Wildlife Department for wildlife management purposes. Surface-water supplies are delivered to these reservoirs by major canal systems originating in the Neches and Trinity River basins.

Description of Brownsville-Harlingen-San Benito SMSA - The SMSA is area No. 5 on Figure 1, and is composed of Cameron County which covers about 896 square miles in parts of the Rio Grande basin and the Nueces-Rio Grande Coastal basin. Normal annual precipitation ranges from 24 to 26 inches. Mean annual temperature is about 73.5°F. The principal cities are Brownsville, Harlingen, and San Benito.

Economy of Brownsville-Harlingen-San Benito SMSA - The area economy is characterized by high concentrations in the agriculture and trade sectors. Food processing and apparel production are the most important source of manufacturing employment. Manufacturing contributes 13.2 percent to the total personal income of the SMSA. The regional outlook is for rapid growth with enhanced industrial potential and continuing emphasis on agriculture.

Water Quality Planning in Brownsville-Harlingen-San Benito SMSA - A background discussion of the purpose, scope, goals, status, etc. of Section 208 (P.L. 92-500) water quality planning in Texas is given in the "Statewide Perspective" section of this report. The SMSA is located within the Lower Rio Grande Valley Designated Area. In 1975, the Governor designated the Lower Rio Grande Valley Development Council (LRGVDC) as the planning agency of this designated area. One of the most important activities accomplished under the initial plan was the identification of the municipal wastewater management needs and cost for a 20 year period. Existing and projected wasteloads were evaluated and sewage treatment plat effluent limitations were recommended. Continuing planning activities are mainly focused on

determining the extent and impacts of agriculturally related potential nonpoint sources of pollution including nutrients, heavy metals, and pesticides. This is being accomplished through related activities of the LRGVDC, the TDWR, the Texas State Soil and Water Conservation Board, and the U.S. Fish and Wildlife Service. The investigation is being carried out because U.S. Fish and Wildlife Service data show some high values of pesticide contamination in fish. Data from the U.S. Corps of Engineers, TDWR and Texas Parks and Wildlife Department also show some high pesticide concentrations in either fish or sediments. Since the valley area contains intensive agriculture production, which uses large quantities of pesticides, the extent and impacts of the pesticides and other materials on water quality and fish life needs to be determined. Another activity will be determining the management agency requirements and wastewater treatment needs of the many unincorporated communities or "colonies" which occur in the Rio Grande Valley. Intensive public participation activities were carried out during the initial planning and will be continued during the continuing planning process. A water quality advisory committee has been established in the Lower Rio Grande Valley Designated Area. The committee has representation from four groups: public officials, economic interests, public interests, and private citizens. The committee will review and make recommendations on planning outputs.

Floodplain Management Program in the Brownsville-Harlingen-San Benito SMSA - The Federal Emergency Management Agency has designated Cameron County and 14 incorporated cities in the Brownsville-Harlingen-San Benito SMSA as being subject to potential flooding problems from a 100-year flood event (Appendix B). Flood hazard boundary maps identifying flood-prone areas have been published for the county and for 13 of the incorporated cities in the SMSA

(Appendix B). Presently, the county and 11 cities in the SMSA (Appendix B) have adopted local floodplain management programs in compliance with the requirements regarding participation in the National Flood Insurance Program (NFIP). Participation in the NFIP makes flood insurance available to SMSA residents presently in the floodplain and will afford some degree of protection against monetary losses due to flooding. Enforcement of the local floodplain management programs would assure that future developments will be located so as to eliminate damage from the 100-year flood. Detailed Flood Insurance Rate Studies presently in various stages of completion will supply detailed 10-year, 50-year, 100-year, and 500-year flood event data for Cameron County and 10 cities in the SMSA (Appendix B).

Population and Employment in Brownsville-Harlingen-San Benito SMSA

Item	1960	1970	1980	1990	2000
			(thousands)		
Total Population	151.1	140.4	208.1	263.6	324.8
Urban Population	116.5	110.9	160.4	202.8	254.8
Other Population	34.6	29.5	47.7	60.8	70.0
Employment	43.3	40.2	65.2	81.8	105.9

Estimated Water Use and Projected Water Requirements Within the Brownsville-Harlingen-San Benito SMSA 1/

Demand Categories	Estimated Use 1980	Projected Requirements 1990	2000
	(Thousands of Acre-feet)		
Municipal 2/	49.0	63.8	80.8
Manufacturing 3/	4.8	5.1	6.8
Steam-Electric 4/	2.8	2.8	2.8
Mining 5/	0.1	0.1	0.1
SMSA Totals	56.7	71.8	90.5

Source: Texas Department of Water Resources projections of water required under drought conditions. One acre-foot of water is 325,851 gallons.

1/ Additional water for agriculture (irrigation and livestock watering) will be required within the SMSA. Total SMSA agricultural uses were estimated at 393.1 thousand acre-feet in 1980. Projected future irrigation water requirements for 1990 and 2000 are not presented because urban growth within the SMSA and the resulting potential for this growth to impinge on irrigation in the area has not been predicted. (See footnote 1/, Table 1 for estimated total statewide irrigation water requirements for 1980, 1990 and 2000).

2/ Includes water used in cities for household purposes, fire protection, drinking and sanitation in public and commercial establishments, lawn watering, car washes, and other uses.

3/ Includes water used in the production processes and for cooling and heat exchange in manufacturing establishments.

4/ Estimated evaporation of cooling water used in steam-electric power plants. Additional water will be required for steam-electric power generation at plants outside the SMSA which supply electrical energy to users within the SMSA.

5/ Includes water used in the flooding of petroleum bearing formations to increase oil and gas production plus water used in sand and gravel and other mining activities.

Water Supply Outlook and Problems in the Brownsville-Harlingen-San Benito SMSA - Currently within the SMSA, approximately 97 percent of the water used for urban needs (municipal, manufacturing, steam-electric power generation, and mining purposes) is supplied by developed surface-water resources in and adjacent to the SMSA. The remaining three percent is supplied by ground-water resources. In the year 2000, approximately 99 percent of the SMSA's projected urban water requirements are expected to be supplied by developed surface-water resources, and approximately one percent by ground-water resources.

Many of the growing urban water systems within the SMSA have been and will continue to be faced with problems related to physical conditions, facility costs, and water rights. Many of the systems are located in areas distant from reliable sources of supply. Under this condition, the cost of required delivery and treatment facilities to develop a reliable supply may be relatively high in relation to costs. Also, sufficient surface or ground-water rights to adequately fulfill the water needs of these urban systems may not be readily available or may not be accessible through an entity having water rights.

The SMSA occurs within the Lower Rio Grande Valley which will continue to be provided, along with the Middle Rio Grande Valley, surface water from the Lake Amistad-Lake Falcon system (Figure 10). Supplies from the system for in-basin needs, as well as needs for the southern portion of the Nueces-Rio Grande Coastal basin in the Lower Rio Grande Valley, are presently allocated on the basis of 1977 rules of the Texas Water Commission. These rules are based upon water rights recognized in the "Lower Rio Grande Valley Water Case," and in the Middle Rio Grande (between Lake Amistad and Lake Falcon) upon a "Final Determination" of water rights and claims by the Commission. The 1977 specific water allocation for urban uses from the reservoir system is about 186.0 thousand acre-feet per year. Total urban water needs within the SMSA and other areas served by the Lake Amistad-Lake Falcon system are expected to reach about 291.7 thousand acre-feet in the year 2000. Serious regional urban water shortages within the Lake Amistad-Lake Falcon service area are expected to occur between 1985 and 1990 based on the current urban water allocation (supply) of 186.0 thousand acre-feet. Under present conditions, an additional 100.0 thousand acre-feet of storage in Lake Amistad and Lake Falcon are set aside for emergency urban needs under drought conditions for the Middle and Lower Rio Grande Valleys for authorized allocations by the adjudication certificates.

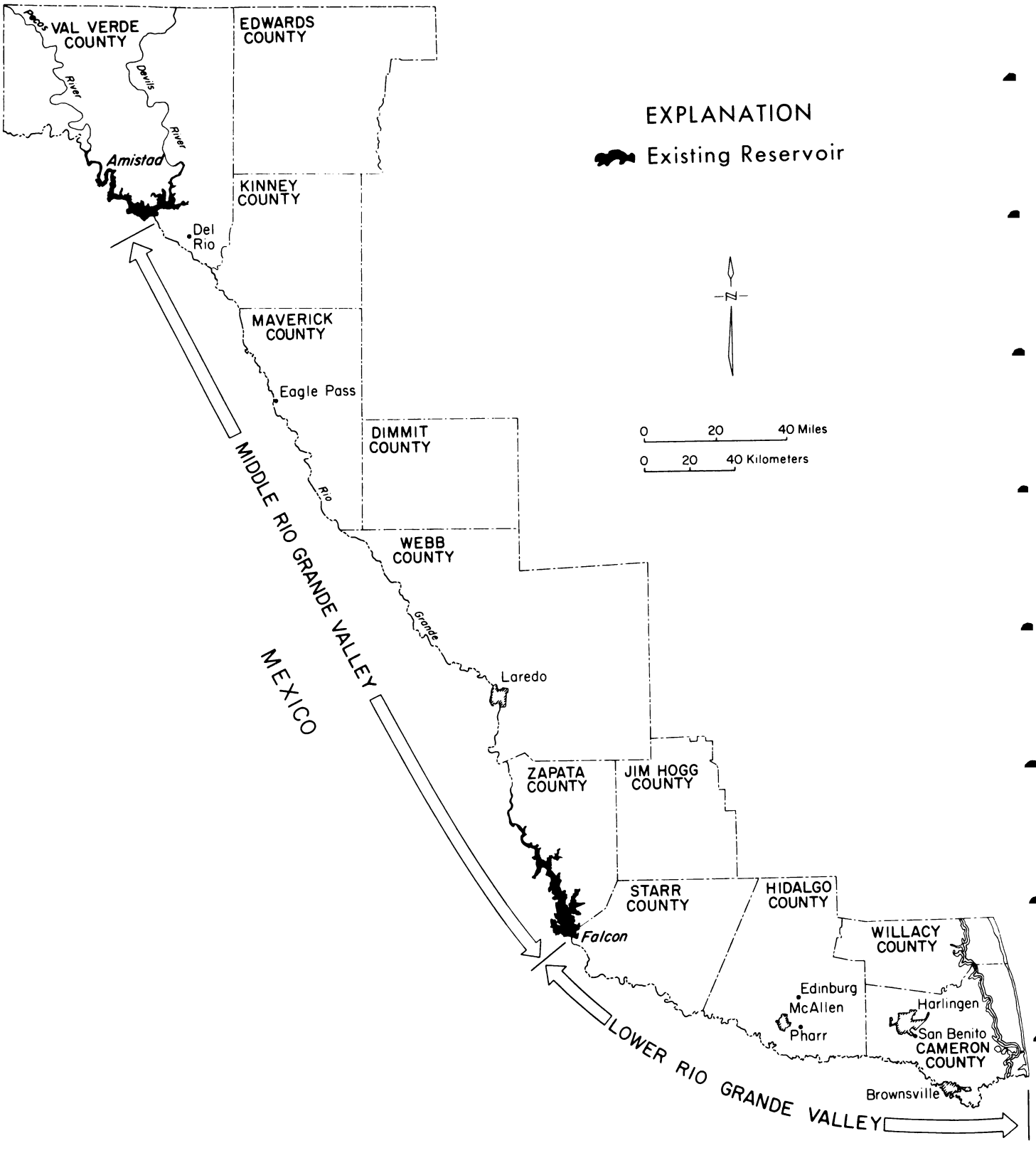


Figure 10

Brownsville-Harlingen-San Benito SMSA Water Supply Projects

On the basis of experience of the irrigators served by the Lake Amistad-Lake Falcon system, and the results of the Department's analysis of long-term reservoir operation studies of the system conducted by the International Boundary and Water Commission, shortages of water necessary to meet the full demands of the currently adjudicated acreage in the Lower Valley below Lake Falcon (about 740 thousand acres or about 1.87 million acre-feet of water) are expected to occur more than 70 percent of the time, although substantial or serious shortages would occur less than 30 percent of the time. During critical drought periods, substantial shortages will occur and a significant part of the current irrigated acreage will have no irrigation water supply.

High concentrations of total dissolved solids are often encountered in ground-water supplies from the Gulf Coast Aquifer (Figure 3) within the SMSA. Salinity coupled with the low permeability of the aquifer and low recharge rates do not permit adequate amounts of ground water to be developed for moderate to large municipal and manufacturing supplies within the SMSA.

BRYAN-COLLEGE STATION SMSA

Description of Bryan-College Station SMSA - The SMSA is area No. 6 on Figure 1, and is composed of Brazos County which covers about 586 square miles in the Brazos River basin. Normal annual precipitation ranges from 26 to 40 inches. Mean annual temperature is about 68°F. Principal cities are Bryan and College Station.

Economy of Bryan-College Station SMSA - The area economy is characterized by a significant concentration of employment in the state and local government sector, with recent increases of activity in the mining and manufacturing sectors. Aluminum building products is an important source of manufacturing employment, and contributes 6.4 percent to the total personal income of the SMSA. The economic outlook for the SMSA is rapid growth of Texas A&M University and continued activity in the mining and manufacturing sectors.

Water Quality Planning in Bryan-College Station SMSA - A background discussion of the purpose, scope, goals, status, etc. of Section 208 (P.L. 92-500) water quality planning in Texas is given in the "Statewide Perspective" section of this report. The SMSA is located in the Brazos Basin State Planning Area. The Brazos River Authority, through contracts with the Texas Department of Water Resources, serves as the Brazos River basin planning agency. The most important activity performed during the initial planning was the identification of those entities which potentially had wastewater treatment needs within five years. For those areas so identified, the sewage treatment needs were determined for a 20-year period. With respect to continuing planning, the SMSA has not been identified for special studies.

Therefore, the major planning activity will be the continued assessment of sewage treatment needs within a 20 year time frame, and the designation of sewage treatment and collection management agencies. Intensive public participation activities were carried out during the initial planning and will be continued during the continuing planning process. A water quality advisory committee has been established in the Brazos Basin State Planning Area. The committee membership represents four groups: public officials, economic interests, public interests, and private citizens. The committee will review and make recommendations on planning outputs.

Floodplain Management Program in the Bryan-College Station SMSA - The Federal Emergency Management Agency has designated Brazos County and the two incorporated cities in the SMSA as being subject to potential flooding problems from a 100-year flood event (Appendix B). Flood hazard boundary maps identifying flood-prone areas have been published for both the county and the incorporated cities in the SMSA (Appendix B). Presently, the two cities in the SMSA have adopted local floodplain management programs (Appendix B) in compliance with the requirements regarding participation in the National Flood Insurance Program (NFIP). Participation in the NFIP makes flood insurance available to SMSA residents presently in the floodplain and will afford some degree of protection against monetary losses due to flooding. Enforcement of the local floodplain management programs would assure that future developments will be located so as to eliminate damage from the 100-year flood. Detailed Flood Insurance Rate Studies presently in various stages of completion will supply detailed 10-year, 50-year, 100-year, and 500-year flood event data for the two incorporated cities in the SMSA (Appendix B).

Population and Employment in Bryan-College Station SMSA

Item	1960	1970	1980	1990	2000
	(thousands)				
Total Population	44.9	58.0	93.5	115.2	139.4
Urban Population	38.9	51.4	81.6	97.4	113.6
Other Population	6.0	6.6	11.9	17.8	25.8
Employment	15.6	21.9	40.0	48.6	59.8

Estimated Water Use and Projected Water Requirements Within the Bryan-College Station SMSA 1/

Demand Categories	Estimated Use 1980	Projected Requirements 1990	2000
	(Thousands of Acre-feet)		
Municipal 2/	22.2	27.5	33.4
Manufacturing 3/	1.6	1.9	2.7
Steam-Electric 4/	2.0	22.0	22.0
Mining 5/	0.3	0.3	0.3
SMSA Totals	26.1	51.7	58.4

Source: Texas Department of Water Resources projections of water required under drought conditions. One acre-foot of water is 325,851 gallons.

1/ Additional water for agriculture (irrigation and livestock watering) will be required within the SMSA. Total SMSA agricultural uses were estimated at 7.4 thousand acre-feet in 1980. Projected future irrigation water requirements for 1990 and 2000 are not presented because urban growth within the SMSA and the resulting potential for this growth to impinge on irrigation in the area has not been predicted. (See footnote 1/, footnote 1/, Table 1 for estimated total statewide irrigation water requirements for 1980, 1990 and 2000.)

2/ Includes water used in cities for household purposes, fire protection, drinking and sanitation in public and commercial establishments, lawn watering, car washes, and other uses.

3/ Includes water used in the production processes and for cooling and heat exchange in manufacturing establishments.

4/ Estimated evaporation of cooling water used in steam-electric power plants. Additional water will be required for steam-electric power generation at plants outside the SMSA which supply electrical energy to users within the SMSA.

5/ Includes water used in the flooding of petroleum bearing formations to increase oil and gas production plus water used in sand and gravel and other mining activities.

Water Supply Outlook and Problems in the Bryan-College Station SMSA - Currently within the SMSA, all of the water used for urban needs (municipal, manufacturing, steam-electric power generation, and mining purposes) is supplied by developed ground water resources in the SMSA.

In the year 2000, approximately 70 percent of the SMSA's projected urban water requirements are expected to be supplied by developed surface-water resources, and approximately 30 percent by ground-water resources.

Many of the smaller yet growing urban water systems within the SMSA have been and will continue to be faced with problems related to physical conditions, facility costs, and water rights. Many of the smaller, growing systems are located in areas distant from reliable sources of supply. Under this condition, the cost of required delivery and treatment facilities to develop a reliable supply may be relatively high in relation to costs for other cities within the SMSA. Also, sufficient surface or ground-water rights to adequately fulfill the water needs of the smaller urban systems may not be readily available or may not be accessible through a larger system having water rights.

Based on projected water requirements and estimated ground-water yields, the cities of Bryan and College Station, as well as other smaller urban water systems and power plants in the SMSA, will need to acquire surface-water to supplement current ground-water supplies. The authorized Corps of Engineers' reservoirs on the Navasota River-Lakes Millican and Navasota-will provide the major part of these supplemental requirements provided development of the Navasota River can be implemented in a timely manner. The Millican

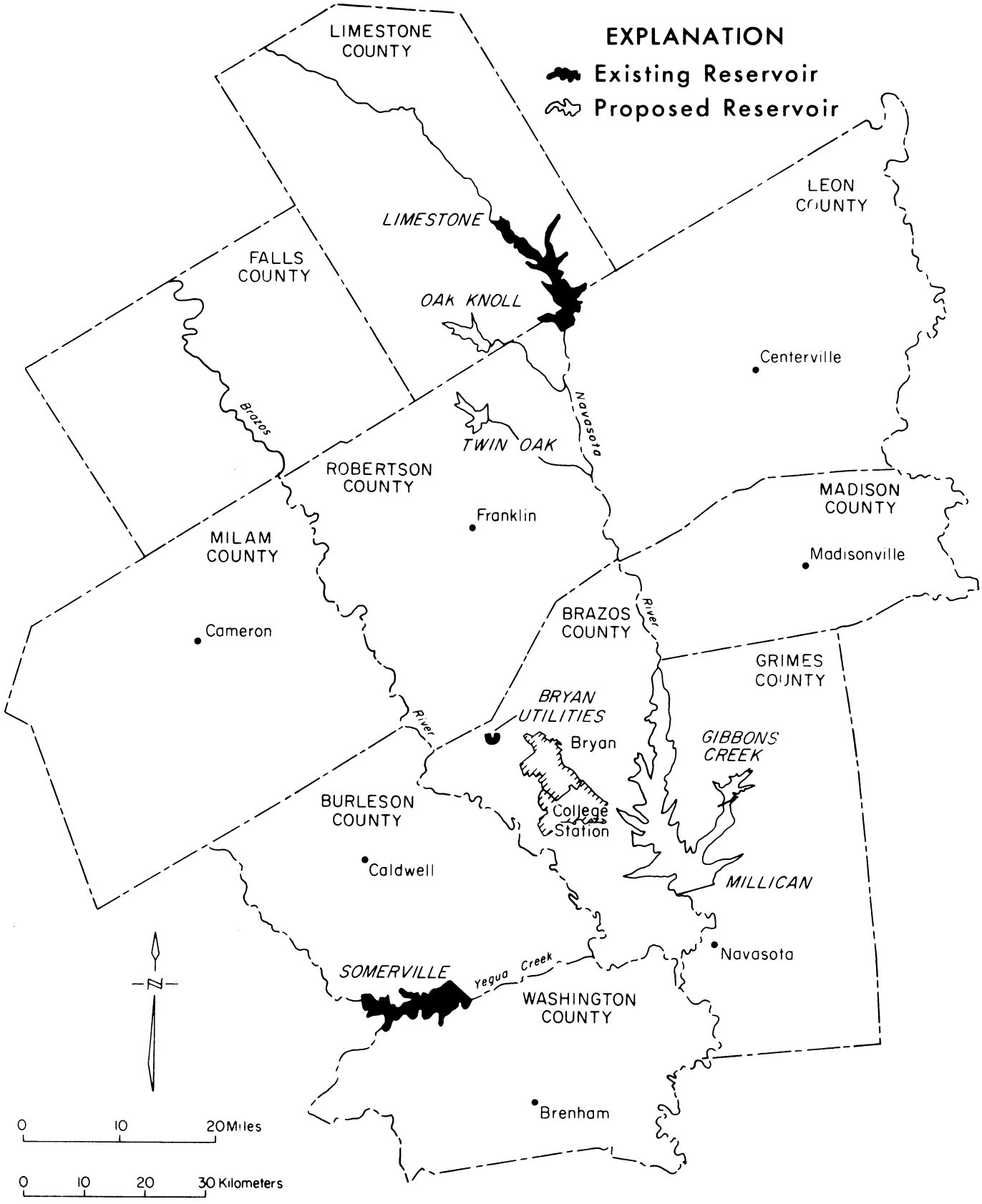


Figure 11

Bryan-College Station SMSA Water Supply Projects

Reservoir Project, authorized for construction first, is in the advanced engineering and design phase. However, the existence of potentially commercial, near-surface lignite deposits in the reservoir area, part of which has been acquired by utilities, poses a significant conflict. The Corps of Engineers is currently reassessing the plan of development for the Navasota River, which includes examination of several alternatives and possible reformulation of the authorized plan of development of the Navasota River. For current planning purposes, it has been assumed that the authorized Millican Lake will be constructed before the year 2000. This would provide an additional firm yield of 141.6 thousand acre-feet annually to the basin supply. The authorized Navasota Lake project would be constructed during the period 2000 to 2030.

Between 1995 and 2000, additional surface-water supplies will be needed in and adjacent to the SMSA. Lake Millican, a proposed reservoir on the Navasota River in Brazos and Grimes counties (Figure 11), could provide an additional dependable yield of about 144.1 thousand acre-feet to meet the additional urban and irrigation needs within and adjacent to the SMSA.

In the year 2000, urban water systems within the SMSA are expected to be using about 15 thousand acre-feet per year of ground-water from the Carrizo-Wilcox Aquifer (Figure 3) and Queen City Aquifer (Figure 4). Bryan Utilities Lake (Figure 11) in Brazos County is owned by the City of Bryan and is used to store a small amount of local surface-water runoff as a supplemental water supply. The lake is also used to store and cool a small amount of high temperature ground water pumped from the city's well field near the lake.

Description of Corpus Christi SMSA - The SMSA is area No. 7 on Figure 1, and is composed of Nueces and San Patricio counties which cover about 1,526 square miles in parts of the Nueces River basin and the San Antonio-Nueces and Nueces-Rio Grande Coastal basins. Normal annual precipitation ranges from 26 to 32 inches. Mean annual temperatures range from about 71°F to 72°F. The principal city is Corpus Christi.

Economy of Corpus Christi SMSA - The area economy is weighted toward the agricultural, mining and construction sectors. Port activity, refining, petrochemicals, and production of offshore drilling equipment are important sources of manufacturing employment, and contribute 11.7 percent to the total personal income of the SMSA. The regional economic outlook is for continuing dependence on the port and continued growth in the petrochemical and drilling equipment industries.

Water Quality Planning in the Corpus Christi SMSA - A background discussion of the purpose, scope, goals, status, etc. of Section 208 (P.L. 92-500) water quality planning in Texas is given in the "Statewide Perspective" section of this report. In 1975, the Governor of Texas and the Environmental Protection Agency designated the Coastal Bend Council of Governments (CBCOG) as the areawide planning agency for the Corpus Christi designated area, under Section 208 of the Federal Water Pollution Control Act (Public Law 92-500). The study area includes significant parts of Aransas, Nueces and San Patricio counties The 208 planning program began on August 1,

1975 with the development of a work program to guide the study. One main objective was to develop a cost-effective and implementable plan that would meet the 1983 goals of the Act. Other objectives dealt with water pollution problems, nonstructural approaches to pollution control, deficiencies in collection, transportation and treatment of residential and industrial wastes, point and nonpoint sources of pollution and their interrelationship. Other objectives were the development and selection of a management system best suited for assuring implementation of the plan and the production of a method for periodic review and updating of the plan. The resulting plan, developed by the CBCOG consists of eleven Interim Reports. Public participation is involved in all of the continuing planning programs. The 208 Planning Advisory Committee for the lower Nueces River basin has representation from four groups: private citizens, public officials, public interests, and economic interests. This committee reviews all documents released by CBCOG. CBCOG is also assisting the Texas Department of Water Resources in the identification of waste treatment management agencies for the designated area and also identifying the needs for communities through the year 2000 in five year increments. The needs are expressed in three categories: collection systems, interceptor and sewage treatment plant construction or rehabilitation. In 1981-1982 the CBCOG will continue to develop long-range water quality management programs.

Floodplain Management Program in the Corpus Christi SMSA - The Federal Emergency Management Agency has designated both counties and 14 incorporated cities in the Corpus Christi SMSA as being subject to potential flooding problems from a 100-year flood event (Appendix B). Flood hazard boundary maps identifying flood-prone areas have been published for both counties

and the 14 incorporated cities in the SMSA (Appendix B). Presently, all counties and 13 cities in the SMSA have adopted local floodplain management programs (Appendix B) in compliance with the requirements regarding participation in the National Flood Insurance Program (NFIP). Participation in the NFIP makes flood insurance available to SMSA residents presently in the floodplain and will afford some degree of protection against monetary losses due to flooding. Enforcement of the local floodplain management programs would assure that future developments will be located so as to eliminate damage from the 100-year flood. Detailed Flood Insurance Rate Studies presently in various stages of completion will supply detailed 10-year, 50-year, 100-year, and 500-year flood event data for both counites and 13 cities in the SMSA (Appendix B).

Population and Employment in Corpus Christi SMSA

Item	1960	1970	1980	1990	2000
			(thousands)		
Total Population	266.6	284.8	324.2	363.6	402.1
Urban Population	215.6	262.4	296.5	333.3	371.1
Other Population	51.0	22.4	27.7	30.3	31.0
Employment	82.4	96.3	133.8	146.4	166.3

Estimated Water Use and Projected Water Requirements Within the Corpus Christi SMSA 1/

Demand Categories	Estimated Use 1980	Projected Requirements 1990	2000
	(Thousands of Acre-feet)		
Municipal 2/	73.7	84.3	95.7
Manufacturing 3/	43.1	41.6	52.4
Steam-Electric 4/	3.3	3.3	3.3
Mining 5/	1.9	2.0	2.1
SMSA Totals	I22.0	131.2	153.5

Source: Texas Department of Water Resources projections of water required under drought conditions. One acre-foot of water is 325,851 gallons.

1/ Additional water for agriculture (irrigation and livestock watering) will be required within the SMSA. Total SMSA agricultural uses were estimated at 7.5 thousand acre-feet in 1980. Projected future irrigation water requirements for 1990 and 2000 are not presented because urban growth within the SMSA and the resulting potential for this growth to impinge on irrigation in the area has not been predicted. (See footnote 1/, Table 1 for estimated total statewide irrigation water requirements for 1980, 1990 and 2000).

2/ Includes water used in cities for household purposes, fire protection, drinking and sanitation in public and commercial establishments, lawn watering, car washes, and other uses.

3/ Includes water used in the production processes and for cooling and heat exchange in manufacturing establishments.

4/ Estimated evaporation of cooling water used in steam-electric power plants. Additional water will be required for steam-electric power generation at plants outside the SMSA which supply electrical energy to users within the SMSA.

5/ Includes water used in the flooding of petroleum bearing formations to increase oil and gas production plus water used in sand and gravel and other mining activities.

Water Supply Outlook and Problems in the Corpus Christi SMSA - Currently within the SMSA, approximately 92 percent of the water used for urban needs (municipal, manufacturing, steam-electric power generation, and mining purposes) is supplied by developed surface-water resources in and adjacent to the SMSA. The remaining eight percent is supplied by ground-water resources. In the year 2000, approximately 98 percent of the SMSA's pro-

jected urban water requirements are expected to be supplied by developed surface-water resources, and approximately two percent by ground-water resources.

As indicated in the "Projected Water Requirements" within the SMSA (see table above), the reduction of the projected manufacturing water requirements from 1980 to 1990 results from expected compliance with clean water goals of P.L. 92-500, the Federal Water Pollution Control (Clean Water) Act. The cost of treatment methods and facilities needed to meet the effluent water quality standards required by the Act is expected to result in a reduction in the quantity of manufacturing water used within the SMSA; particularly in the petroleum refining and petrochemical, industries.

Many of the smaller yet growing urban water systems within the SMSA have been and will continue to be faced with problems related to physical conditions, facility costs, and water rights. Many of the smaller, growing systems are located in areas distant from reliable sources of supply. Under this condition, the cost of required delivery and treatment facilities to develop a reliable supply may be relatively high in relation to costs for other cities within the SMSA. Also, sufficient surface and ground-water rights to adequately fulfill the water needs of the smaller urban systems may not be readily available or may not be accessible through a larger system having water rights.

The City of Corpus Christi water system and other urban water systems within the SMSA and the adjacent coastal bend region will obtain their water supplies from the Choke Canyon Lake - Lake Corpus Christi system (Figure 12) in the Nueces River basin. The system will start operating with Choke Canyon Lake in the early 1980's and have a dependable yield of about 252

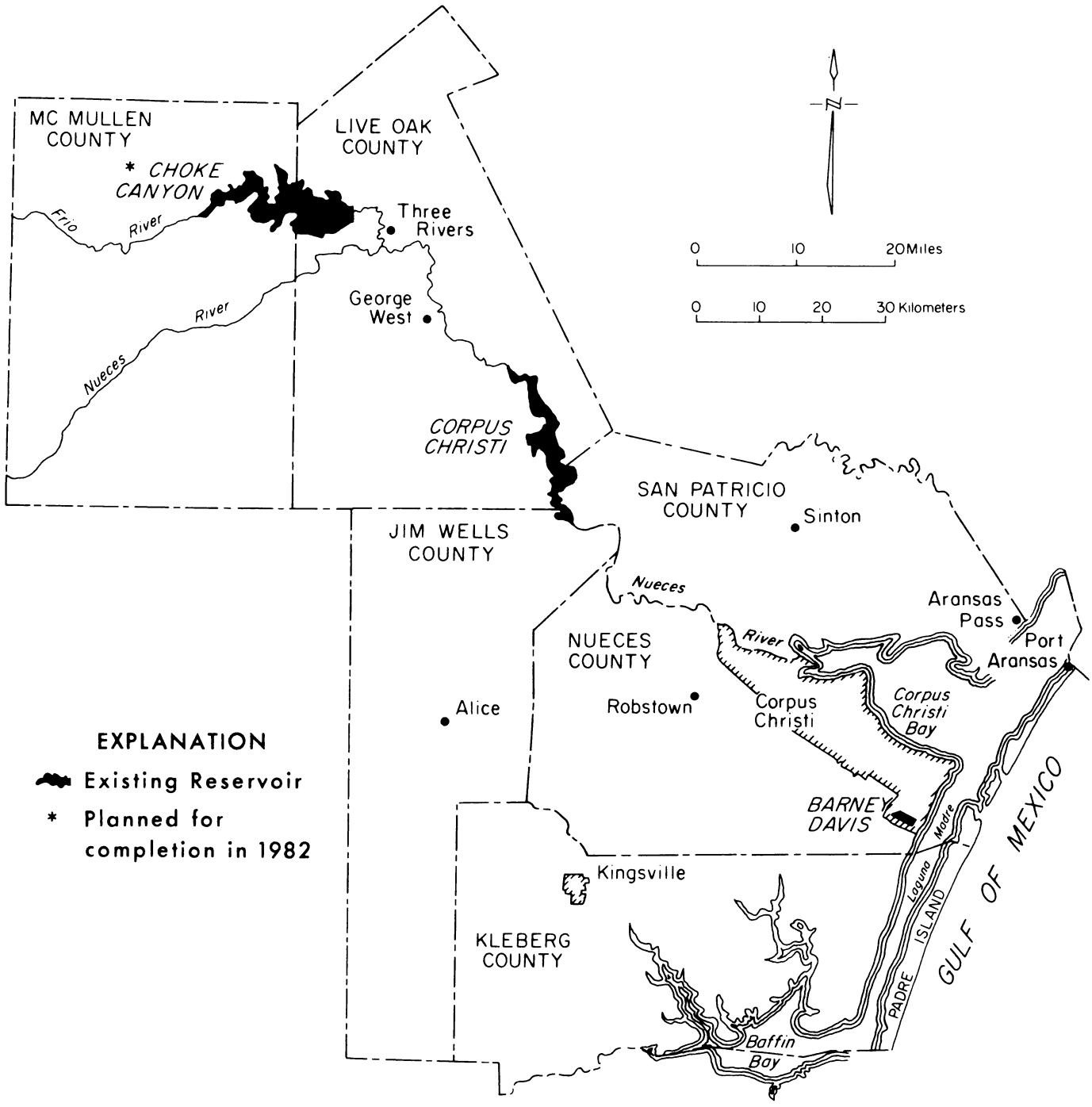


Figure 12

Corpus Christi SMSA Water Supply Projects

thousand acre-feet annually. In addition, the system is expected to capture annually about 7.5 and 14 thousand acre-feet of reusable return flows in 2000 and 2030, respectively. The total projected urban water needs to be served by the Choke Canyon Lake-Lake Corpus Christi system (including the SMSA) is expected to be about 169 and 345 thousand acre-feet per year in the years 2000 and 2030, respectively. Based on these projections and the dependable supply of the reservoir system, the SMSA and adjacent coastal bend region will need an additional surface-water supply between the years 2015 and 2020 to meet the regional urban water needs.

The Barney M. Davis Lake in Nueces County (Figure 12) is a Central Power and Light cooling-water reservoir which uses saline water from the Laguna Madre.

Additional small water systems currently supplied by ground water from the Gulf Coast Aquifer may need to seek surface-water supplies in the future due to limited and inferior quality ground-water supplies. Over development of ground water within the SMSA and surrounding region are expected to cause problems due to land subsidence, movement of geologic faults, and saline-water encroachment.

Description of Dallas-Fort Worth SMSA - The SMSA is area No. 3 on Figure 1, and is composed of Collin, Dallas, Denton, Ellis, Hood, Johnson, Kaufman, Parker, Rockwall, Tarrant, and Wise counties which cover about 8,360 square miles in parts of the Trinity, Brazos, and Sabine River basins. Normal annual precipitation ranges from 30 to 42 inches. Mean annual temperatures range from 64°F to 66°F. The principal cities are Dallas, Fort Worth and Denton.

Economy of Dallas-Fort Worth SMSA - The area's economy is characterized by diversity; being fairly well balanced in manufacturing, trade, transportation, finance and services. The light manufacturing industries producing electronics, aircraft, apparel, oil-field equipment, and other high technology goods have become the most important sources of manufacturing employment, which contributes 19.3 percent to the total personal income of the SMSA. The regional economic outlook is for a good continuing business climate and steady growth.

Water Quality Planning in Dallas-Fort Worth SMSA - A background discussion of the purpose, scope, goals, status, etc. of Section 208 (P.L. 92-500) water quality planning in Texas is given in the "Statewide Perspective" section of this report. In 1975, the Governor of Texas and the U.S. Environmental Protection Agency designated the North Central Texas Council of Governments (NCTCOG) as the area-wide water quality management planning agency for the Dallas-Fort Worth area, under Section 208 of the Federal Water Pollution Control Act (P.L. 92-500). The designated planning area includes all of Dallas County and most of Tarrant County, and portions of Denton, Collin, Rockwall, Kaufman, Ellis, and Johnson counties.

The desginated area includes most of the Dallas-Fort Worth SMSA. The NCTCOG turned its attention in the 1970's to the improvement of municipal sewage treatment systems. These improvements were set out in the development of the 1977 Annual Water Quality Management Plan and subsequent plans. These plans have resulted in the construction of new plants and the upgrading of older plants a advanced secondary treatment. The benefits of these improvements are now being recognized. The total biological oxygen demand loading has been reduced by 40 percent since 1977. According to the draft copy of the 1980 work plan now being developed by NCTCOG, the continuing planning programs area being forcused on the assessment of nonpoint and point sources of pollution, with special attention being directed to nonpoint sources. NCTCOG is currently identifying a full range of control techniques, including such innovative technology as solar powered instream aeration. Public participation is involved in all of the continuing planning program. The Environmentl Resources Advisory Committee of NCTCOG has representation from four groups: private citizens, public interest, public officials, and economic interest. This committee reviews all documents released by NCTCOG. NCTCOG is also assisting the Texas Department of Water Resources in the identification of Waste Treatment Manage- Agencies for the designated area and is identifying the needs for communities through the year 2000 in five year increments. The needs are expressed in three categories: collection systems, interceptor and sewage treatment plan construction, or rehabilitation. In 1981-1982 the NCTCOG will continue to develop long-range water quality management program.

Floodplain Management Program In Dallas-Fort Worth SMSA - The Federal Emergency Management Agency has designated all eleven counties and 149 incorporated cities

in the Dallas-Fort Worth SMSA as being subject to potential flooding problems from a 100-year flood event (Appendix B). Flood hazard boundary maps identifying flood-prone areas have been published for ten of the eleven counties and for 140 of the incorporated cities in the SMSA (Appendix B). Presently, six counties and 94 cities in the SMSA have adopted local floodplain management programs (Appendix B) in compliance with the requirements regarding participation in the National Flood Insurance Program (NFIP). Participation in the NFIP makes flood insurance available to SMSA residents presently in the floodplain and will afford some degree of protection against monetary losses due to flooding. Enforcement of the local floodplain management programs would assure that future developments will be located so as to eliminate damage from the 100-year flood. Detailed Flood Insurance Rate Studies presently in various stages of completion will supply detailed 10-year, 50-year, 100-year, and 500-year flood event data for four counties and 72 cities in the SMSA (Appendix B).

Population and Employment in Dallas-Fort Worth SMSA

Item	1960	1970	1980	1990	2000
			(thousands)		
Total Population	1,738.0	2,377.6	2,960.3	3,589.2	4,206.5
Urban Population	1,595.0	2,213.5	2,748.3	3,293.7	3,825.4
Other Population	143.0	164.1	212.0	295.5	381.1
Employment	684.7	997.6	1,446.8	1,676.3	1,873.0

Estimated Water Use and Projected Water Requirements Within the Dallas-Fort Worth SMSA 1/

Demand Categories	Estimated Use 1980	Projected Requirements 1990	2000
	(Thousands of Acre-feet)		
Municipal 2/	690.5	851.5	1,011.9
Manufacturing 3/	113.7	122.3	164.3
Steam-Electric 4/	26.0	26.0	29.0
Mining 5/	12.0	13.4	16.0
SMSA Totals	842.2	1,013.2	1,221.2

Source: Texas Department of Water Resources projections of water required under drought conditions. One acre-foot of water is 325,851 gallons.

1/ Additional water for agriculture (irrigation and livestock watering) will be required within the SMSA. Total SMSA agricultural uses were estimated at 17.6 thousand acre-feet in 1980. Projected future irrigation water requirements for 1990 and 2000 are not presented because urban growth within the SMSA and the resulting potential for this growth to impinge on irrigation in the area has not been predicted. (See footnote 1/, Table 1 for estimated total statewide irrigation water requirements for 1980, 1990 and 2000).

2/ Includes water used in cities for household purposes, fire protection, drinking and sanitation in public and commercial establishments, lawn watering, car washes, and other uses.

3/ Includes water used in the production processes and for cooling and heat exchange in manufacturing establishments.

4/ Estimated evaporation of cooling water used in steam-electric power plants. Additional water will be required for steam-electric power generation at plants outside the SMSA which supply electrical energy to users within the SMSA.

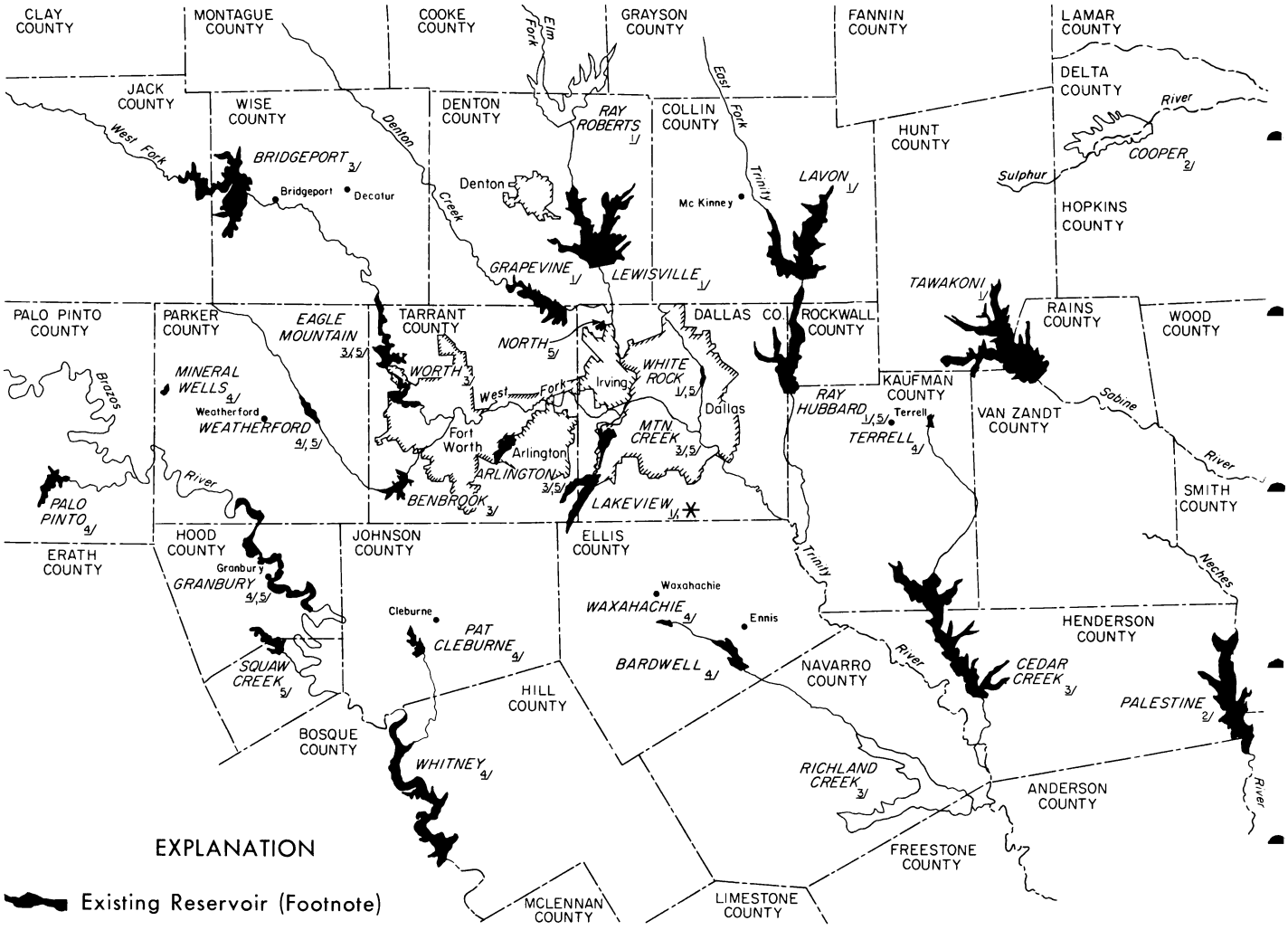
5/ Includes water used in the flooding of petroleum bearing formations to increase oil and gas production plus water used in sand and gravel and other mining activities.

Water Supply outlook and Problems in the Dallas - Fort Worth SMSA - Currently within the SMSA, approximately 89 percent of the water used for urban needs (municipal, manufacturing, steam-electric power generation, and mining purposes) is supplied by developed surface-water resources in and adjacent to the SMSA. The remaining 11 percent is supplied by ground-water resources. In the year 2000, approximately 98 percent of the SMSA's projected urban water requirements are expected to be supplied by developed surface-water resources, and approximately 2 percent by ground-water resources.

Many of the smaller yet growing urban water systems within the SMSA have been and will continue to be faced with problems related to physical conditions, facility, costs, and water rights. Many of the smaller, growing systems are located in areas distant from reliable sources of supply. Under this condition, the cost of required delivery and treatment facilities to develop a reliable supply may be relatively high in relation to costs for other cities within the SMSA. Also, sufficient surface and ground-water rights to adequately fulfill the water needs of the smaller urban systems may not be readily available or may not be accessible through a larger system having water rights.

The existing and proposed surface-water projects related to the current and future urban water needs of the SMSA are shown on Figure 13, which also generally explains the complicated reservoir (supply) - water system (user) relationship that exists within the SMSA. Surface-water development is near maximum potential in the upper Trinity River basin in the SMSA. The following surface-water projects are anticipated for completion in the 1980's to provide additional water supplies for the SMSA:

Project	River Basin Location of Lake (Figure 13)	Additional Supply Permitted by
Ray Roberts Lake	Upper Trinity	Cities of Dallas and Denton
Lakeview Lake	Upper Trinity	Cities of Cedar Hill, et al. through the Trinity River Authority
Pipeline from Palestine Lake	Upper Neches	City of Dallas
Additional Pipeline From Tawakoni Lake	Upper Sabine	City of Dallas
Cooper Lake	Upper Sulphur	North Texas Municipal Water District, City of Irving, and Sulphur River Municipal Water District.
Richland Creek Lake	Middle Trinity	Tarrant County WCID No. 1



Footnotes

1/ Existing or proposed water supply for the Dallas, North Texas Municipal Water District, and Denton Systems

2/ Existing or proposed water supply for the Dallas, et al. Systems from a part of the reservoir's yield

3/ Existing or proposed water supply for the Fort Worth, Tarrant County WCID No.1, and Arlington Systems

4/ Existing water supply currently used or proposed for use by other urban water systems within the SMSA

5/ Existing Water supply for power plants within the SMSA

* Planned for completion in 1981

Figure 13

Dallas-Fort Worth SMSA Water Supply Projects

Projected urban water demands indicate that the Dallas Water System will need additional water supplies in about the year 2010. These additional supplies will have to be obtained from additional development of the surface-water resources of the upper (western) portions of the Neches, Sabine, or Sulphur River basins (Figure 2).

After the year 2000, urban water systems in Tarrant County and adjacent areas are expected to need an additional surface-water supply. This additional supply could be provided by the development of Lake Tehuacana in Freestone County (Figure 2).

Recoverable ground-water storage in the major and minor aquifers (Figures 3 and 4) within the SMSA has been depleted to such an extent that maximum depths to water levels occur from about 350 feet to more than 1,000 feet below the land surface. These deep water levels are causing pumping costs to be burdensome. The quality of ground water has deteriorated in some areas within the SMSA. Fluoride in ground waters produced by many of the urban water systems within the SMSA are too high; exceeding the Environmental Protection Agency-Texas State Health Department (EPA-TSAD) maximum allowable level of 1.6 milligrams per liter for the SMSA. Also, many of the urban ground-water systems produce water with high iron concentrations which exceed the EPA-TSHD maximum allowable level of 0.3 milligrans per liter.

Description of El Paso SMSA - The SMSA is area No. 9 on Figure 1, and is composed of El Paso County which covers about 1,057 square miles in the Rio Grande basin. Normal annual precipitation is about 8 inches. Mean annual temperatures range from about 61°F to 63°F. The principal city is El Paso.

Economy of El Paso SMSA - The area economy is characterized by relatively high employment concentrations in the trades, transportation, communications, and public utilities sectors, with significant activity in the processing and distribution of products of the extractive industries. The apparel industry remains the most important source of manufacturing employment, which contributes 13.0 percent to the total personal income of the SMSA. The regional economic outlook is for steady growth. El Paso will continue its role as a transportation and trade center.

Water Quality Planning in the El Paso SMSA - A background discussion of the purpose, scope, goals, status, etc. of Section 208 (P.L. 92-500) water quality planning in Texas is given in the "Statewide Perspective" section of this report. The SMSA is located entirely in the Upper Rio Grande Basin Planning Area. The West Texas Council of Governments, through contracts with the Texas Department of Water Resources serves as the basin planning agency. The most important activity performed during the initial planning was the identification of those entities which potentially had wastewater treatment needs within five years. For those areas so identified, the sewage treatment needs were determined for a 20 year period.

With respect to continuing planning, the SMSA has not been identified for special studies. Therefore, the major planning activity will be the continued assessment of sewage treatment needs within a 20 year time frame, and the designation of sewage treatment and collection management agencies. Intensive public participation activities were carried out during the initial planning and will be continued during the continuing planning process. A water quality advisory committee has been established in the Upper Rio Grande Basin Planning Area. The committee has representation from four groups: public officials, economic interests, public interests, and private citizens. The committee will review and make recommendations on planning outputs.

Floodplain Management Program in the El Paso SMSA - The Federal Emergency Management Agency has designated El Paso County and five incorporated cities as being subject to potential flooding problems from a 100-year flood event. (Appendix B). Flood hazard boundary maps identifying flood-prone areas have been published for the county and for four of the incorporated cities (Appendix B). Presently, the county and three cities in the SMSA have adopted local floodplain management programs (Appendix B) in compliance with the requirements regarding participation in the National Flood Insurance Program (NFIP). Participation in the NFIP makes flood insurance available to SMSA residents presently in the floodplain and will afford some degree of protection against monetary losses due to flooding. Enforcement of the local floodplain management programs would assure that future developments will be located so as to eliminate damage from the 100-year flood. The City of El Paso is the only entity within the SMSA which has Detailed Flood Insurance Rate Studies in progress (Appendix B). These studies provide detailed data on 10-year, 50-year, 100-year, and 500-year flood events.

Population and Employment in El Paso SMSA

Item	1960	1970	1980	1990	2000
	(thousands)				
Total Population	314.1	359.3	478.8	582.0	679.2
Urban Population	282.3	346.8	449.2	542.0	632.6
Other Population	31.8	12.5	29.6	40.0	46.6
Employment	86.9	106.9	155.7	187.9	223.3

Estimated Water Use and Projected Water Requirements Within the El Paso SMSA 1/

Demand Categories	Estimated Use 1980	Projected Requirements 1990	2000
	(Thousands of Acre-feet)		
Municipal 2/	144.2	176.7	208.5
Manufacturing 3/	14.3	14.8	19.5
Steam-Electric 4/	3.7	3.7	3.7
Mining 5/	5.4	5.2	5.7
SMSA Totals	167.6	200.4	237.4

Source: Texas Department of Water Resources projections of water required under drought conditions. One acre-foot of water is 325,851 gallons.

1/ Additional water for agriculture (irrigation and livestock watering) will be required within the SMSA. Total SMSA agricultural uses were estimated at 180.2 thousand acre-feet in 1980. Projected future irrigation water requirements for 1990 and 2000 are not presented because urban growth within the SMSA and the resulting potential for this growth to impinge on irrigation in the area has not been predicted. (See footnote 1/, Table 1 for estimated total statewide irrigation water requirements for 1980, 1990 and 2000.)

2/ Includes water used in cities for household purposes, fire protection, drinking and sanitation in public and commercial establishments, lawn watering, car washes, and other uses.

3/ Includes water used in the production processes and for cooling and heat exchange in manufacturing establishments.

4/ Estimated evaporation of cooling water used in steam-electric power plants. Additional water will be required for steam-electric power generation at plants outside the SMSA which supply electrical energy to users within the SMSA.

5/ Includes water used in the flooding of petroleum bearing formations to increase oil and gas production plus water used in sand and gravel and other mining activities.

Water Supply Outlook and Problems in the El Paso SMSA - Currently within the SMSA, approximately 87 percent of the water used for urban needs (municipal, manufacturing, steam-electric power generation, and mining purposes) is supplied by ground water resources within the SMSA. The remaining 13 percent is supplied by surface-water resources. In the year 2000, approximately 93 percent of the SMSA's projected urban water requirements are expected to be supplied by ground-water resources, and approximately seven percent by surface-water resources.

Many of the smaller yet growing urban water systems within the SMSA have been and will continue to be faced with problems related to physical conditions, facility costs, and water rights. Many of the smaller, growing systems are located in areas distant from reliable sources of supply. Under this condition, the cost of required delivery and treatment facilities to develop a reliable supply may be relatively high in relation to costs for other cities within the SMSA. Also, sufficient surface and ground-water rights to adequately fulfill the water needs of the smaller urban systems may not be readily available or may not be accessible through a larger system having water rights.

Through the 1980's, the City of El Paso water system and other municipal, manufacturing, steam-electric power generation, and mining water systems in the SMSA will continue to obtain most of their water supply from the ground-water resources of the Hueco and Mesilla Bolson Aquifers (Figure 14). The city system will continue to receive comparatively small quantities of Rio Grande Project water through the El Paso County Water Improvement District which annually supplies about 180 thousand acre-feet to irrigation

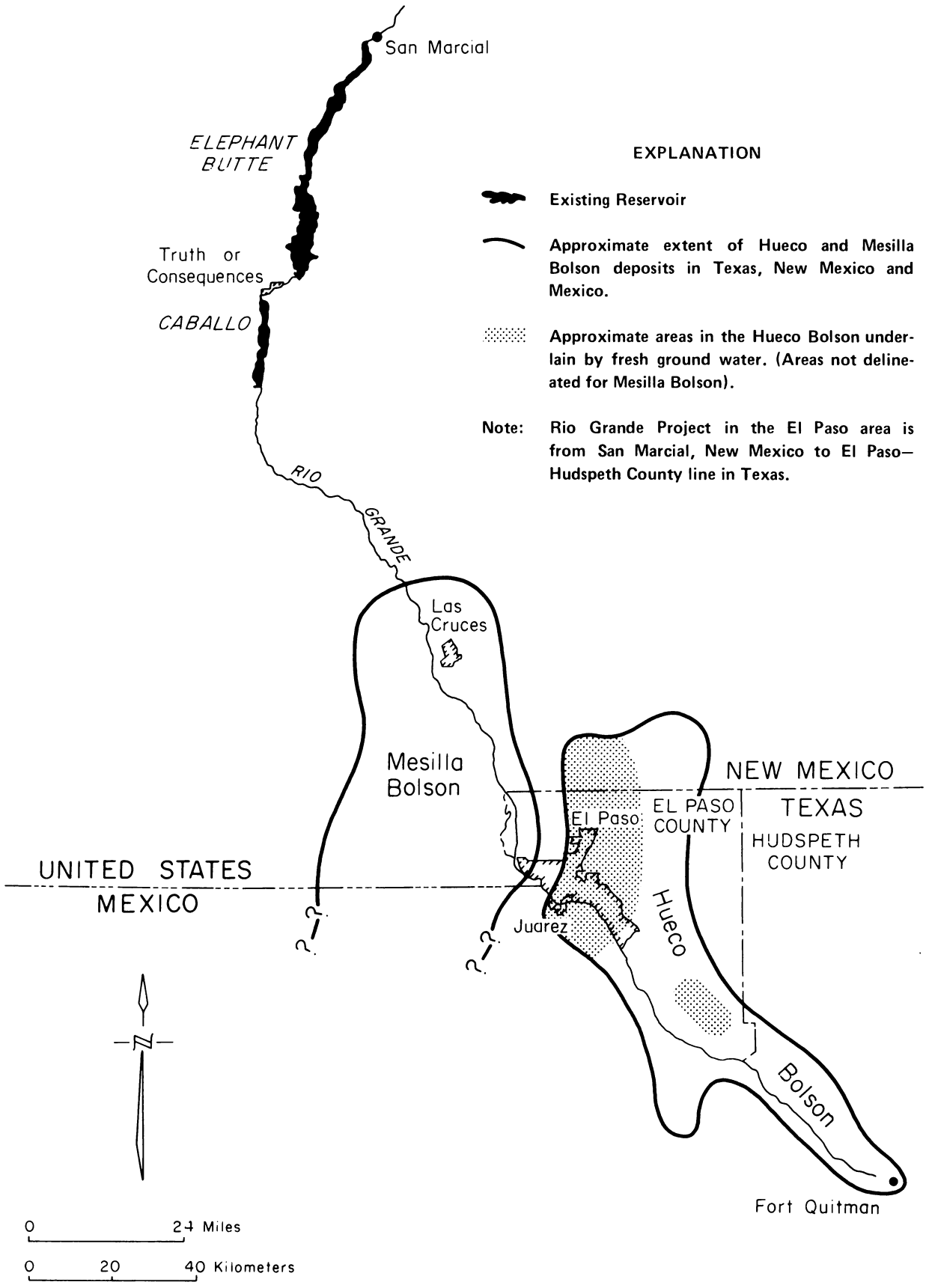


Figure 14

El Paso SMSA Water Supply Projects

farmers in the Mesilla and El Paso Valleys in Texas. Rio Grande Project water is obtained from the Elephant Butte-Caballo Reservoir system in New Mexico (Figure 14).

Currently, the city plans to implement a pilot-type project to treat some sewage effluent (about 10 million gallons per day) which will be artifically recharged into the Hueco Bolson Aquifer north of the city. If proven feasible, this program and future programs using additional treated effluent could provide a significant net increase in the city's ground-water supply.

Through the year 2000, the city system and other systems in the SMSA will continue to obtain water supplies from exhaustible ground-water resources within the SMSA. Under these conditions, water levels will continue to decline, individual well yields will decrease, and ground-water quality will surely deteriorate. The City of El Paso is very concerned that ground-water reserves may not be able to supply the city's summer peak demand by sometime between 1995 and 2000. Since the SMSA and Juarez, Mexico have a common aquifer (Hueco Bolson) (Figure 14), the large withdrawal of ground water for municipal and manufacturing uses anticipated in the City of Juarez area will significantly add to the ground-water mining problem. 1/

1/ Some reserves of ground water for municipal and manufacturing needs exist in New Mexico in the Hueco and Mesilla Bolsons just across the State line from the SMSA (El Paso County). However, New Mexico law presently precludes the export of ground waters outside of New Mexico's borders. No significant ground-water reserves or surface-water resources exist at a reasonable distance east of the SMSA in Texas.

Description of Galveston-Texas City SMSA - The SMSA is area No. 10 on Figure 1, and is composed of Galveston County which covers about 399 square miles in parts of the Neches-Trinity and San Jacinto-Brazos Coastal basins. Normal annual precipitation ranges from 48 to 52 inches. Mean annual temperature is about 69°F. The principal cities are Galveston and Texas City.

Economy of Galveston-Texas City SMSA - The area economy is characterized by high concentrations in the manufacturing and state and local government sectors. The petrochemical and shipbuilding industries remain the most important source of manufacturing employment, which contributes 19.7 percent to the total personal income of the SMSA. The regional economic outlook is for steady growth with continuing dependence on the manufacturing sector.

Water Quality Planning in Galveston-Texas City SMSA - A background discussion of the purpose, scope, goals, status, etc. of Section 208 (P.L. 92-500) water quality planning in Texas is given in the "Statewide Perspective" section of this report. The SMSA (Galveston County) is located mostly within the San Jacinto Basin State Planning Area but a small portion of northern Galveston County is located within the Houston Designated Area. The San Jacinto River Authority, through contract with the Texas Department of Water Resources, serves as the basin planning agency. The most important activity performed during the initial planning was the identification of those entities which potentially had wastewater treatment needs within five years. For those areas so identified, the sewage treatment needs were determined for a 20 year future period. With respect to continuing planning, the SMSA area has not been identified for

special studies. Therefore, the major planning activity will be the continued assessment of sewage treatment needs within a 20 year time frame, and the designation of sewage treatment and collection management agencies. Intensive public participation activities were carried out during the initial planning and will be continued during the continuing planning process. A water quality advisory committee has been established in the San Jacinto Basin State Planning Area. The committee has membership from four groups: public officials, economic interests, public interests, and private citizens. The committee will review and make recommendations on planning outputs.

Floodplain Management Program in the Galveston-Texas City SMSA - The Emergency Management Agency has designated Galveston County and 12 incorporated cities in the SMSA as being subject to potential flooding problems from a 100-year flood event (Appendix B). Flood hazard boundary maps identifying flood-prone areas have been published for the county and 11 of the incorporated cities in the SMSA (Appendix B). Presently, the county and 10 of the cities in the SMSA have adopted local floodplain management programs (Appendix B) in compliance with the requirements regarding participation in the National Flood Insurance Program (NFIP). Participation in the NFIP makes flood insurance available to SMSA residents presently in the floodplain and will afford some degree of protection against monetary losses due to flooding. Enforcement of the local floodplain management programs would assure that future developments will be located so as to eliminate damage from the 100-year flood. Detailed Flood Insutrance Rate Studies presently in various stages of completion will supply detailed 10-year, 50-year, 100-year, and 500-year flood event data for Galveston County and all 12 cities in the SMSA (Appendix B).

Population and Employment in Galveston-Texas City SMSA

Item	1960	1970	1980	1990	2000
	(thousands)				
Total Population	140.4	169.8	194.1	223.8	247.3
Urban Population	124.2	152.3	165.3	182.7	195.1
Other Population	16.2	17.5	28.8	41.1	52.2
Employment	50.8	65.0	76.9	88.3	99.6

Estimated Water Use and Projected Water Requirements Within the Galveston-Texas SMSA 1/

Demand Categories	Estimated Use	Projected Requirements	
	1980	1990	2000
	(Thousands of Acre-feet)		
Municipal 2/	42.6	49.4	55.1
Manufacturing 3/	91.6	101.1	144.6
Steam-Electric 4/	-0-	-0-	-0-
Mining 5/	0.4	0.4	0.4
SMSA Totals	134.9	150.9	200.1

Source: Texas Department of Water Resources projections of water required under drought conditions. One acre-foot of water is 325,851 gallons.

1/ Additional water for agriculture (irrigation and livestock watering) will be required within the SMSA. Total SMSA agricultural uses were estimated at 17.7 thousand acre-feet in 1980. Projected future irrigation water requirements for 1990 and 2000 are not presented because urban growth within the SMSA and the resulting potential for this growth to impinge on irrigation in the area has not been predicted. (See footnote 1/, Table 1 for estimated total statewide irrigation water requirements for 1980, 1990 and 2000).

2/ Includes water used in cities for household purposes, fire protection, drinking and sanitation in public and commercial establishments, lawn watering, car washes, and other uses.

3/ Includes water used in the production processes and for cooling and heat exchange in manufacturing establishments.

4/ Estimated evaporation of cooling water used in steam-electric power plants. Additional water will be required for steam-electric power generation at plants outside the SMSA which supply electrical energy to users within the SMSA.

5/ Includes water used in the flooding of petroleum bearing formations to increase oil and gas production plus water used in sand and gravel and other mining activities.

Water Supply Outlook and Problems in the Galveston-Texas City SMSA - Currently within the SMSA, approximately 66 percent of the water used for urban needs (municipal, manufacturing, and mining purposes) is supplied by developed surface-water resources adjacent to the SMSA. The remaining 34 percent is supplied by ground-water resources. In the year 2000, approximately 90 percent of the SMSA's projected urban water requirements are expected to be supplied by developed surface-water resources, and approximately 10 percent by ground-water resources.

Many of the smaller yet growing urban water systems within the SMSA have been and will continue to be faced with problems related to physical conditions, facility costs, and water rights. Many of the smaller, growing systems are located in areas distant from reliable sources of supply. Under this condition, the cost of required delivery and treatment facilities to develop a reliable supply may be relatively high in relation to costs for other cities within the SMSA. Also, sufficient surface and ground-water rights to adequately fulfill the water needs of the smaller urban systems may not be readily available or may not be accessible through a larger system having water rights.

The major water supply projects providing water to the SMSA (Galveston County) are shown on Figure 15. Canals A and B which are operated by the Brazos River Authority, supply Brazos River water to the industrial complex in the Texas City area and irrigation within the SMSA. Canals A and B also provide Brazos River water for urban and agricultural needs in Brazoria and Fort Bend counties. The Galveston County Lake shown on Figure 15 is a holding reservoir for Brazos River water delivered by Canals A and B. Texas City which

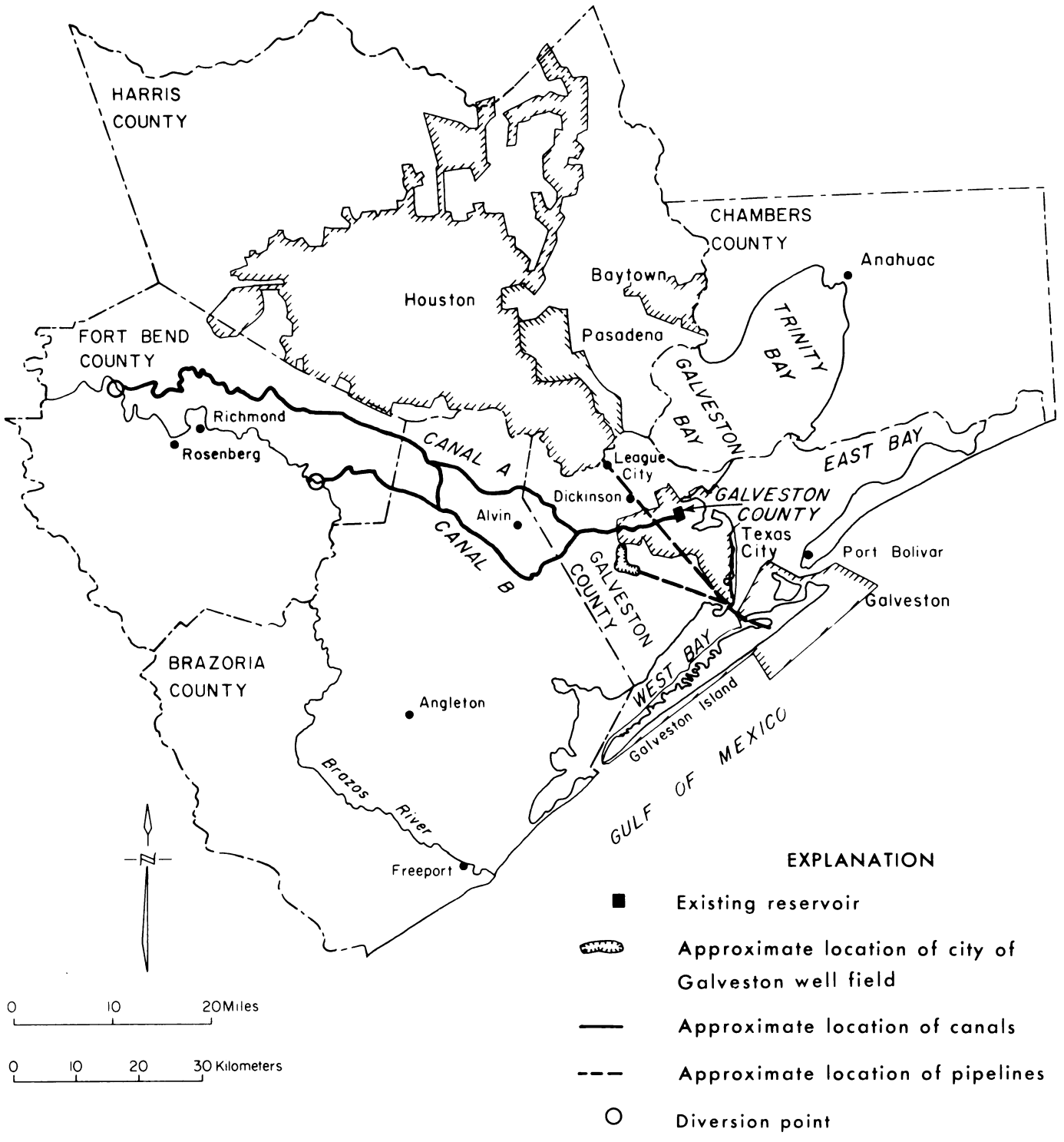


Figure 15
Galveston-Texas City SMSA Water Supply Projects

currently uses ground water from the Gulf Coast Aquifer (Figure 3) for municipal purposes (most of the city's wells are located within the city limits), is planning to obtain Brazos River water from the Canal A-B system.

Current urban water needs for the City of Galveston are met from two sources. The oldest source is the city's well field (Figure 15) which is completed in the Gulf Coast Aquifer (Figure 3) and currently supplies via pipeline (Figure 15) only about 2,200 acre-feet annually. Pumpage from the well field was reduced in about 1973, because of saline-water encroachment. Before about 1973, the well field was the sole supply of water for the City of Galveston. The second and newest (since about 1973) source of water for the city is surface water delivered via pipeline (Figure 15) from the Houston system. This surface water is treated by Houston and supplied by the Houston system from Lake Houston in northeastern Harris County (Figure 2).

Most of the SMSA's urban water requirements through the year 2030 will have to be met by surface waters secured from the Houston system and the Brazos River via the Canal A-B system. Through the year 2030, ground-water withdrawals for urban needs within the SMSA (Galveston County) will need to be held at a maximum level of about 20 thousand acre-feet annually to control land subsidence, fault movement, and saline water encroachment. Under these conditions, approximately 180 and 541 thousand acre-feet of surface water will have to be delivered to the SMSA in the years 2000 and 2030, respectively.

Description of Houston SMSA - The SMSA is area No. 11 on Figure 1, and is composed of Brazoria, Fort Bend, Harris, Liberty, Montgomery, and Waller counties which cover about 6,794 square miles in parts of the Brazos, San Jacinto, Trinity and Neches River basins and the Brazos-Colorado, San Jacinto-Brazos, Trinity-San Jacinto, and Neches-Trinity Coastal basins. Normal annual precipitation ranges from about 40 to 52 inches. Mean annual temperatures range from about 67.5°F to 70°F. The principal cities are Houston, Pasadena, Baytown, Conroe, Freeport, Angleton, Richmond, Rosenburg, Hempstead and Liberty.

Economy of Houston SMSA - The area economy is characterized by even distribution among the various sectors with some concentration in manufacturing and trade. The oil and petrochemical industry remains the most important source of manufacturing employment, which contributes 18.4 percent to the total personal income of the Houston SMSA. The regional economic outlook is for continuing dependence on oil and natural gas with a rapid growth rate.

Water Quality Planning in the Houston SMSA - A background discussion of the purpose, scope, goals, status, etc. of Section 208 (P.L. 92-500) water quality planning in Texas is given in the "Statewide Perspective" section of this report. The SMSA is included in both designated and nondesignated planning areas. The Houston-Galveston Area Council (H-GAC) was designated by the Governor in April, 1975, as the planning agency for the Houston Designated Area. The designated area covers all of Harris, and portions of Brazoria, Fort Bend, Galveston, Montgomery, and Waller Counties. As of November, 1976, 208 planning for non-designated (or state planning) areas has been performed by the State. The

Texas Department of Water Resources (TDWR) has been designated by the Governor as the state 208 planning agency for all activities except those dealing with agricultural or silvicultural controls. The Texas State Soil and Water Conservation Board (TSSWB) has been designated by the Governor as the state 208 planning agency for activities dealing with agricultural or silvicultural controls. The TDWR divided the state planning area into river basin planning areas and designated a planning agency for each one. The SMSA includes three basin planning areas: the Brazos, San Jacinto, and Trinity and the planning agencies are the Brazos River Authority, San Jacinto River Authority, and Trinity River Authority, respectively. Planning activities were similar in all areas except that it was more intensive in the designated area as more water quality problems existed and more funds were available. One of the most important aspects was the identification of municipal wastewater treatment needs and costs for a 20 year period. Existing and projected wasteloads were evaluated and sewage treatment plant effluent limitations were recommended for attainment of water quality standards. Nonpoint sources of pollution were evaluated and several areas were identified as potentially having nonpoint source problems which might preclude the attainment of water quality standards even after the initiation of stringent point source effluent limitations. Further 208 planning in the SMSA will include the continued identification and reevaluation of wastewater treatment needs because of the continued rapid urbanization in the area. The effects and sources of suspended solids and sedimentation in Lake Houston are being evaluated. Nonpoint sources of pollution will be evaluated in Clear Creek and the West Fork of the San Jacinto River. Advanced Waste Treatment and Advanced Secondary Treatment point source effluent limitation requirements will be reevalauted in many stream segments in the SMSA. Intensive public participation activities were carried out during the initial planning and will be continued during the continuing planning

process. Water quality advisory committees have been established in each planning area. These committees have representation from four groups: public officials, economic interest, public interests, and private citizens. The committees will review and make recommendations on planning outputs.

Floodplain Management Program in the Houston SMSA - The Federal Emergency Management Agency has designated all six counties and 89 incorporated cities in the SMSA as being subject to potential flooding problems from a 100-year flood event (Appendix B). Flood hazard boundary maps identifying flood-prone areas have been published for the six counties and for 76 of the incorporated cities in the SMSA (Appendix B). Presently, five counties and 73 cities in the SMSA have adopted local floodplain management programs (Appendix B) in compliance with the requirements regarding participation in the National Flood Insurance Program (NFIP). Participation in the NFIP makes flood insurance available to SMSA residents presently in the floodplain and will afford some degree of protection against monetary losses due to flooding. Enforcement of the local floodplain management programs would assure that future developments will be located so as to eliminate damage from the 100-year flood. Detailed Flood Insurance Rate Studies presently in various stages of completion will supply detailed 10-year, 50-year, 100-year, and 500-year flood event data for five counties and 72 cities in the SMSA (Appendix B).

Population and Employment in Houston SMSA

Item	1960	1970	1980	1990	2000
	(thousands)				
Total Population	1,430.4	1,993.3	2,887.0	3,801.9	4,729.3
Urban Population	1,222.7	1,632.0	2,132.1	2,568.3	2,977.4
Other Population	207.7	361.3	754.9	1,233.6	1,751.9
Employment	530.4	802.2	1,381.0	1,795.1	2,260.3

Estimated Water Use and Projected Water Requirements Within the Houston SMSA 1/

Demand Catagories	Projected Requirements		
	1980	1990	2000
	(Thousands of Acre-feet)		
Municipal 2/	617.6	822.6	1,035.1
Manufacturing 3/	783.3	934.4	1,448.3
Steam-Electric 4/	38.0	60.3	70.3
Mining 5/	30.1	34.4	41.2
SMSA Totals	1,469.0	1,851.7	2.594.9

Source: Texas Department of Water Resources projections of water required under drought conditions. One acre-foot of water is 325,851 gallons.

1/ Additional water for agriculture (irrigation and livestock watering) will be required within the SMSA. Total SMSA agricultural requirements are estimated at 459.9 thousand acre-feet per year in 1980. Projected future irrigation requirements for 1990 and 2000 are not presented because urban growth within the SMSA and the resulting potential for this growth to impinge on irrigation in the area has not been predicted. (See footnote 1/, Table 1 for estimated total statewide irrigation water requirements for 1980, 1990 and 2000.)

2/ Includes water used in cities for household purposes, fire protection, drinking and sanitation in public and commercial establishments, lawn watering, carwashes, and other uses.

3/ Includes water used in the production processes and for cooling and heat exchange in manufacturing establishments.

4/ Estimated evaporation of cooling water used in steam-electric power plants. Additional water will be required for steam-electric power generation at plants outside the SMSA which supply electrical energy to users within the SMSA.

5/ Includes water used in the flooding of petroleum bearing formations to increase oil and gas production plus water used in sand and gravel and other mining activities.

Water Supply Outlook and Problems in the Houston SMSA - Currently within the SMSA, approximately 54 percent of the water used for urban needs (municipal, manufacturing, steam-electric power generation, and mining purposes) is supplied by ground-water resources in the SMSA. The remaining 46 percent is supplied by developed surface-water resources in and adjacent to the SMSA. In the year 2000, approximately 88 percent of the SMSA's projected urban water requirements are expected to be supplied by developed surface-water resources in and adjacent to the SMSA, and approximately 12 percent by ground-water resources within the SMSA.

Many of the smaller yet growing urban water systems within the SMSA have been and will continue to be faced with problems related to physical conditions, facility costs, and water rights. Many of the smaller, growing systems are located in areas distant from reliable sources of supply. Under this condition, the cost of required delivery and treatment facilities to develop a reliable supply may be relatively high in relation to costs for other cities within the SMSA. Also, sufficient surface and ground-water rights to adequately fulfill the water needs of the smaller urban systems may not be readily available or may not be accessible through a larger system having water rights.

The existing and proposed surface-water projects related to the current and future urban water needs of the SMSA are shown on Figure 16. Currently, most of the urban water needs within and just adjacent to the SMSA are supplied by the following sources and systems:

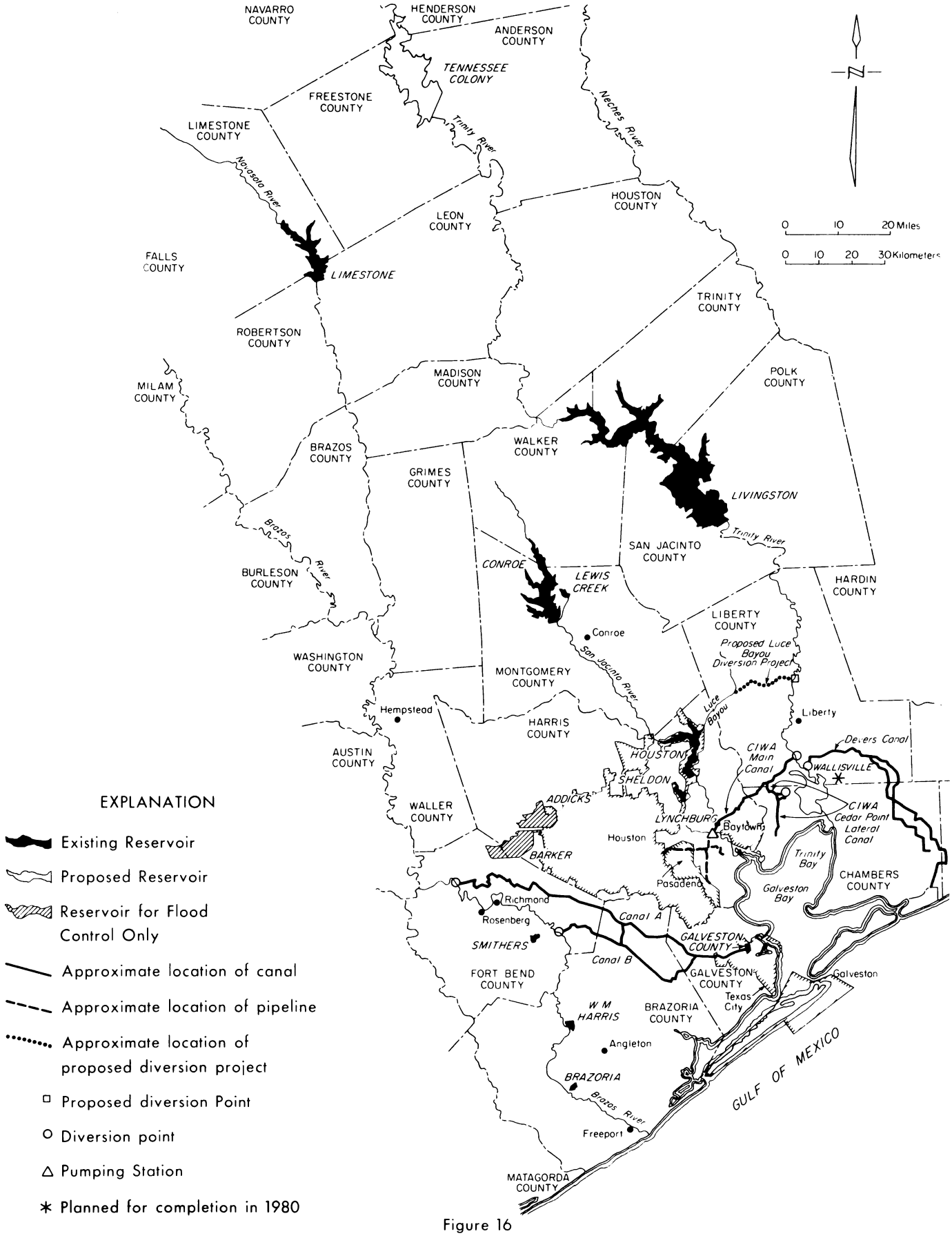


Figure 16

Houston SMSA Water Supply Projects

Source	System	Location Reference	Users
Gulf Coast Aquifer	Numerous well Fields	Figure 3	City of Houston, other cities, and industries
Trinity River from Lake Livingston (City of Houston has 70 percent share yield)	Coastal Industrial Water Authority Canal and Pipeline System	Figure 16	Mainly industries in the ship channel area of Harris County and industries in eastern Chambers County
Trinity River from Lake Livingston through Trinity River Authority	Devers Canal System	Figure 16	Small amount used by sulfur mining industry in southern Liberty County. Mainly for irrigators in Liberty and Chambers Counties.
San Jacinto River from Lake Conroe, Lewis Creek, Houston, and Sheldon	River and Pipeline	Figure 16	City of Houston, San Jacinto River Authority, and power plants.
Brazos River through the Brazos River Authority	Canals A and B System	Figure 16	Various cities and industries in Fort Bend, Brazoria and Galveston Counties.

Municipal, manufacturing, steam-electric, and mining water requirements during the 1980's in Harris, Galveston, and Montgomery counties (including the Houston and other large systems) will have to continue to be met by both ground and surface water resources. However, because of land subsidence, movement of geologic faults, and potential saline-water encroachment, ground water withdrawals will need to be reduced more than 50 percent of the withdrawals estimated in 1974 (approximately 573 thousand acre-feet in Harris, Galveston and Montgomery counties). The remainder of the requirements throughout the 1980's will need to be met by existing surface-water supplies in the San Jacinto and Trinity River basins; namely Lakes Conroe, Houston, and Livingston (Figure 16). Supplies from Lake Livingston in the Trinity River basin will be adequately conveyed to the Houston area via the Coastal Industrial Water Authority (CIWA) canal and

pipeline system (Figure 16) and the Luce Bayou Diversion Project (Figure 16). The City of Houston's share of Wallisville Lake could be conveyed to the Houston area via the CIWA System. In the year 1990 the total dependable supply from Lakes Conroe, Houston, Livingston and Wallisville will be approximately 1.0 million acre-feet. The projected urban needs for surface water for the Houston system and other systems in Harris, Galveston and Montgomery counties is expected to be about 1.6 million acre-feet in the year 2000. Therefore, between 1990 and 1995, the Houston et al systems in the three counties are expected to need additional surface-water supplies. Also, comparison of projected surface-water requirements (1.6 and 4.1 million acre-feet in 2000 and 2030, respectively) with the supplies from Lakes Conroe and Houston and the delivery capabilities of the CIWA System and the Luce Bayou Diversion Project (a total of about 1.8 million acre-feet) indicate that additional facilities for conveyance of water from the Trinity River basin to the three counties will be needed between the years 2000 and 2005. Additional surface-water supplies needed in the three counties within the SMSA between 1990 and 1995 will have to be obtained from new and existing reservoirs in (1) the Trinity River basin, such as Lake Tennessee Colony (Figure 16), or (2) the Neches and Sabine River basins (Figure 2) east of the Trinity where substantial surface-water surpluses are expected to exist in the year 1990 and beyond.

The ground-water resources of the Gulf Coast Aquifer (Figure 3), Brazos River water delivered by the Canals A and B System (Figure 16), and Trinity River water delivered by the Devers Canal System (Figure 16) supply other large urban water needs within and adjacent to the SMSA in Waller, Fort Bend, Brazoria, Galveston and Liberty counties. Lakes Wm. Harris and Brazoria (Figure 16-Brazoria County) are off-channel regulating reservoirs which are used in a system to deliver Brazos River water for municipal and industrial

needs in the Freeport area. Lake Smithers (Figure 16-Fort Bend County) is a relatively small impoundment on Dry Creek which is used as a cooling reservoir by a power plant operated by Houston Lighting and Power Company. All of these water supplies and their related facilities are expected to adequately supply the remaining large urban water needs of the SMSA through the year 2030.

Description of Killeen-Temple SMSA - The SMSA is area No. 12 on Figure 1, and is composed of Bell and Coryell counties which cover about 2,090 square miles in the Brazos River basin. Normal annual precipitation is about 32 inches. Mean annual temperature is 67°F. The principal cities are Killeen, Temple and Belton.

Economy of Killeen-Temple SMSA - The area economy is characterized by concentrations in trade, government, hospitals, and military. The furniture industry remains the most important source of manufacturing employment, which contributes 4.6 percent to the total personal income of the SMSA. The regional economic outlook is for continuing dominance of the economy by the military sector, with increasing employment opportunities due to industrial expansion.

Water Quality Planning in the Killeen-Temple SMSA - A background discussion of the purpose, scope, goals, status, etc. of Section 208 (P.L. 92-500) water quality planning in Texas is given in the "Statewide Perspective" section of this report. The SMSA is included in both designated and nondesignated 208 planning areas. The Central Texas Council of Governments (CTCOG) was designated by the Governor in May, 1976, as the planning agency for the Killeen-Temple Designated Area. The designated area covers the urbanized parts of Bell and Coryell Counties. As of November, 1976, the remaining portion of the two counties was included in the State Brazos Basin Planning Area. The Brazos River Authority serves as the planning agency for the Brazos Basin Planning Area. Planning activities were similar in both areas except that it was more intensive in the designated areas as more water

quality problems existed and more funds were available. One of the most important aspects was the identification of municipal wastewater treatment needs and costs for a 20 year period. Existing and projected wasteloads were evaluated and sewage treatment plant effluent limitations were recommended. With respect to nonpoint sources, septic tank concentrations around Belton and Stillhouse Hollow Lakes and Salado Creek were identified as potential problems. Also, a better understanding of nonpoint source loads and impacts to Stillhouse Hollow Lake are needed. Continuing planning activities will include some further identification of municipal waste treatment needs. The major activities are to be focused on determining the effects of septic tank concentrations on the two lakes and Salado Creek and the nonpoint source loads to Stillhouse Hollow. Intensive public participation activities were carried out during the initial planning and will be continued during the continuing planning process. Water quality advisory committees have been established in each planning area. These committees are composed of essential balanced representation of four groups: public officials, economic interests, public interests, and private citizens. The committees will review and make recommendations on planning outputs.

Floodplain Management Program in the Killeen-Temple SMSA - The Federal Emergency Management Agency has designated both counties and 12 incorporated cities in the SMSA as being subject to potential flooding problems from a 100-year flood event (Appendix B). Flood hazard boundary maps identifying flood-prone areas have been published for the counties and the 12 incorporated cities in the SMSA (Appendix B). Presently, the two counties and 10 of the cities in the SMSA have adopted local floodplain management programs (Appendix B) in compliance with the requirements regarding participation in the National Flood Insurance Program (NFIP). Participation in the NFIP makes

flood insurance available to SMSA residents presently in the floodplain and will afford some degree of protection against monetary losses due to flooding. Enforcement of the local floodplain management programs would assure that future developments will be located so as to eliminate damage from the 100-year flood. Detailed Flood Insurance Rate Studies presently in progress will supply detailed 10-year, 50-year, 100-year, and 500-year flood event data for both counties and the 12 incorporated cities (Appendix B).

Population and Employment in Killeen-Temple SMSA

Item	1960	1970	1980	1990	2000
			(thousands)		
Total Population	118.1	159.8	214.0	258.3	324.9
Urban Population	72.6	132.8	169.3	208.6	263.1
Other Population	45.5	27.0	44.7	49.7	61.8
Employment	28.8	38.3	60.1	78.2	105.0

Estimated Water Use and Projected Water Requirements Within the Killeen-Temple SMSA 1/

Demand Categories	Estimated Use 1980	Projected Requirements 1990	2000
	(Thousands of Acre-feet)		
Municipal 2/	47.6	58.9	75.6
Manufacturing 3/	2.6	3.5	5.1
Steam-Electric 4/	0.1	-0-	-0-
Mining 5/	1.0	1.6	2.6
SMSA Totals	51.3	64.0	83.3

Source: Texas Department of Water Resources projections of water required under drought conditions. One acre-foot of water is 325,851 gallons.

1/ Additional water for agriculture (irrigation and livestock watering) will be required within the SMSA. Total SMSA agricultural uses were estimated at 5.7 thousand acre-feet in 1980. Projected future irrigation water requirements for 1990 and 2000 are not presented because urban growth within the SMSA and the resulting potential for this growth to impinge on irrigation in the area has not been predicted. (See footnote 1/, Table 1 for estimated total statewide irrigation water requirements for 1980, 1990 and 2000).

2/ Includes water used in cities for household purposes, fire protection, drinking and sanitation in public and commercial establishments, lawn watering, car washes, and other uses.

3/ Includes water used in the production processes and for cooling and heat exchange in manufacturing establishments.

4/ Estimated evaporation of cooling water used in steam-electric power plants. Additional water will be required for steam-electric power generation at plants outside the SMSA which supply electrical energy to users within the SMSA.

5/ Includes water used in the flooding of petroleum bearing formations to increase oil and gas production plus water used in sand and gravel and other mining activities.

Water Supply Outlook and Problems in the Killeen-Temple SMSA - Currently within the SMSA, approximately 83 percent of the water used for urban needs (municipal, manufacturing, steam-electric power generation, and mining purposes) is supplied by developed surface-water resources in the SMSA. The remaining 17 percent is supplied by ground-water resources. In the year 2000, approximately 91 percent of the SMSA's projected urban water requirements are expected to be supplied by developed surface-water resources, and approximately nine percent by ground-water resources.

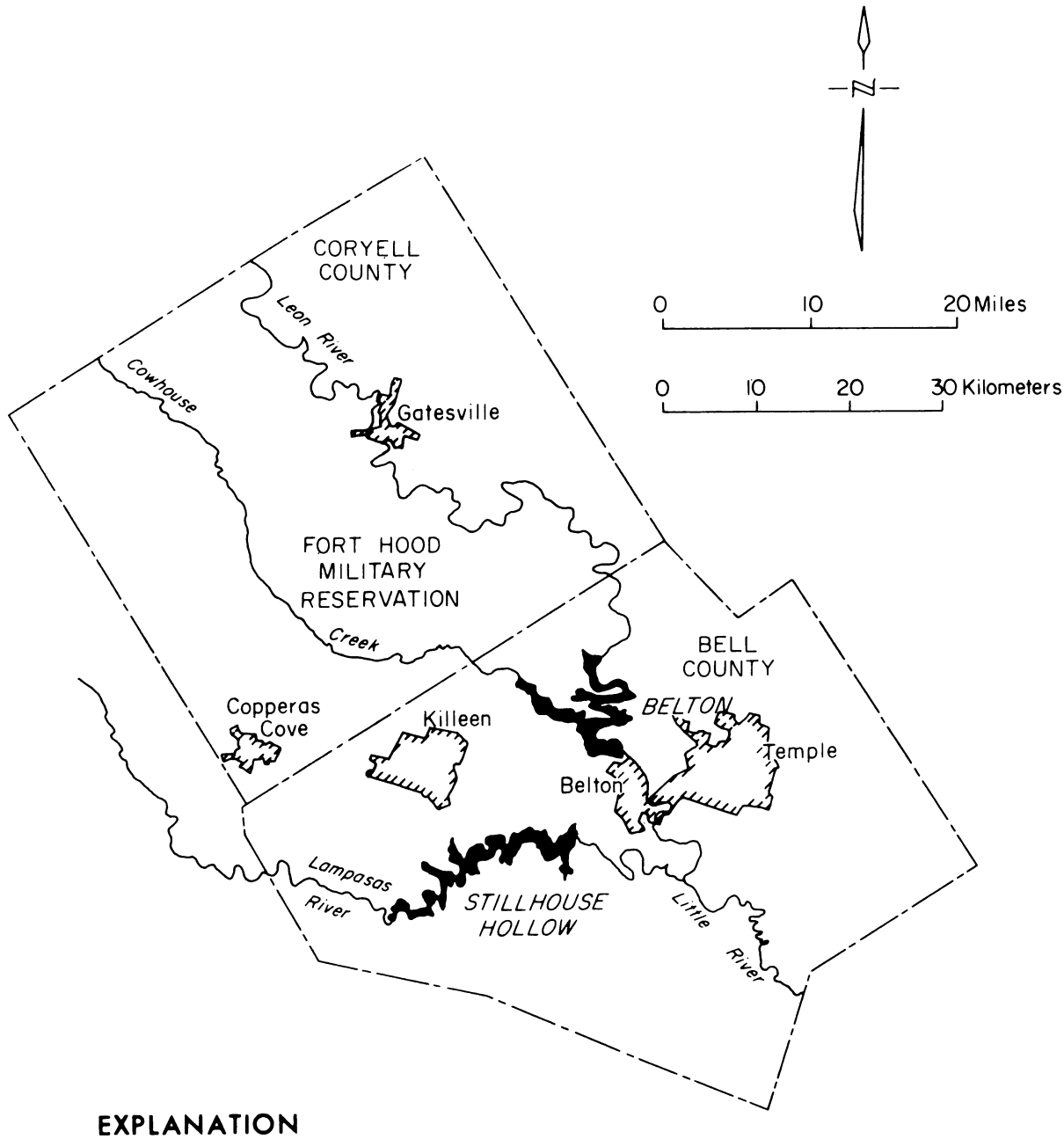


Figure 17

Killeen-Temple SMSA Water Supply Projects

Many of the smaller yet growing urban water systems within the SMSA have been and will continue to be faced with problems related to physical conditions, facility costs, and water rights. Many of the smaller, growing systems are located in areas distant from reliable sources of supply. Under this condition, the cost of required delivery and treatment facilities to develop a reliable supply may be relatively high in relation to costs for other cities within the SMSA. Also, sufficient surface and ground-water rights to adequately fulfill the water needs of the smaller urban systems may not be readily available or may not be accessible through a larger system having water rights.

All major municipal, military, and manufacturing water systems in the SMSA will be adequately supplied by Lakes Belton and Stillhouse Hollow through the year 2030. The larger systems include Temple, Killeen, Fort Hood, Belton and Copperas Cove. The Gatesville system and other smaller systems in Bell and Coryell counties are expected to be adequately supplied by the ground-water resources of the Trinity Group Aquifer through the year 2030. Continued ground-water withdrawal from the Trinity Group Aquifer is expected to continue to cause some decline in water levels, some decreasing well yields, and some water quality deterioration. However, these conditions should not create serious problems before the year 2030.

Description of Laredo SMSA - The SMSA is area No. 13 on Figure 1, and is composed of Webb County which covers about 3,306 square miles in parts of the Rio Grande and Nueces River basins. Normal annual precipitation ranges from 18 to 22 inches. Mean annual temperatures range from about 72°F to 73°F. The principal city is Laredo.

Economy of Laredo SMSA - The area economy is characterized by primary concentration in the wholesale and retail trade sectors. The apparel and food processing industries remain the most important sources of manufacturing employment, which contributes 7.7 percent to the total personal income of the SMSA. The regional economic outlook is for continuing dependence on trade generated by Laredo's location on the Mexican border.

Water Quality Planning in Laredo SMSA - A background discussion of the purpose, scope, goals, status, etc. of Section 208 (P.L. 92-500 water quality planning in Texas is given in the "Statewide Perspective" section of this report. The SMSA is approximately equally divided between the Middle Rio Grande Basin and the Nueces Basin State Planning Areas. The Nueces River Authority, at the request of the Texas Department of Water Resources (TDWR) serves as the basin planning agency for the Nueces Basin portion of the SMSA. The TDWR serves directly as the planning agency for the Middle Rio Grande Basin. The most important activity performed during the initial planning was the identification of those entities which potentially had wastewater treatment needs within five years. For those areas so identified, the sewage treatment needs were determined for a 20 year period. With respect to continuing planning, the SMSA area has not been identified for special studies. Therefore, the

major planning activity will be the continued assessment of sewage treatment needs within a 20 year time frame, and the designation of sewage treatment and collection management agencies. Intensive public participation activities were carried out during the initial planning and will be continued during the continuing planning process. A water quality advisory committee has been established in the Nueces Basin State Planning Area. The committee is composed of essentially balanced representation of four groups: public officials, economic interests, public interests, and private citizens. The committee will review and make recommendations on planning outputs.

Floodplain Management Program in the Laredo SMSA - The Federal Emergency Management Agency has designated Webb County and the City of Laredo as being subject to potential flooding problems from a 100-year flood event (Appendix B). Flood hazard boundary maps identifying flood-prone areas have been published for both the county and the city (Appendix B), but presently, only the city has adopted a local floodplain management program (Appendix B) in compliance with the requirements regarding participation in the National Flood Insurance Program (NFIP). Participation in the NFIP makes flood insurance available to SMSA residents presently in the floodplain and will afford some degree of protection against monetary losses due to flooding. Enforcement of the local floodplain management programs would assure that future developments will be located so as to eliminate damage from the 100-year flood. Webb County and the City of Laredo do not have detailed Flood Insurance Rate Studies in progress (Appendix B). These studies provide detailed10-year, 50-year, 100-year, and 500-year flood event data.

Population and Employment in Laredo SMSA

Item	1960	1970	1980	1990	2000
	(thousands)				
Total Population	64.8	72.9	99.0	124.0	138.6
Urban Population	60.7	69.1	91.2	112.1	125.5
Other Population	4.1	3.8	7.8	11.9	13.1
Employment	16.4	19.0	30.4	39.0	46.9

Estimated Water Use and Projected Water Requirements Within the Laredo SMSA 1/

Demand Categories	Estimated Use	Projected Requirements	
	1980	1990	2000
	(Thousands of Acre-feet)		
Municipal 2/	27.0	34.3	39.1
Manufacturing 3/	0.4	0.4	0.5
Steam-Electric 4/	1.0	0.7	0.7
Mining 5/	0.1	0.1	0.1
SMSA Totals	28.5	35.5	40.4

Source: Texas Department of Water Resources projections of water required under drought conditions. One acre-foot of water is 325,851 gallons.

1/ Additional water for agriculture (irrigation and livestock watering) will be required within the SMSA. Total SMSA agricultural uses were estimated at 17.3 thousand acre-feet in 1980. Projected future irrigation water requirements for 1990 and 2000 are not presented because urban growth within the SMSA and the resulting potential for this growth to impinge on irrigation in the area has not been predicted. (See footnote 1/, Table 1 for estimated total statewide irrigation water requirements for 1980, 1990 and 2000).

2/ Includes water used in cities for household purposes, fire protection, drinking and sanitation in public and commercial establishments, lawn watering, car washes, and other uses.

3/ Includes water used in the production processes and for cooling and heat exchange in manufacturing establishments.

4/ Estimated evaporation of cooling water used in steam-electric power plants. Additional water will be required for steam-electric power generation at plants outside the SMSA which supply electrical energy to users within the SMSA.

5/ Includes water used in the flooding of petroleum bearing formations to increase oil and gas production plus water used in sand and gravel and other mining activities.

Water Supply Outlook and Problems in the Laredo SMSA - Currently within the SMSA, approximately 96 percent of the water used for urban needs (municipal, manufacturing, steam-electric power generation, and mining purposes) is supplied by developed surface-water resources adjacent to the SMSA. The remaining four percent is supplied by ground-water resources. In the year 2000, approximately 98 percent of the SMSA's projected urban water requirements are expected to be supplied by developed surface-water resources, and approximately two percent by ground-water resources.

Many of the smaller yet growing urban water systems within the SMSA have been and will continue to be faced with problems related to physical conditions, facility costs, and water rights. Many of the smaller, growing systems are located in areas distant from reliable sources of supply. Under this condition, the cost of required delivery and treatment facilities to develop a reliable supply may be relatively high in relation to costs for other cities within the SMSA. Also, sufficient surface and ground-water rights to adequately fulfill the water needs of the smaller urban systems may not readily be available or may not be accessible through a larger system having water rights.

The Laredo SMSA occurs within the Middle Rio Grande Valley which will continue to be provided surface water from Lake Amistad which is part of the Lake Amistad-Lake Falcon system (Figure 18). Supplies from the system for in-basin needs, as well as needs for the southern portion of the Nueces-Rio Grande Coastal basin in the Lower Rio Grande Valley, are presently allocated on the basis of 1977 rules of the Texas Water Commission. These rules are based upon water rights recognized in the Middle Rio Grande (between Lake Amistad and Lake Falcon) from water rights and claims of a "Final Determination" by the Commission, and in the "Lower Rio Grande Valley Water Case." The 1977 specific water allocation

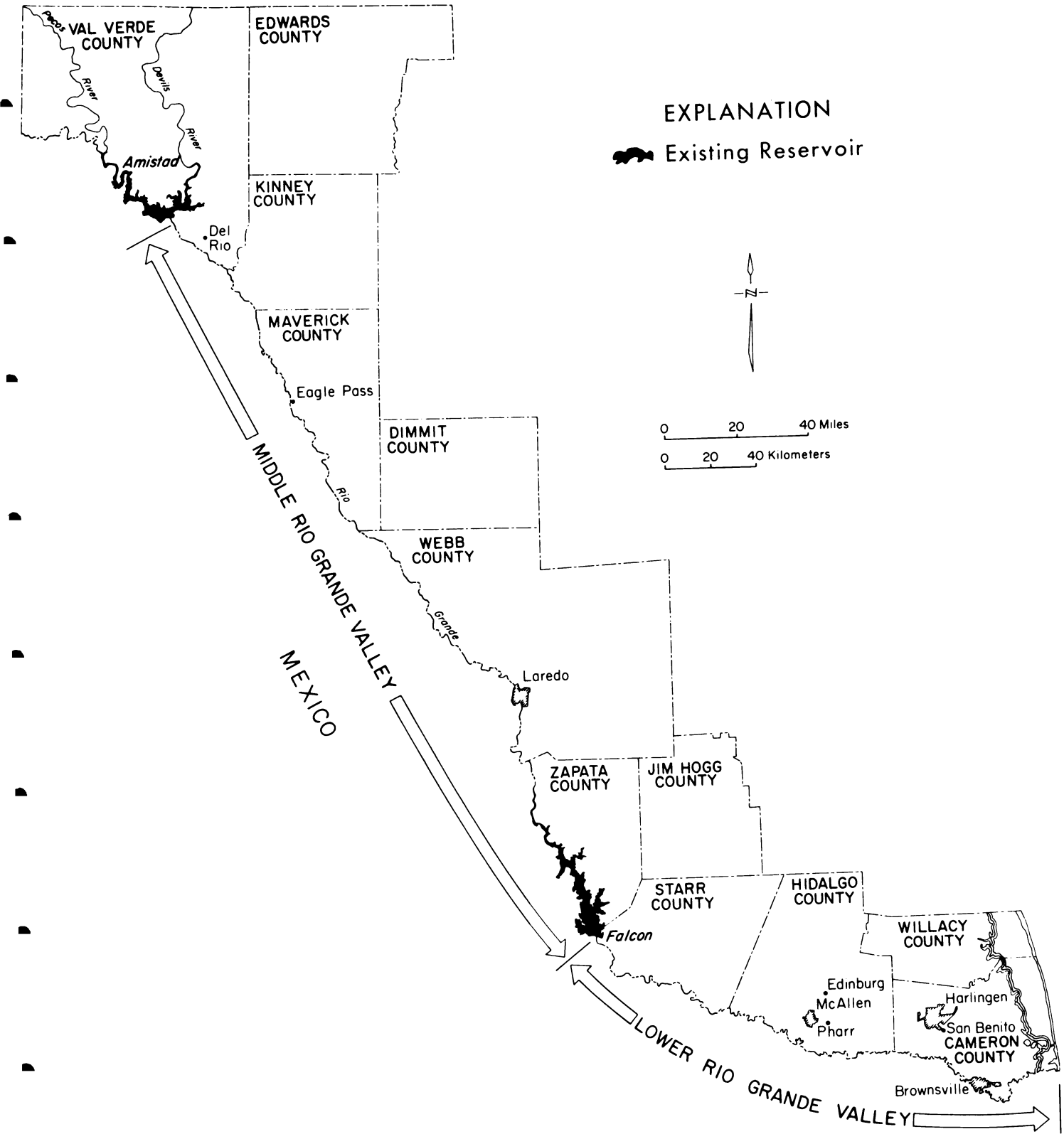


Figure 18

Laredo SMSA Water Supply Projects

for urban uses from the reservoir system is about 186.0 thousand acre-feet per year. Total urban water needs within the service area of the Lake Amistad-Lake Falcon system including the Laredo SMSA is expected to reach about 291.7 thousand acre-feet in the year 2000. Serious regional urban water shortages within the Lake Amistad-Lake Falcon service area are expected to occur between 1985 and 1990 based on the current urban water allocation (supply) of 186.0 thousand acre-feet. Under present conditions, an additional 100.0 thousand acre-feet of storage in Lake Amistad and Lake Falcon are set aside for emergency urban needs under drought conditions for the Middle and Lower Rio Grande Valleys for authorized allocations by the adjudication certificates.

On the basis of experience of the irrigators served by the Lake Amistad-Lake Falcon system, and the results of the Department's analyses of long-term reservoir operation studies of the system conducted by the International Boundary and Water Commission, shortages of water necessary to meet the full demands of the currently adjudicated acreage in the Lower Valley below Lake Falcon (about 740 thousand acres of about 1.87 million acre-feet of water) are expected to occur more than 70 percent of the time, although substantial or serious shortages would occur less than 30 percent of the time. During critical drought periods, substantial shortages will occur and a significant part of the current irrigated acreage will have no irrigation water supply.

High concentrations of total dissolved solids occur in ground-water supplies from the Carrizo-Wilcox Aquifer (Figure 3) within the Laredo SMSA. Salinity coupled with the low permeability of the aquifer and low recharge rates do not permit adequate amounts of ground water to be developed for moderate to large municipal and manufacturing supplies within the SMSA.

Description of Longview SMSA - The SMSA is area No. 14 on Figure 1, and is composed of Gregg and Harrison counties which cover about 1,176 square miles in parts of the Cypress Creek and Sabine River basins. Normal annual precipitation ranges from 46 to 48 inches. Mean annual temperature is about 65°F. The principal cities are Longview, Kilgore, and Marshall.

Economy of the Longview SMSA - The area economy is characterized by a high concentration of activity in the manufacturing and mining sectors. Manufacturing is diversified and contributes 28.7 percent to the total personal income of the SMSA. The regional economic outlook is for steady growth and continuing development of the oil, gas, and lignite extraction industries.

Water Quality Planning in the Longview SMSA - A background discussion of the purpose, scope, goals, status, etc. of Section 208 (P.L. 92-500) water quality planning in Texas is given in the "Statewide Perspective" section of this report. The Texas Department of Water Resources (TDWR) is the 208 planning agency for this area since it is a nondesignated planning area. The TDWR contracts with the Sabine River Authority (SRA) to do the planning for that portion of the SMSA which is in the Sabine River Basin which comprises the greater portion of Gregg County and the southern half of Harrison County. The TDWR contracts with the Northeast Texas Municipal Water District (NTMWD) to do the planning for the remainder of the SMSA which is in the Cypress Creek basin. The Sabine River in the vicinity of the Longview urban area was addressed in previous 208 planning because of recurring dissolved oxygen depletion problems. Historically, the Sabine River above Toledo Bend Reservoir has experienced recurrent critical dissolved oxygen levels, particularly in the area downstream from Longview. An important part of the initial 208

efforts was mathematical modeling of the stream system. Simplified modeling of the instream impact of combined point and nonpoint source loads has indicated that stormwater runoff may represent a potentially significant detriment to the oxygen resources of this receiving stream. However, nonpoint source loading estimates developed in the initial planning phase must be refined and substantiated through sampling before implementation of control strategies can be developed and assessed. Under future 208 planning efforts, the cause/effect relationships in the Longview urban area and, if necessary, any appropriate controls need to be defined and documented. Additionally, the assimilative capacity of this area needs to be adequately defined, the potential effects of wastewater discharges verified, and the necessary controls defined and documented. The NTMWD did facility needs analysis in the initial phase of the 208 planning process. This effort will be continued in the future 208 planning process. Both planning agencies (SRA and NTMWD) will have "208 Citizen Advisory Committees" made up of four categories of citizens; private citizens, public interest, public officials, and economic interest. These committees will review all documents released by the respective planning agencies for the SMSA. Both planning agencies will continue to assist the TDWR in the identification of Waste Treatment Management Agencies for this SMSA. They will also assist in the identification of needs for communities within this area through the year 2000 in five year increments. These needs are expressed in three categories: collection systems, interceptor lines, and sewage treatment plant construction or rehabilitation.

Floodplain Management Program in the Longview SMSA - The Federal Emergency Management Agency has designated both counties and 12 incorporated cities in the SMSA as being subject to potential flooding problems from a 100-year

flood event (Appendix B). Flood hazard boundary maps identifying flood-prone areas have been published for both of the counties and for 11 of the incorporated cities in the SMSA (Appendix B). Presently, only five cities in the SMSA have adopted local floodplain management programs (Appendix B) in compliance with the requirements regarding participation in the National Flood Insurance Program (NFIP). Participation in the NFIP makes flood insurance availble to SMSA residents presently in the floodplain and will afford some degree of protection against monetary losses due to flooding. Enforcement of the local floodplain management programs would assure that future developments will be located so as to eliminate damage from the 100-year flood. Detailed Flood Insurance Rate Studies presently in various stages of completion will supply detailed 10-year, 50-year, 100-year, and 500-year flood event data for four cities in the SMSA (Appendix B).

Population and Employment in Longview SMSA

Item	1960	1970	1980	1990	2000
	(thousands)				
Total Population	115.0	120.8	150.1	183.2	219.3
Urban Population	80.1	84.9	108.6	137.6	170.7
Other Population	34.9	35.9	41.5	45.6	48.6
Employment	40.0	44.4	61.8	76.3	92.6

Estimated Water Use and Projected Water Requirements Within the Longview SMSA 1/

Demand Categories	Estimated Use 1980	Projected Requirements 1990	2000
	(Thousands of Acre-feet)		
Municipal 2/	30.7	38.3	47.2
Manufacturing 3/	40.4	39.4	50.8
Steam-Electric 4/	4.0	20.0	40.0
Mining 5/	1.1	0.9	0.8
SMSA Totals	76.2	98.6	138.8

Source: Texas Department of Water Resources projections of water required under drought conditions. One acre-foot of water is 325,851 gallons.

1/ Additional water for agriculture (irrigation and livestock watering) will be required within the SMSA. Total SMSA agricultural uses were estimated at 1.6 thousand acre-feet in 1980. Projected future irrigation water requirements for 1990 and 2000 are not presented because urban growth within the SMSA and the resulting potential for this growth to impinge on irrigation in the area has not been predicted. (See footnote 1/, Table 1 for estimated total statewide irrigation water requirements for 1980, 1990 and 2000).

2/ Includes water used in cities for household purposes, fire protection, drinking and sanitation in public and commercial establishments, lawn watering, car washes, and other uses.

3/ Includes water used in the production processes and for cooling and heat exchange in manufacturing establishments.

4/ Estimated evaporation of cooling water used in steam-electric power plants. Additional water will be required for steam-electric power generation at plants outside the SMSA which supply electrical energy to users within the SMSA.

5/ Includes water used in the flooding of petroleum bearing formations to increase oil and gas production plus water used in sand and gravel and other mining activities.

Water Supply Outlook and Problems in the Longview SMSA - Currently within the SMSA, approximately 86 percent of the water used for urban needs (municipal, manufacturing, steam-electric power generation, and mining purposes) is supplied by developed surface-water resources in and adjacent to the SMSA. The remaining 14 percent is supplied by ground-water resources. In the year 2000, approximately 98 percent of the SMSA's projected urban water requirements are expected to be supplied by developed surface-water resources, and approximately two percent by ground-water resources

As indicated in the "Projected Water Requirements" within the SMSA (see table above), the reduction of the projected manufacturing water requirements from 1980 to 1990 results from expected compliance with the clean water goals of P.L. 92-500, the Federal Water Pollution Control (Clean Water) Act. The cost of treatment methods and facilities needed to meet the effluent water quality standards required by the Act is expected to result in a reduction in the quantity of manufacturing water used within the SMSA; particularly in the petroleum and lignite development industries. The reduction in projected water requirements for mining is because of improved technology in the use of water for mining purposes; particularly in the petroleum industry's enhanced recovery operations and lignite development within the SMSA.

Many of the smaller yet growing urban water systems within the SMSA have been and will continue to be faced with problems related to physical conditions, facility costs, and water rights. Many of the smaller, growing systems are located in areas distant from reliable sources of supply. Under this condition, the cost of required delivery and treatment facilities to develop a reliable supply may be relatively high in relation to costs for other cities within the SMSA. Also, sufficient surface and ground-water rights to adequately fulfill the water needs of the smaller urban systems may not be readily available or may not be accessible through a larger system having water rights.

The major urban surface-water requirements within the SMSA is expected to be about 96 thousand acre-feet in the year 2000, which includes the municipal and industrial needs for the Longview, Marshall, Kilgore, Gladewater, and other urban water systems. These requirements can be adequately met by the dependable supplies from Lakes Cherokee, Gladewater, Caddo (Little Cypress Bayou), Kilgore 2 (proposed), and Lake Fork (scheduled for completion in 1981) (Figure 19),

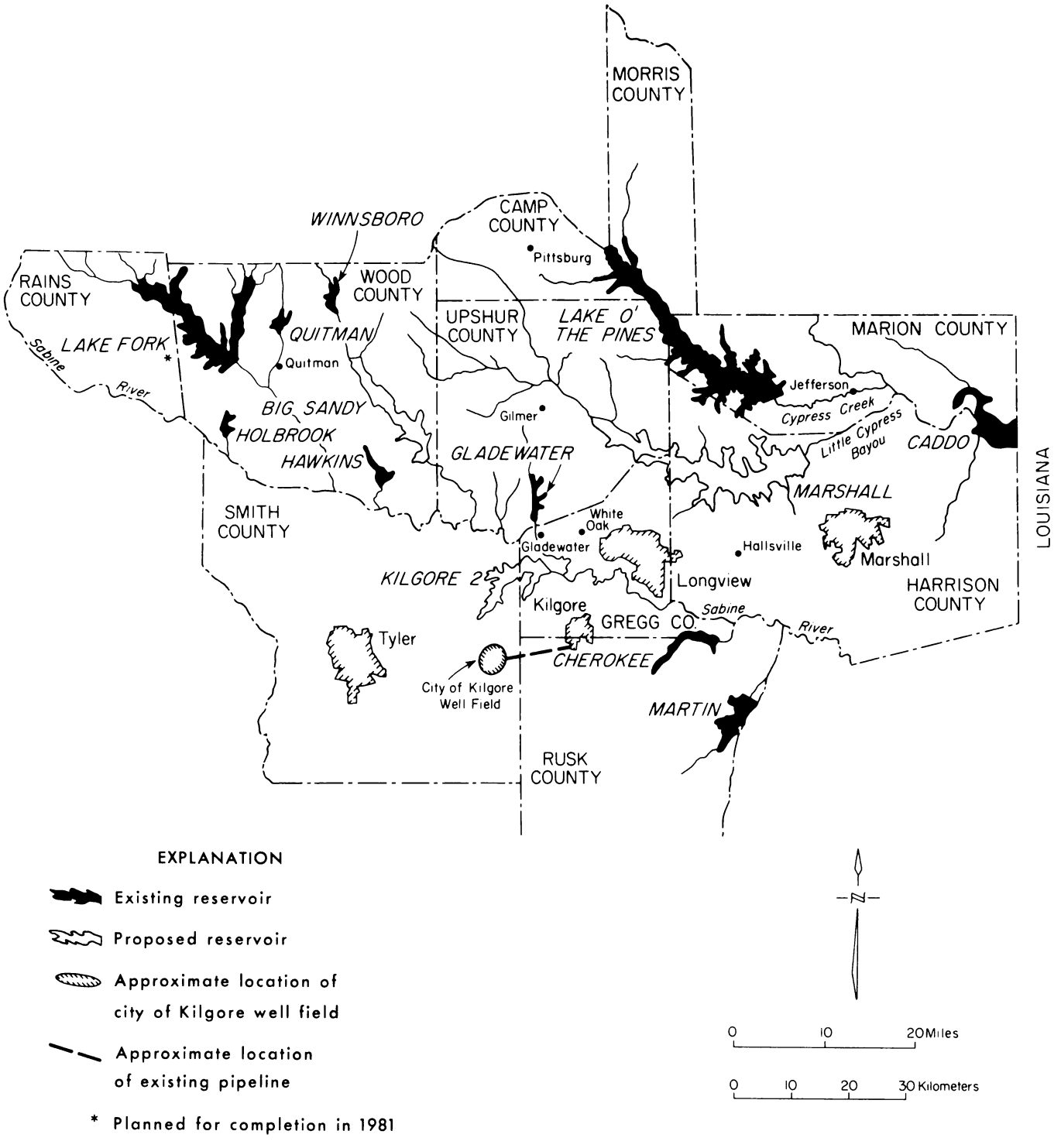


Figure 19

Longview SMSA Water Supply Project

which together can supply about 127 thousand acre-feet to the SMSA in the year 2000. This determination assumes that the City of Kilgore will convert their supply from the well field (Figure 19) completed in the Carrizo-Wilcox Aquifer (Figure 3) to Lake Kilgore 2 (Figure 19) by the year 2000, and that the City of Marshall will obtain additional needed supplies from either Lake Fork through the City of Longview, Caddo Lake, or other sources within the Cypress Creek Basin.

Between the years 2005 and 2010, the urban water needs of the SMSA are expected to exceed the available supplies from the five reservoirs mentioned above. Additional supplies for the SMSA will have to be obtained from proposed reservoirs outside of the SMSA; namely Big Sandy Lake on Sandy Creek in the Sabine River basin and/or Lake Marshall on Little Cypress Bayou in the Cypress Creek Basin (Figure 19). It is very likely that future additional water supplies needed by the City of Longview will be provided by Big Sandy Lake. Future additional supplies needed by the Marshall water system will very likely come from Lake Marshall.

Description of Lubbock SMSA - The SMSA is area No. 15 on Figure 1, and is composed of Lubbock County which covers about 893 square miles in the Brazos River Basin. Normal annual precipitation ranges from about 17 to 20 inches. Mean annual temperatures range from about 58.5°F to 60°F. The principal city is Lubbock.

Economy of Lubbock SMSA - The area economy is characterized by high employment concentrations in the trade sector. The heavy equipment and electronics industries have become the most important sources of manufacturing employment, which contributes 11.9 percent to the total personal income of the SMSA. The regional economic outlook is for continuing dependence on agriculture with increasing employment opportunities in manufacturing.

Water Quality Planning in the Lubbock SMSA - A background discussion of the purpose, scope, goals, status, etc. of Section 208 (P.L. 92-500) water quality planning in Texas is given in the "Statewide Perspective" section of this report. The Lubbock SMSA is located entirely within the Brazos Basin Planning Area. The Brazos River Authority through a contract with the Texas Department of Water Resources serves as the Brazos River Basin planning agency. The most important activity performed during the initial planning was the identification of those entities which potentially had wastewater treatment needs within five years. For those areas so identified, the sewage treatment needs were determined for a 20-year period. With respect to continuing planning, the Lubbock SMSA has not been identified for special studies. Therefore, the major planning activity will be the continued

assessment of sewage treatment needs within a 20-year time frame, and the designation of sewage treatment and collection management agencies. Intensive public participation activities were carried out during the initial planning and will be continued during the continuing planning process. A water quality advisory committee has been established in the Brazos Basin planning area. The committee is composed of essentially balanced representation of four groups: public officials, economic interests, public interests, and private citizens. The committee will review and make recommendations on planning outputs.

Floodplain Management Program in the Lubbock SMSA - The Federal Emergency Management Agency has designated Lubbock County and five incorporated cities in the county as being subject to potential flooding problems from a 100-year flood even (Appendix B). Flood hazard boundary maps identifying flood-prone areas have been published for the county and for four of the incorporated cities in the SMSA (Appendix B). Presently, only three of the cities have adopted local floodplain management programs (Appendix B) in compliance with the requirements regarding participation in the National Flood Insurance Program (NFIP). Participation in the NFIP makes flood insurance available to SMSA residents presently in the floodplain and will afford some degree of protection against monetary losses due to flooding. Enforcement of the local floodplain management programs would assure that future developments will be located so as to eliminate damage from the 100-year flood. As indicated in Appendix B, Detailed Flood Insurance Rate Studies have not been initiated in Lubbock County or the five incorporated cities. These studies provide detailed 10-year, 50-year, 100-year, and 500-year flood event data.

Population and Employment in Lubbock SMSA

Item	1960	1970	1980	1990	2000
	(thousands)				
Total Population	156.3	179.3	211.8	239.7	269.0
Urban Population	138.8	163.1	186.9	208.9	234.6
Other Population	17.5	16.2	24.9	30.8	34.4
Employment	56.6	67.6	97.2	104.9	120.0

Estimated Water Use and Projected Water Requirements Within the Lubbock, SMSA 1/

Demand Categories	Estimated Use	Projected Requirements	
	1980	1990	2000
	(Thousands of Acre-feet)		
Municipal 2/	53.1	61.2	69.9
Manufacturing 3/	3.8	4.6	5.6
Steam-Electric 4/	11.5	11.5	13.0
Mining 5/	0.2	0.2	0.3
SMSA Totals	68.6	77.5	88.8

Source: Texas Department of Water Resources projections of water required under drought conditions. One acre-foot of water is 325,851 gallons.

1/ Additional water for agriculture (irrigation and livestock watering) will be required within the SMSA. Total SMSA agricultural uses were estimated at 280.4 thousand acre-feet in 1980. Projected future irrigation water requirements for 1990 and 2000 are not presented because urban growth within the SMSA and the resulting potential for this growth to impinge on irrigation in the area has not been predicted. (See footnote 1/, Table 1 for estimated total statewide irrigation water requirements for 1980, 1990 and 2000).

2/ Includes water used in cities for household purposes, fire protection, drinking and sanitation in public and commercial establishments, lawn watering, car washes, and other uses.

3/ Includes water used in the production processes and for cooling and heat exchange in manufacturing establishments.

4/ Estimated evaporation of cooling water used in steam-electric power plants. Additional water will be required for steam-electric power generation at plants outside the SMSA which supply electrical energy to users within the SMSA.

5/ Includes water used in the flooding of petroleum bearing formations to increase oil and gas production plus water used in sand and gravel and other mining activities.

Water Supply Outlook and Problems in the Lubbock SMSA - Currently within the SMSA, approximately 77 percent of the water used for urban needs (municipal, manufacturing, steam-electric power generation, and mining purposes) is supplied by developed surface-water resources adjacent to the SMSA. The remaining 23 percent is supplied by ground-water resources. In the year 2000, approximately 76 percent of the SMSA's projected urban water requirements are expected to be supplied by developed surface-water resources, and approximately 24 percent by ground-water resources.

Many of the smaller yet growing urban water systems within the SMSA have been and will continue to be faced with problems related to physical conditions, facility costs, and water rights. Many of the smaller, growing systems are located in areas distant from reliable sources of supply. Under this condition, the cost of required delivery and treatment facilities to develop a reliable supply may be relatively high in relation to costs for other cities within the SMSA. Also, sufficient surface and ground-water rights to adequately fulfill the water needs of the smaller urban systems may not be readily available or may not be accessible through a larger system having water rights.

The City of Lubbock is the largest urban water system in the SMSA. Currently, the Lubbock System receives its water supply from (1) Lake Meredith (Figure 2) via the Canadian River Municipal Water Authority (CRMWA) pipeline (Figure 20), and (2) the Sand Hills well field, Shallowater Well Field, and wells within the city (Figure 20), all of which are completed in the Ogallala Aquifer (Figure 3). Currently, on an average basis these supplies provide about 59.9 thousand acre-feet annually to the Lubbock System with about 73 percent from Lake Meredith and 27 percent from the Ogallala Aquifer well fields. However, the Ogallala Aquifer within and near the city's well fields as well as throughout the High Plains is not a renewable source of water. A steam electric

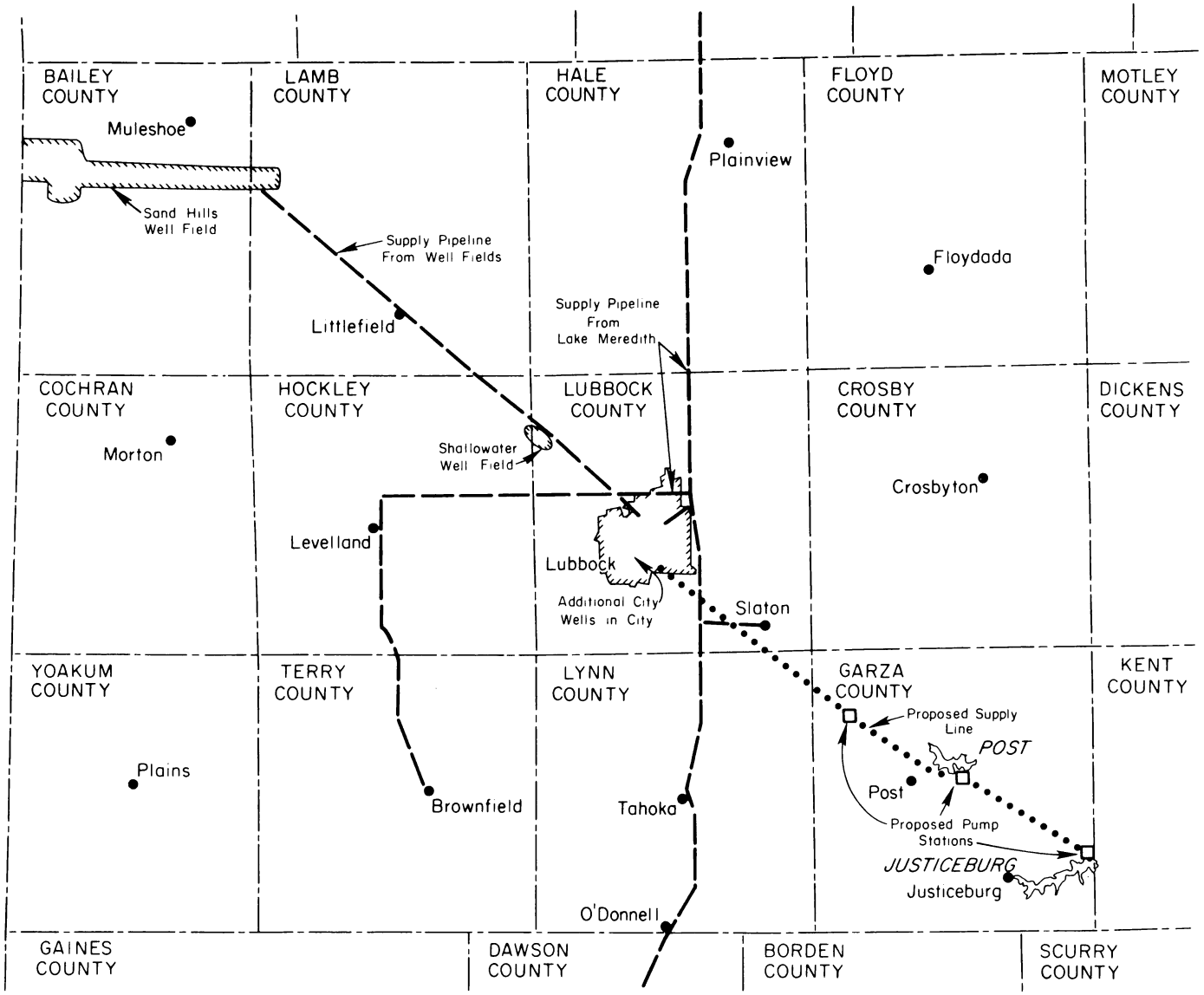


Figure 20

Lubbock SMSA Water Supply Projects

power plant and an irrigator within the SMSA are presently using sewage effluent from the Lubbock System as a source of water, in order to increase overall water use efficiency, and reduce the load on existing water supplies.

The use of ground water from within and adjacent to the SMSA is expected to continue to cause declining water levels and reduction of well yields. The City of Lubbock is currently developing plans to obtain additional surface-water supplies to supplement present supplies from Lake Meredith and the Ogallala Aquifer. These additional supplies being considered include Lakes Post and Justiceburg which are proposed to be located on the North and South Forks of the Double Mountain Fork of the Brazos River in Garza County (Figure 20). These reservoirs operated as one system are expected to be capable of delivering a dependable supply of about 37.0 thousand acre-feet annually, of which about 32.5 thousand acre-feet per year might be made available to the City of Lubbock. One possible plan, if implemented, could result in the City receiving water from Lake Post in 1986 and from the Lakes Post-Justiceburg System in 1992. These additional supplies, along with the supplies from Lake Meredith (37.79 thousand acre-feet per year) and the Ogallala Aquifer would be expected to meet the urban water needs of Lubbock and the SMSA through the year 2030.

Description of McAllen-Pharr-Edinburg SMSA - The SMSA is area No. 16 on Figure 1, and is composed of Hidalgo County which covers about 1,543 square miles in parts of the Rio Grande basin and the Nueces-Rio Grande Coastal basin. Normal annual precipitation ranges from about 19 to 25 inches. Mean annual temperature is about 73.5°F. The principal cities are McAllen, Pharr and Edinburg.

Economy of McAllen-Pharr-Edinburg SMSA - The area economy is characterized by a concentration of employment in the trade sector. The food processing industry remains the most important source of manufacturing employment, which contributes 5.5 percent to the total personal income of the SMSA. The regional economic outlook is for continuing dependence on agriculture with a rapid growth rate.

Water Quality Planning in the McAllen-Pharr-Edinburg SMSA - A background discussion of the purpose, scope, goals, status, etc. of Section 208 (P.L. 92-500) water quality planning in Texas is given in the "Statewide Perspective" section of this report. The SMSA is located entirely within the Lower Rio Grande Valley 208 Designated Area. In 1975, the Governor designated the Lower Rio Valley Development Council (LRGVDC) as the planning agency of the designated area. One of the most important activities accomplished under the initial plan was the identification of the municipal wastewater management needs and cost for a 20 year period. Existing and projected wasteloads were evaluated and sewage treatment plant effluent limitations were recommended. Continuing planning activities are mainly focused on determing the extent and impacts of agriculturally related potential nonpoint sources of pollution including

nutrients, heavy metals, and pesticides. This is being accomplished through related activities of the LRGVDC, the Texas Department of Water Resources, the Texas State Soil and Water Conservation Board, and the U.S. Fish and Wildlife Service. The investigation is being carried out because U.S. Fish and Wildlife Service data show some high values of pesticide contamination in fish flesh. Data from the U.S. Corps of Engineers, Texas Department of Water Resources, and Texas Parks and Wildlife Department also show some high pesticide concentrations in either fish or sediments. Since the valley area contains intensive agriculture production, which uses large quantities of pesticides, the extent and impacts of the pesticides and other materials on water quality and fish life needs to be determined. Another activity will be determining the management agency requirements and wastewater treatment needs of the many unincorporated communities or "colonies" which occur in the Lower Rio Grande Valley. Intensive public participation activities were carried out during the initial planning and will be continued during the continuing planning process. A water quality advisory committee has been established in the Lower Rio Grande Valley Designated Area. The committee is composed of representatives from four groups: public officials, economic interests, public interests, and private citizens. The committee will review and make recommendations on planning ouputs.

Floodplain Management Program in the McAllen-Pharr-Edinburg SMSA - The Federal Emergency Management Agency has designated Hidalgo County and 14 incorporated cities in the SMSA as being subject to potential flooding problems from a 100-year flood even (Appendix B). Flood hazard boundary maps identifying flood-prone areas have been published for Hidalgo County and for 11 of the incorporated cities in the SMSA (Appendix B). Presently, Hidalgo County and the 14 incorporated cities in the SMSA have adopted local floodplain manage-

ment programs (Appendix B) in compliance with the requirements regarding participation in the National Flood Insurance Program (NFIP). Participation in the NFIP makes flood insurance available to SMSA residents presently in the floodplain and will afford some degree of protection against monetary losses due to flooding. Enforcement of the local floodplain management programs would assure that future developments will be located so as to eliminate damage from the 100-year flood. Detailed Flood Insurance Rate Studies presently in various stages of completion will supply detailed 10-year, 50-year, 100-year, and 500-year flood event data for Hidalgo County and nine cities in the SMSA (Appendix B).

Population and Employment in McAllen-Pharr-Edinburg SMSA

Item	1960	1970	1980	1990	2000
	(thousands)				
Total Population	180.9	181.5	279.2	363.6	445.1
Urban Population	131.2	135.8	202.3	265.6	332.8
Other Population	49.7	45.7	76.9	98.0	112.3
Employment	57.1	52.1	78.9	101.7	130.8

Estimated Water Use and Projected Water Requirements Within the McAllen-Pharr-Edinburg SMSA 1/

Demand Categories	Estimated Use 1980	Projected Requirements 1990	2000
	(Thousands of Acre-feet)		
Municipal 2/	65.0	87.6	110.2
Manufacturing 3/	3.1	3.4	4.2
Steam-Electric 4/	1.5	1.5	1.5
Mining 5/	1.6	1.7	2.1
SMSA Totals	71.2	94.2	118.0

Source: Texas Department of Water Resources projections of water required under drought conditions. One acre-foot of water is 325,851 gallons.

1/ Additional water for agriculture (irrigation and livestock watering) will be required within the SMSA. Total SMSA agricultural uses were estimated at 604.2 thousand acre-feet per year in 1980. Projected future irrigation water requirements for 1990 and 2000 are not presented because urban growth within the SMSA and the resulting potential for this growth to impinge on irrigation in the area has not been predicted. (See footnote 1/, Table 1 for estimated total statewide irrigation water requirements for 1980, 1990 and 2000).

2/ Includes water used in cities for household purposes, fire protection, drinking and sanitation in public and commercial establishments, lawn watering, car washes, and other uses.

3/ Includes water used in the production processes and for cooling and heat exchange in manufacturing establishments.

4/ Estimated evaporation of cooling water used in steam-electric power plants. Additional water will be required for steam-electric power generation at plants outside the SMSA which supply electrical energy to users within the SMSA.

5/ Includes water used in the flooding of petroleum bearing formations to increase oil and gas production plus water used in sand and gravel and other mining activities.

Water Supply Outlook and Problems in the McAllen-Pharr-Edinburg SMSA - Currently within the SMSA, approximately 84 percent of the water used for urban needs (municipal, manufacturing, steam-electric power generation, and mining purposes) is supplied by developed surface-water resources adjacent to the SMSA. The remaining 16 percent is supplied by ground-water resources. In the year 2000, approximately 98 percent of the SMSA's projected urban water requirements are expected to be supplied by developed surface-water resources, and approximately two percent by ground-water resources.

Many of the growing urban water systems within the SMSA have been and will continue to be faced with problems related to physical conditions, facility costs, and water rights. Many of the systems are located in areas distant from reliable sources of supply. Under this condition, the cost of required delivery and treatment facilities to develop a reliable supply may be relatively high in relation to costs. Also, sufficient surface or ground-water rights to adequately fulfill the water needs of these urban systems may not be readily available or may not be accessible through an entity having water rights.

The SMSA occurs within the Lower Rio Grande Valley which will continue to be provided, along with the Middle Rio Grande Valley, surface water from the Lake Amistad-Lake Falcon system (Figure 21). Supplies from the system for in-basin needs, as well as needs for the souther portion of the Nueces-Rio Grande Coastal basin in the Lower Rio Grande Valley, are presently allocated on the basis of 1977 rules of the Texas Water Commission. These rules are based upon water rights recognized in the "Lower Rio Grande Valley Water Case," and in the Middle Rio Grande (between Lake Amistad and Lake Falcon) upon a "Final Determination" of water rights and claims by the Commission. The 1977 specific water allocation for urban uses from the reservoirs system is about 186.0 thousand acre-feet per year. Total urban water needs within the SMSA and other areas served by the Lake Amistad-Lake Falcon system is expected to reach about 291.7 thousand acre-feet in the year 2000. Serious regional urban water shortages within the Lake Amistad-Lake Falcon service area are expected to occur between 1985 and 1990 based on the current urban water allocation (supply) of 186.0 thousand acre-feet. Under present conditions, an additional 100.0 thousand acre-feet of storage in Lake Amistad and Lake Falcon are set aside for emergency urban needs under drought conditions for the Middle and Lower Rio Grande Valleys for authorized allocations by the adjudication certificates.

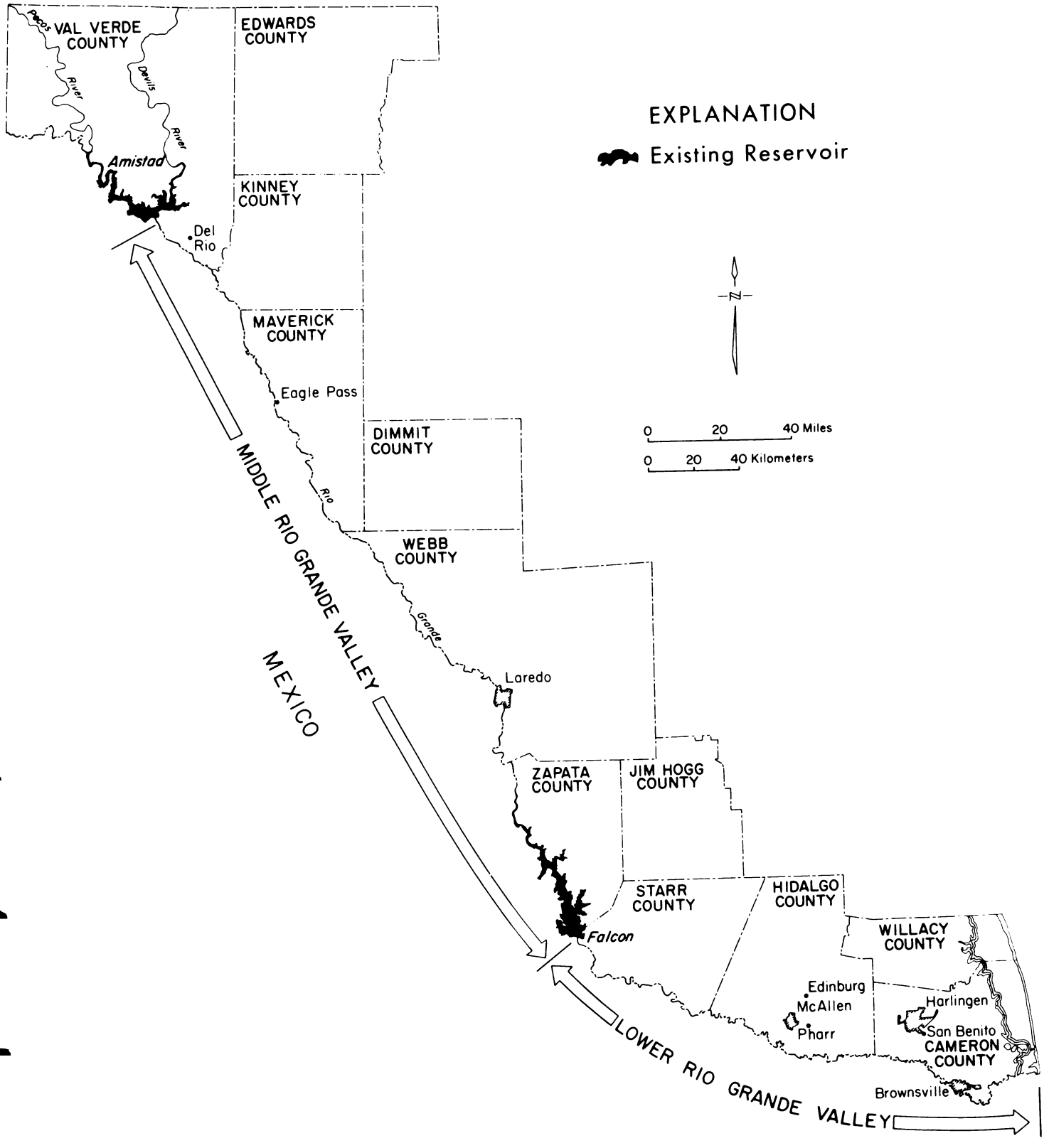


Figure 21

McAllen-Pharr-Edinburg SMSA Water Supply Projects

On the basis of experience of the irrigators served by the Lake Amistad-Lake Falcon system, and the results of the Department's analyses of long-term reservoir operation studies of the system conducted by the International Boundary and Water Commission, shortages of water necessary to meet the full demands of the currently adjudicated acreage in the Lower Valley below Lake Falcon (about 740 thousand acres or about 1.87 million acre-feet of water) are expected to occur more than 70 percent of the time, although substantial or serious shortages would occur less than 30 percent of the time. During critical drought periods, substantial shortages will occur and a significant part of the current irrigated acreage will have no irrigation water supply.

High concentrations of total dissolved solids are often encountered in ground-water supplies from the Gulf Coast Aquifer (Figure 3) within the SMSA. Salinity coupled with the low permeability of the aquifer and low recharge rates do not permit adequate amounts of ground water to be developed for moderate to large municipal and manufacturing supplies within the SMSA.

Description of Midland SMSA - The SMSA is area No. 17 on Figure 1, and is composed of Midland County which covers about 839 square miles, all of which is within the Colorado River basin. Normal annual precipitation is about 13 inches. Mean annual temperatures range from about 63°F to 65°F. The principal city is Midland.

Economy of Midland SMSA - The area economy is characterized by high employment concentrations in the petroleum sector, with secondary emphasis in construction and trades. The petrochemical and oil and gas drilling equipment industries are the most important sources of manufacturing employment, which contributes 6.1 percent to the total personal income of the SMSA. The regional economic outlook is for steady growth and diversification with continuing dependence on energy resources.

Water Quality Planning in the Midland SMSA - A background discussion of the purpose, scope, goals, status, etc. of Section 208 (P.L. 92-500) water quality planning in Texas is given in the "Statewide Perspective" section of this report. The SMSA lies within the upper part of the Colorado River basin and is essentially non-contributing to the Colorado River. Through contract with the Department of Water Resources, the Colorado River Municipal Water District is the 208 water quality planning agency for the SMSA and adjacent areas. The initial phase of the 208 water quality planning program included information on existing wastewater treatment facilities; existing water quality; existing land use patterns; existing population; and projections of economic growth, population, and probable land use patterns. During this phase, problems with the wastewater treatment plans of Midland were identified. During the later

phases of the plan, feasible alternative solutions were developed and an environmental assessment was done.The area's 208 continuing planning program includes public participation. A citizens advisory committee consisting of representatives from four groups (private citizens, public officials, public interest, and economic interest) reviews all documents developed during the program.

Floodplain Management Program in the Midland SMSA - The Federal Emergency Management Agency has designated Midland County (Appendix B) as being subject to potential flooding problems from a 100-year flood event. Flood hazard boundary maps identifying flood-prone areas have been published for Midland County and the City of Midland (Appendix B), and both entities have adopted local floodplain management programs (Appendix B) in compliance with the requirements regarding participation in the National Flood Insurance Program (NFIP). Participation in the NFIP makes flood insurance available to SMSA residents presently in the floodplain and will afford some degree of protection against monetary losses due to flooding. Enforcement of the local floodplain management programs would assure that future developments will be located so as to eliminate damage from the 100-year flood. Detailed Flood Insurance Rate Studies to supply detailed 10-year, 50-year, 100-year, and 500-year flood event data have not been made in Midland County and the City of Midland (Appendix B).

Population and Employment in Midland SMSA

Item	1960	1970	1980	1990	2000
			(thousands)		
Total Population	67.7	65.4	82.3	98.6	111.8
Urban Population	62.6	59.4	70.3	83.3	94.4
Other Population	5.1	6.0	12.0	15.3	17.4
Employment	26.1	26.5	44.6	52.1	59.4

Estimated Water Use and Projected Water Requirements Within the Midland SMSA 1/

Demand Categories	Estimated Use	Projected Requirements	
	1980	1990	2000
	(Thousands of Acre-feet)		
Municipal 2/	22.3	27.0	31.1
Manufacturing 3/	2.0	2.0	2.6
Steam-Electric 4/	-0-	-0-	-0-
Mining 5/	3.9	3.8	3.8
SMSA Totals	28.2	32.8	37.5

Source: Texas Department of Water Resources projections of water required under drought conditions. One acre-foot of water is 325,851 gallons.

1/ Additional water for agriculture (irrigation and livestock watering) will be required within the SMSA. Total SMSA agricultural uses were estimated at 35.2 thousand acre-feet in 1980. Projected future irrigation requirements for urban growth within the SMSA and the resulting potential for this growth to impinge on irrigation in the area has not been predicted. . (See Foognote 1/, Table 1 for estimated total statewide irrigation water requirements for 1980, 1990 and 2000.)

2/ Includes water used in cities for household purposes, fire protection, drinking and sanitation in public and commercial establishments, lawn watering, car washes, and other uses.

3/ Includes water used in the production processes and for cooling and heat exchange in manufacturing establishments.

4/ Estimated evaporation of cooling water used in steam-electric power plants. Additional water will be required for steam-electric power generation at plants outside the SMSA which supply electrical energy to users within the SMSA.

5/ Includes water used in the flooding of petroleum bearing formations to increase oil and gas production plus water used in sand and gravel and other mining activities.

Water Supply Outlook and Problems in the Midland SMSA - Currently within the SMSA, approximately 55 percent of the water used for urban needs (municipal, manufacturing, steam-electric power generation, and mining purposes) is supplied by developed surface-water resources adjacent to the SMSA. The remaining 45 percent is supplied by ground-water resources. In the year 2000, approximately 80 percent of the SMSA's projected urban water requirements are expected to be supplied by developed surface-water resources, and approximately 20 percent by ground-water resources.

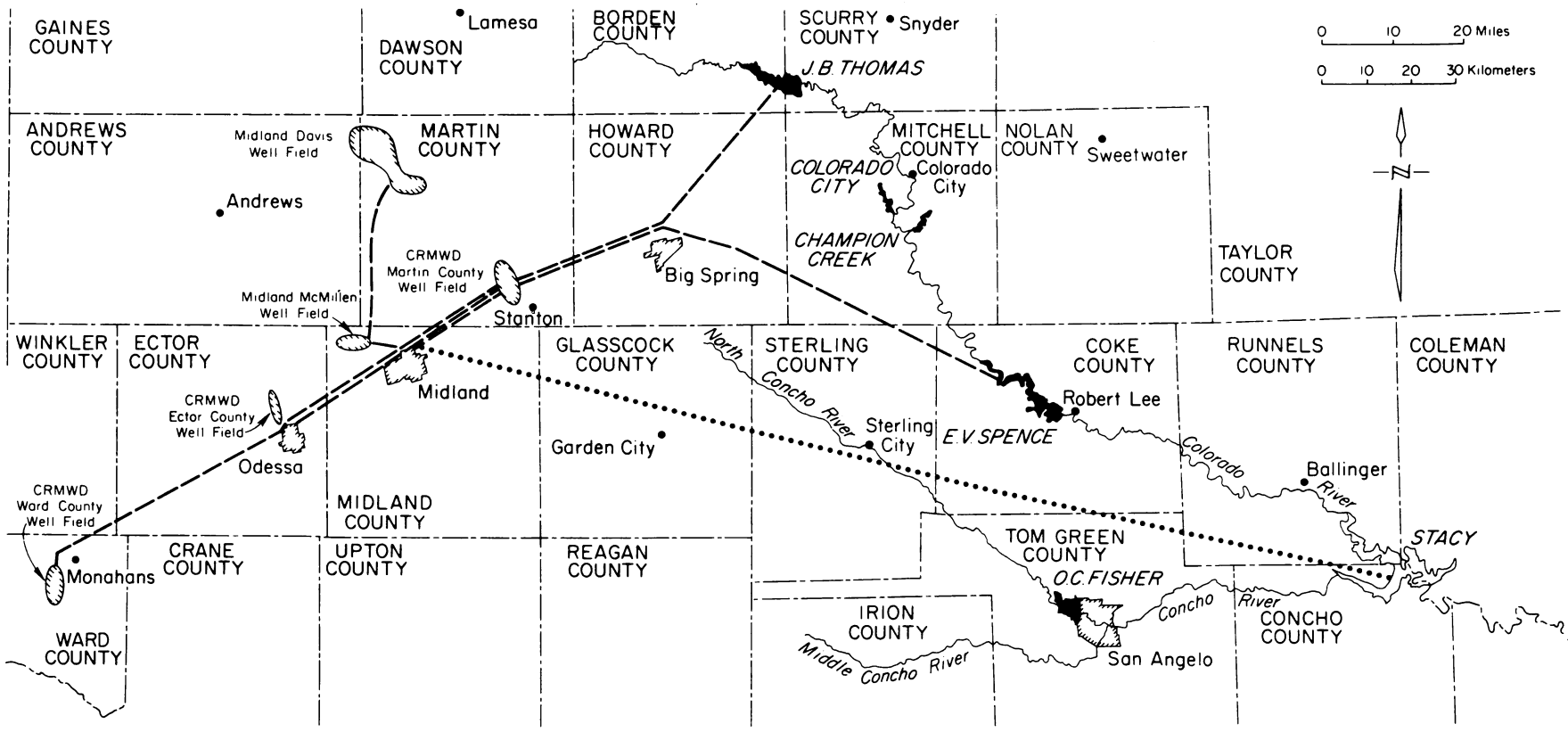
As indicated in the "Projected Water Requirements" within the SMSA (see table above), the same (unchanged) projected manufacturing water requirements for 1980 and 1990 (2.0 thousand acrefeet per year) results from expected compliance with the clean water goals of P.L. 92-500, the Federal Water Pollution Control (Clean Water) Act. The cost of treatment methods and facilities needed to meet the effluent water quality standards required by the Act is expected to result in a reduction in the quantity of manufacturing water used within the SMSA; particularly in the petroleum industry. The reduction in projected water requirements for mining is expected because of improved technology in the use of water for mining purpose; particularly in the petroleum industry's enhanced recovery operations.

The growing urban water systems within the SMSA have been and will continue to be faced with problems related to physical conditions, facility costs, and water rights. These systems are located in areas distant from reliable sources of supply. Under this condition, the cost of required delivery and treatment facilities to develop a reliable supply may be relatively high in relation to costs. Also, sufficient surface and ground-water rights to adequately fulfill

the water needs of the urban systems may not be readily available or may not be accessible through a system having water rights.

The City of Midland which is the only large urban water system in the SMSA (Midland County) obtains part of its water supply from the Colorado River Municipal Water District (CRMWD). Currently, most of Midland's supply is from surface water provided by Lakes J.B. Thomas (Scurry and Borden County) and E.V. Spence (Coke County) (Figure 22). The other current CRMWD supply for Midland is ground water from the Martin County well field (Figure 22). In 1980, the city has a contract with the CRMWD to receive about 11.9 thousand acre-feet from the above CRMWD sources. Current city contracts with the CRMWD have arrangements for the city to receive about a 50 million gallon per year increase; i.e., the 1981 delivery to the city will be about 12.1 thousand acre-feet. The City of Midland's remaining water supply is ground water from the city owned and operated Davis and McMillen well fields (Figure 22). However, both well fields when operated extensively have demonstrated water-level declines and decreasing well yields. Currently, the City of Midland produces most of its supplemental supply from the Davis well field. In the future, the city plans to take Davis well field water and recharge the McMillen well field where a significant amount of dewatered, unsaturated formation is available for underground storage. In the summer, the recharged water will be pumped from the McMillen well field to meet the city's peak demand.

The major current and proposed water supply projects and distribution facilities of the CRMWD are shown on Figure 22. The CRMWD not only supplies part of the water for the City of Midland but also provides all or part of the water supply for (1) the cities of Odessa, Big Spring, Snyder, Stanton, San Angelo and Robert Lee (Figure 22), (2) a power plant in Ward County, and



EXPLANATION

- Existing Reservoir
- Proposed Reservoir
- Approximate location of major pipelines of the CRMWD
- Approximate location of proposed supply line of the CRMWD
- Approximate location of well fields used as water supplies for urban needs within the Midland and Odessa SMSAs

CRMWD- Colorado River Municipal Water District

Figure 22

Midland SMSA Water Supply Projects

(3) fourteen industrial customers throughout the region involved in petroleum refining, production of petrochemicals, natural gas processing, metal refining, and oil field enhanced recovery operations. Currently, the CRMWD delivers about 50 thousand acre-feet per year to its customer cities and industries. Of the 50 thousand acre-feet annual delivery, about 84 percent was for municipal use and 16 percent was for manufacturing, steam-electric power generation, and mining. Approximately 74 percent of the annual water supply of the CRMWD is from Lakes J.B. Thomas and E.V. Spence and other diversions from the Colorado River. The remaining 26 percent of the annual supply is from the regions very limited ground-water resources provided by well fields, three of which are shown on Figure 22 in Martin, Ector, and Ward counties.

The projected urban surface-water requirements of the CRMWD service area including the Midland SMSA are expected to be about 113 thousand acre-feet in the year 2000. These requirements will continue to be met from Lakes J.B. Thomas and E.V. Spence. However, shortly after 1990, an additional surface-water supply will be needed by the CRMWD and its customer cities and industries. This additional firm supply can be provided by Lake Stacy, a proposed reservoir to be located on the Colorado and Concho Rivers in Runnels, Coleman and Concho counties (Figure 22). The CRMWD has been granted a permit by the Texas Water Commission to build Lake Stacy. This annual supply plus the annual dependable supplies from Lakes J.B. Thomas and E.V. Spence will be capable of meeting the projected surface-water requirements of the CRMWD including the Midland SMSA through the year 2030.

Description of Odessa SMSA - The SMSA is Area No. 18 on Figure 1, and is composed of Ector County which covers about 907 square miles in parts of the Rio Grande and Colorado River basins. Normal annual precipitation is about 12 inches. Mean annual temperatures are from about 63°F to 64°F. The principal city is Odessa.

Economy of Odessa SMSA - The area economy is characterized by high employment concentrations in the petroleum sector, with secondary emphasis in construction and trades. The petrochemical and oil and gas drilling equipment industries are the most important source of manufacturing employment, which contributes 14.1 percent to the total personal income of the SMSA. The regional economic outlook is for continuing dependence on energy resources.

Water Quality Planning in Odessa SMSA - A background discussion of the purpose, scope, goals, status, etc. of Section 208 (P.L. 92-500) water quality planning in Texas is given in the "Statewide Perspective" section of this report. Since most of the SMSA (Ector County) lies within the Colorado River basin, the Colorado River Municipal Water District through a contract with the Texas Department of Water Resources is the designated 208 planning agency for the SMSA and adjacent area. The SMSA essentially is noncontributing to the Colorado River. The initial phase of the 208 water quality planning program included information on existing wastewater treatment facilities; existing water quality; existing land use patterns; existing population; and projections of economic growth, population, and probable land use patterns. During this phase, problems with the wastewater treatment plants of Odessa were identified.

During the later phases of the plan, feasible alternative solutions were developed and an environmental assessment was done. All 208 continuing planning programs include a public participation program. A citizens advisory committee consisting of representatives of four groups (private citizens, public officials, public interest and economic interest) reviews all documents developed during the program.

Floodplain Management Program in the Odessa SMSA - The Federal Emergency Management Agency has designated Ector County and two incorporated cities (Appendix B) as being subject to potential flooding problems from a 100-year flood event. Flood hazard boundary maps identifying flood-prone areas have been published for Ector County and the City of Odessa (Appendix B). Presently, the county and the two cities in the SMSA have no local floodplain management programs (Appendix B) in compliance with the requirements regarding participation in the National Flood Insurance Program (NFIP). Lack of participation in the NFIP makes flood insurance unavailable to SMSA residents presently in the floodplain and thus no protection against monetary losses due to flooding is afforded. Participation in the program and enforcement of local floodplain management ordinances would assure that flood insurance would be available and future developments would be located so as to eliminate damage from the 100-year flood. Detailed Flood Insurance Rate Studies to supply detailed 10-year, 50-year, 100-year, and 500-year flood event data have not been made in Ector County and the two incorporated cities (Appendix B).

Population and Employment in Odessa SMSA

Item	1960	1970	1980	1990	2000
	(thousands)				
Total Population	91.0	92.7	115.2	137.0	156.3
Urban Population	80.3	79.1	89.8	99.2	108.3
Other Population	10.7	13.6	25.4	37.8	48.0
Employment	33.3	35.9	58.7	68.5	79.0

Estimated Water Use and Projected Water Requirements Within the Odessa SMSA 1/

Demand Categories	Estimated Use	Projected Requirements	
	1980	1990	2000
	(Thousands of Acre-feet)		
Municipal 2/	26.2	31.4	36.3
Manufacturing 3/	6.0	7.4	11.5
Steam-Electric 4/	-0-	-0-	-0-
Mining 5/	3.3	3.5	1.2
SMSA Totals	35.5	42.3	49.0

Source: Texas Department of Water Resources projections of water required under drought conditions. One acre-foot of water is 325,851 gallons.

1/ Additional water for agriculture (irrigation and livestock watering) will be required within the SMSA. Total SMSA agricultural uses were estimated at 3.7 thousand acre-feet in 1980. Projected future irrigation water requirements for 1990 and 2000 are not presented because urban growth within the SMSA and the resulting potential for this growth to impinge on irrigation in the area has not been predicted. (See footnote 1/, Table 1 for estimated total statewide irrigation water requirements for 1980, 1990 and 2000).

2/ Includes water used in cities for household purposes, fire protection, drinking and sanitation in public and commercial establishments, lawn watering, car washes, and other uses.

3/ Includes water used in the production processes and for cooling and heat exchange in manufacturing establishments.

4/ Estimated evaporation of cooling water used in steam-electric power plants. Additional water will be required for steam-electric power generation at plants outside the SMSA which supply electrical energy to users within the SMSA.

5/ Includes water used in the flooding of petroleum bearing formations to increase oil and gas production plus water used in sand and gravel and other mining activities.

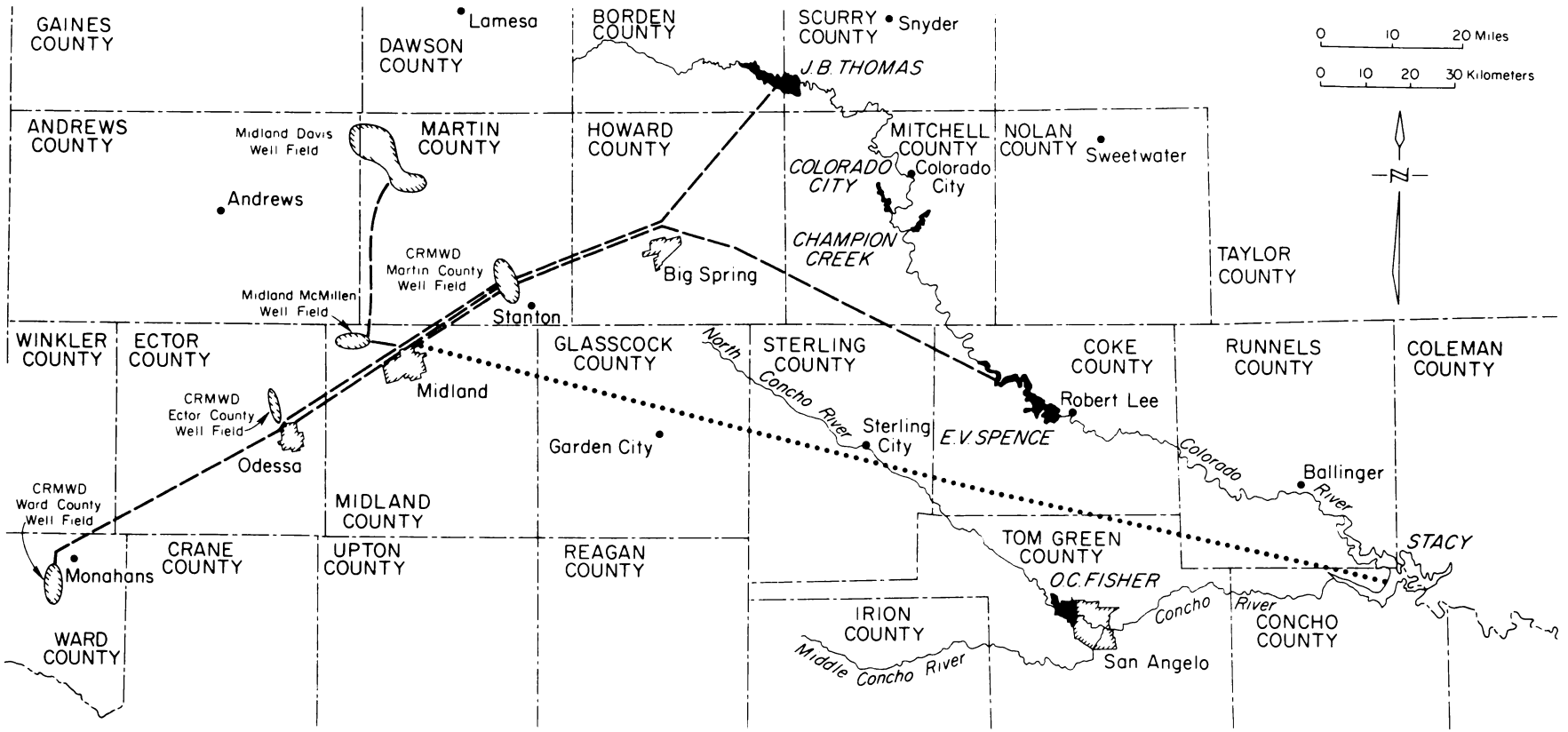
Water Supply Outlook and Problems in the Odessa SMSA - Currently within the SMSA, approximately 73 percent of the water used for urban needs (municipal, manufacturing, steam-electric power generation and mining purposes) is supplied by ground-water resources in and adjacent to the SMSA. The remaining 27 percent is supplied by developed surface-water resources adjacent to the SMSA. In the year 2000, approximately 91 percent of the SMSA's projected urban water requirements are expected to be supplied by developed surface-water resources, and approximately nine percent by ground-water resources.

The growing urban water systems within the SMSA have been and will continue to be faced with problems related to physical conditions, facility costs, and water rights. These systems are located in areas distant from reliable sources of supply. Under this condition, the cost of required delivery and treatment facilities to develop a reliable supply may be relatively high in relation to costs. Also, sufficient surface and/or ground-water rights to adequately fulfill the water needs of the urban systems may not be readily available or may not be accessible through a system having water rights.

The City of Odessa which is the only large urban water system in the SMSA (Ector County) obtains its water supply through the Colorado River Municipal Water District (CRMWD). Currently, most of Odessa's supply is from surface water provided by Lakes J.B. Thomas (Scurry and Borden County) and E.V. Spence (Coke County) (Figure 23). Deliveries of this water at times may contain some ground water from the CRMWD's Martin County well field (Figure 23). The other source of supply is ground water from the CRMWD's Ector County and Ward County well fields (Figure 23).

The major current and proposed water supply projects and distribution facilities of the CRMWD are shown on Figure 23. The Davis well field, McMillen well field, and related pipeline shown on Figure 23 are owned and operated by the City of Midland. The CRMWD not only supplies water to the City of Odessa but also provides all or part of the water supply for (1) the cities of Midland, Big Spring, Snyder, Stanton, San Angelo, and Robert Lee (Figure 23), (2) a power plant in Ward County, and (3) fourteen industrial customers throughout the region involved in petroleum refining, production of petrochemicals, natural gas processing, metal refining, and oil field enhanced recovery operations. Currently, the CRMWD delivers about 50 thousand acre-feet per year to its customer cities and industries. Of the 50 thousand acre-feet annual delivery, about 84 percent was for municipal use and 16 percent was for manufacturing, steam-electric power generation, and mining. Approximately 74 percent of the annual water supply of the CRMWD is from Lakes J.B. Thomas and E.V. Spence and other diversions from the Colorado River. The remaining 26 percent of the annual supply is from the regions very limited ground-water resources provided by well fields, three of which are shown on Figure 23 in Martin, Ector and Ward counties.

The projected urban surface-water requirements of the CRMWD service area including the Odessa SMSA are expected to be about 113 thousand acre-feet in the year 2000. These requirements will continue to be met from Lakes J.B. Thomas and E.V. Spence. However, shortly after 1990 an additional surface-water supply will be needed by the CRMWD and its customer cities and industries. This additional firm supply can be provided by Lake Stacy, a proposed reservoir to be located on the Colorado and Concho Rivers in Runnels,



EXPLANATION

- Existing Reservoir
- Proposed Reservoir
- Approximate location of major pipelines of the CRMWD
- Approximate location of proposed supply line of the CRMWD
- Approximate location of well fields used as water supplies for urban needs within the Midland and Odessa SMSAs

CRMWD- Colorado River Municipal Water District

Figure 23

Odessa SMSA Water Supply Projects

Coleman and Concho counties (Figure 23). The CRMWD has been granted a permit by the Texas Water Commission to build Lake Stacy. This supply plus the annual dependable supplies from Lakes J.B. Thomas and E.V. Spence will be capable of meeting the expected surface-water requirements of the CRMWD including the Odessa SMSA through the year 2030.

Description of San Angelo SMSA - The SMSA is area No. 19 on Figure 1, and is composed of Tom Green County which covers about 1,500 square miles in the Colorado River basin. Normal annual precipitation ranges from about 16 to 22 inches. Mean annual temperatures range from about 65°F to 67°F. The principal city is San Angelo.

Economy of the San Angelo SMSA - The area economy is characterized by high concentrations in the fields of manufacturing, trade, services, and property income. Manufacturing employment, which is diversified and expanding, contributes 12.0 percent to the total personal income of the SMSA. The regional economic outlook is for continuing development of industrial potential and reduction of its dependence on an agricultural base.

Water Quality Planning in the San Angelo SMSA - A background discussion of the purpose, scope, goals, status, etc. of Section 208 (P.L. 92-500) water quality planning in Texas is given in the "Statewide Perspective" section of this report. The Concho Valley Council of Governments (CVCG) through a contract with the Texas Department of Water Resources is the 208 water quality planning for the Middle Colorado Basin which includes the San Angelo SMSA. Initial 208 planning revealed that significant impacts on Concho River water quality are attributable to urban stormwater pollutants from the San Angelo area. The city recently upgraded its sewage treatment plants, but the acquisition of additional needed acreage was declared ineligible on the assumption that the city could discharge into this "effluent limitation"

segment. However, simplified modeling during the initial 208 study indicated that a discharge to the stream segment, even if the city utilized best available treatment followed by post-aeration, would depress the dissolved oxygen concentration below the stream standard of 5.0 mg/l. Under future 28 planning efforts, the cause/effect relationships in the San Angelo SMSA and any appropriate controls need to be defined and documented. Additionally, the assimilative capacity of the Concho River needs to be adequately defined, the potential effects of wastewater the CVCG did a facility needs analysis in the initial phase of the 208 planning process. This effort will be continued throughout 208 continuing planning. The CVCG will continue to have a "208 Citizens Advisory Committee" represented by four groups: private citizens, public interest, public officials, and economic interest. This committee will review all documents released by the CVCG for the San Angelo SMSA. The CVCG will continue to assist the Texas Department of Water Resources in the identification of Waste Treatment Management agencies for this SMSA. They will also assist in the identification of needs for communities within this area through the year 2000 in 5 year increments. These needs are broken down into three categories: collection systems, interceptor lines and sewage treatment plant construction or rehabilitation.

Floodplain Management Program in the San Angelo SMSA - The Federal Emergency Management Agency has designated Tom Green County and the City of San Angelo (only incorporated city in the SMSA) as being subject to potential

flooding problems from a 100-year flood event (Appendix B). Flood hazard boundary maps identifying flood-prone areas have been published for both the county and for the city (Appendix B). Both entities have adopted local floodplain management programs (Appendix B) in compliance with the requirements regarding participation in the National Flood Insurance Program (NFIP). Participation in the NFIP makes flood insurance available to SMSA residents presently in the floodplain and will afford some degree of protection against monetary losses due to flooding. Enforcement of the local floodplain management programs would assure that future developments will be located so as to eliminate damage from the 100-year flood. A Detailed Flood Insurance Rate Study is presently in progress in the City of San Angelo (Appendix B). This study will supply detailed 10-year, 50-year, 100-year and 500-year flood event data.

Population and Employment in San Angelo SMSA

Item	1960	1970	1980	1990	2000
			(thousands)		
Total Population	64.6	71.0	84.2	94.4	103.5
Urban Population	58.8	63.8	72.7	79.1	85.5
Other Population	5.8	7.2	11.5	15.3	18.0
Employment	22.8	25.5	41.5	46.2	52.6

Estimated Water Use and Projected Water Requirements Within the San Angelo SMSA 1/

Demand Categories	Estimated Use 1980	Projected Requirements 1990	2000
	(Thousands of Acre-feet)		
Municipal 2/	20.6	23.3	26.0
Manufacturing 3/	1.6	1.8	2.2
Steam-Electric 4/	0.8	0.8	0.8
Mining 5/	0.2	0.3	0.4
SMSA Totals	23.2	26.2	29.4

Source: Texas Department of Water Resources projections of water required under drought conditions. One acre-foot of water is 325,851 gallons.

1/ Additional water for agriculture (irrigation and livestock watering) will be required within the SMSA. Total SMSA agricultural uses were estimated at 24.9 thousand acre-feet in 1980. Projected future irrigation water requirements for 1990 and 2000 are not presented because urban growth within the SMSA and the resulting potential for this growth to impinge on irrigation in the area has not been predicted. (See footnote 1/, Table 1 for estimated total statewide irrigation water requirements for 1980, 1990 and 2000).

2/ Includes water used in cities for household purposes, fire protection, drinking and sanitation in public and commercial establishments, lawn watering, car washes, and other uses.

3/ Includes water used in the production processes and for cooling and heat exchange in manufacturing establishments.

4/ Estimated evaporation of cooling water used in steam-electric power plants. Additional water will be required for steam-electric power generation at plants outside the SMSA which supply electrical energy to users within the SMSA.

5/ Includes water used in the flooding of petroleum bearing formations to increase oil and gas production plus water used in sand and gravel and other mining activities.

Water Supply Outlook and Problems in the San Angelo SMSA - Currently within the SMSA, approximately 93 percent of the water used for urban needs (municipal, manufacturing, steam-electric power generation, and mining purposes) is supplied by developed surface-water resources in and adjacent to the SMSA. The remaining seven percent is supplied by ground-water resources. In the year 2000, approximately 95 percent of the SMSA's projected urban water requirements are expected to be supplied by developed surface-water resources, and approximately five percent by ground-water resources.

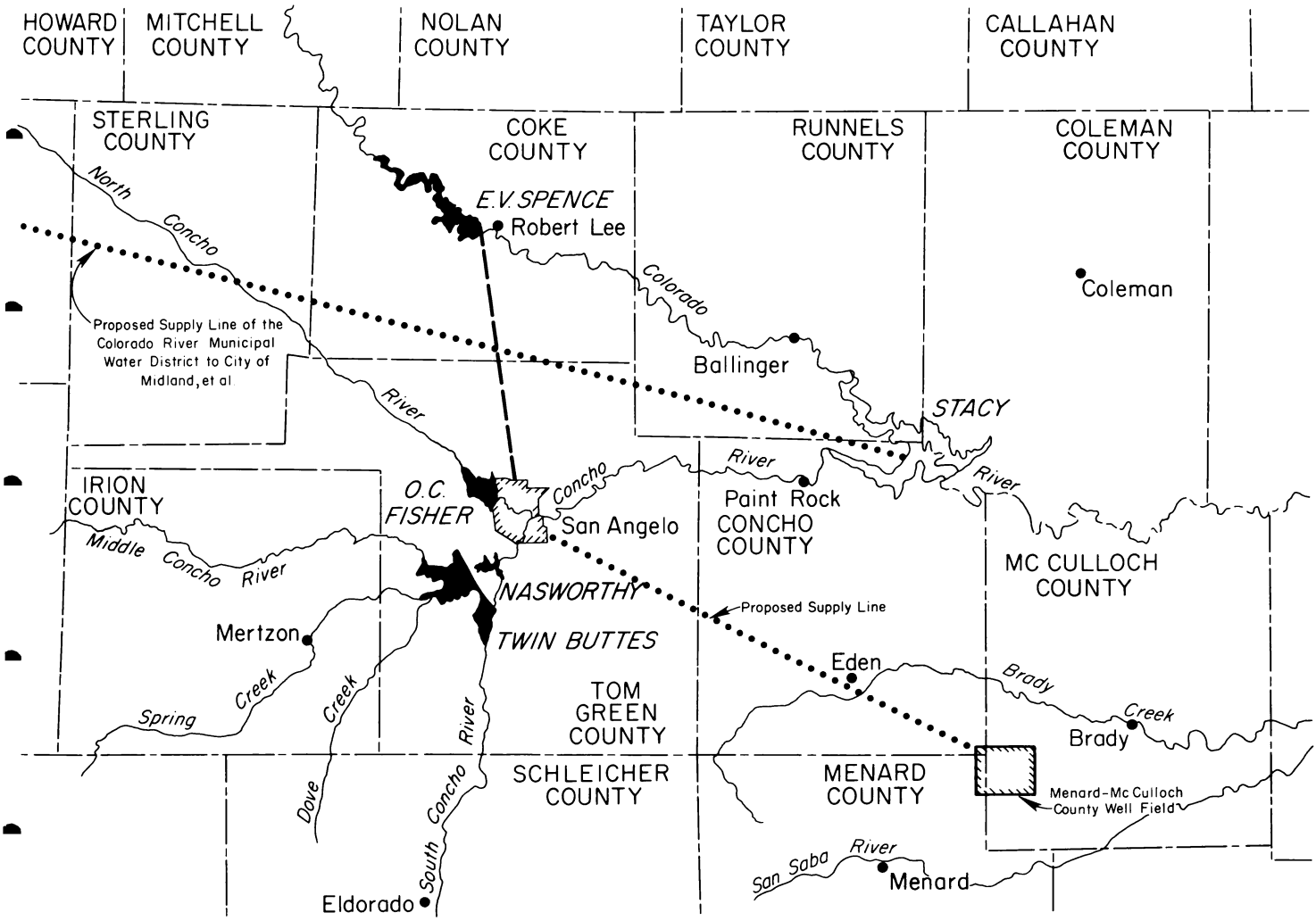
Many of the potential smaller urban water systems expected within the SMSA will be faced with problems related to physical conditions, facility costs, and water rights. Many of the smaller, growing systems probably will be located in areas distant from reliable sources of supply. Under this condition, the cost of required delivery and treatment facilities to develop a reliable supply may be relatively high in relation to costs for other cities within the SMSA. Also, sufficient surface and ground-water rights to adequately fulfill the water needs of the potential smaller urban systems may not be readily available or may not be accessible through a larger system having water rights.

The City of San Angelo and two power plants are the only large urban water users within the SMSA (Tom Green County). The San Angelo Water System presently obtains most of its water supply from Lakes Nasworthy, Twin Buttes, and O.C. Fisher (Figure 24). Currently, about 16 to 17 thousand acre-feet are used from these sources. In addition, the city has a contract with the Colorado River Municipal Water District to receive up to about 3.0 thousand acre-feet annually by pipeline from Lake E.V. Spence (Figure 24). The most current historical use from this source was only about 150 acre-feet. The capacity of the pipeline from E.V. Spence is about 13.2 thousand acre-feet per year. Currently, two power plants which use water from Lake Nasworthy for cooling have a consumptive water use of about 700 to 800 acre-feet per year.

Lake Twin Buttes also provides an annual irrigation water supply for up to about 10,000 acres of irrigated land in the San Angelo Project in the Veribest area of Tom Green County east of San Angelo. A recent irrigation inventory indicated about 10,000 acres were irrigated in the San Angelo

Project using about 20.0 thousand acre-feet of water from Lake Twin Buttes. However, the irrigation delivery from the reservoir varies from year to year depending on available or expected storage in the reservoir. Irrigation deliveries are determined through periodic negotiations between the irrigators and the city. Under current arrangements, the irrigators do not receive water if storage in the reservoir is expected to be less than 50.0 thousand acre-feet. The city is then the sole user of water from Lake Twin Buttes when storage drops below the 50.0 thousand acre-feet level.

Several times in the last 30-year, San Angelo has experienced water availability problems because of extreme drought conditions. As an example in the Spring of 1980, the only reservoirs having sufficient storage available were Lakes Twin Buttes and Nasworthy (Figure 24). Lake O.C. Fisher (Figure 24) was dry. Recently, because of these same similar conditions, the city made arrangements with the CRMWD and constructed a 13.2 thousand acre-feet per year capacity pipeline from Lake E.V. Spence (Figure 24). Also the city has obtained ground-water rights in McCulloch, Menard and Concho counties and has completed an eight-well well field (Figure 24) completed in the Hickory Aquifer (Figure 4). Currently the city plans to run further long-term tests on the eight wells, drill and complete additional wells, and eventually construct a pipeline (Figure 24) from the Menard-McCulloch County well field to the city. Current information indicates that the completed well field should have about 30 wells which will be capable of delivering on a short-term basis about 21 million gallons per day (23.5 thousand acre-feet annually). If feasible, the city will probably construct the pipeline in the early 1980's, and use ground-water from the well field during periods of extended drought, and perhaps in the summer during periods of peak demand.



EXPLANATION

- Existing Reservoir
- Proposed Reservoir
- Approximate location of existing pipeline
- Approximate location of proposed supply line
- Approximate location of City of San Angelo well field

N

0 10 20 Miles

0 10 20 30 Kilometers

Figure 24

San Angelo SMSA Water Supply Projects

The dependable supply from Lakes Twin Buttes, Nasworthy, O.C. Fisher and E.V. Spence for the urban and irrigation water needs of the SMSA is expected to be about 58 and 53 thousand acre-feet annually in the years 2000 and 2030, respectively. If the Menard-McCulloch County well field is completed to include 30 wells, a supplemental annual ground-water supply of about 23.5 thousand acre-feet will be available on a stand-by basis. The sustained yield of this well field is probably only about 3 thousand acre-feet annually. The total projected surface-water requirements for the urban and irrigation water needs of the SMSA are expected to be about 48 and 65 thousand acre-feet in the years 2000 and 2030, respectively. A comparison of supply and demand indicates that an additional firm surface-water supply will be needed by the SMSA between the years 2015 and 2020. One alternative for this additional supply is Lake Stacy a proposed reservoir located on the Colorado and Concho Rivers east of San Angelo (Figure 24). When completed, Lake Stacy will be part of the CRMWD water supply system which could be connected to the San Angelo Water System by an additional pipeline (Figure 24).

Description of the San Antonio SMSA - The SMSA is area No. 20 on Figure 1, and is composed of Bexar, Comal, and Guadalupe counties which cover about 2,527 square miles in parts of the San Antonio, Guadalupe, and Nueces River basins. Normal annual precipitation ranges from about 27 to 32 inches. Mean annual temperatures range from about 66°F to 70°F. The principal cities are San Antonio, New Braunfels and Seguin.

Economy of the San Antonio SMSA - The area economy is characterized by concentrations in the military, trade, and services sectors. Diversified light industry is the source of most manufacturing employment, which contributes 7.6 percent to the total personal income of the San Antonio SMSA. The regional economic outlook is for a continuing impact of military spending and an increasing role as a center for trade with Mexico.

Water Quality Planning in the San Antonio SMSA - A background discussion of the purpose, scope, goals, status, etc. of Section 208 (P.L. 92-500) water quality planning in Texas is given in the "Statewide Perspective" section of this report. The SMSA includes Bexar, Comal, and Guadalupe counties. A portion of the SMSA was originally designated as the San Antonio areawide waste treatment management area. Initial planning for the designated area was undertaken by the Alamo Area Council of Governments. Controversy began developing in the early stages of the planning program for the San Antonio designated area concerning the selection of a continuing planning agency. The designation of the area was eventually canceled. The San Antonio area is now included in the State Water Quality Management Planning Program with planning being undertaken by the City of San Antonio, the Cibolo Creek Municipal Authority, and

the San Antonio River Authority. Most of Comal and Guadalupe counties lies within the Lower Guadalupe River Basin where planning was undertaken by the Guadalupe-Blanco River Authority. One result of the 208 planning program for this area was the identification of the need to study nutrient loadings to Lake Dunlap in Segment 1804. A small portion of Guadalupe County also lies within the planning area of the San Antonio River Authority. The basic objectives of the initial planning program for the previously designated San Antonio Area were to provide a system for classification, storage, processing and retrieval of water quality data, a methodology for predicting nonpoint source pollution, a cost effective and environmentally sound sewage treatment system, and a management framework to allow coordination between local officials and agencies to implement the plan and to insure continuing water quality planning. Facility need analysis was accomplished in the initial phase of the 208 planning process. This effort will continue throughout the continuing planning process.

All planning agencies will have "208 Citizens Advisory Committees" made up of four groups: private citizens, public interest, public officials, and economic interest. These agencies will review all documents released by the respective planning agencies for the San Antonio SMSA. The planning agencies involved in the San Antonio SMSA planning will continue to assist the Texas Department of Water Resources in the identification of Waste Treatment Management Agencies for this area. They will also assist in the identification of needs for communities within this area through the year 2000 in 5 year increments. These needs are broken down into three categories: collection systems, interceptor lines and sewage treatment plant construction or rehabilitation.

Floodplain Management Program in the San Antonio SMSA - The Federal Emergency Management Agency has designated all three counties and 25 incorporated cities in the SMSA as being subject to potential flooding problems from a 100-year flood event (Appendix B). Flood hazard boundary maps indentifying flood-prone areas have been published for the three counties and for the 25 incorporated cities in the SMSA (Appendix B). Presently, all three counties and 22 of the cities in the SMSA have adopted local floodplain management programs (Appendix B) in compliance with the requirements regarding participation in the National Flood Insurance Program (NFIP). Participation in the NFIP makes flood insurance available to SMSA residents presently in the floodplain and will afford some degree of protection against monetary losses due to flooding. Enforcement of the local floodplain management programs would assure that future developments will be located so as to eliminate damage from the 100-year flood. Detailed Flood Insurance Rate Studies presently in various stages of completion will supply detailed 10-year, 50-year, 100-year, and 500-year flood event data for the three counties and 22 cities in the SMSA (Appendix B).

Population and Employment in San Antonio SMSA

Item	1960	1970	1980	1990	2000
	(thousands)				
Total Population	736.0	888.2	1,065.4	1,251.9	1,488.8
Urban Population	628.7	771.2	920.4	1,094.0	1,316.1
Other Population	107.3	117.0	145.0	157.9	172.7
Employment	221.8	285.5	387.4	464.8	564.0

Estimated Water Use and Projected Water Requirements Within the San Antonio SMSA 1/

Demand Categories	Estimated Use 1980	Projected Requirements 1990	2000
	(Thousands of Acre-feet)		
Municipal 2/	252.2	302.7	367.5
Manufacturing 3/	24.2	25.3	30.9
Steam-Electric 4/	26.0	26.0	32.0
Mining 5/	4.3	4.3	4.9
SMSA Totals	306.7	358.3	435.3

Source: Texas Department of Water Resources projections of water required under drought conditions. One acre-foot of water is 325,851 gallons.

1/ Additional water for agriculture (irrigation and livestock watering) will be required within the SMSA. Total SMSA agricultural uses were estimated at 34.1 thousand acre-feet in 1980. Projected future irrigation water requirements for 1990 and 2000 are not presented because urban growth within the SMSA and the resulting potential for this growth to impinge on irrigation in the area has not been predicted. (See footnote 1/, Table 1 for estimated total statewide irrigation water requirements for 1980, 1990 and 2000).

2/ Includes water used in cities for household purposes, fire protection, drinking and sanitation in public and commercial establishments, lawn watering, car washes, and other uses.

3/ Includes water used in the production processes and for cooling and heat exchange in manufacturing establishments.

4/ Estimated evaporation of cooling water used in steam-electric power plants. Additional water will be required for steam-electric power generation at plants outside the SMSA which supply electrical energy to users within the SMSA.

5/ Includes water used in the flooding of petroleum bearing formations to increase oil and gas production plus water used in sand and gravel and other mining activities.

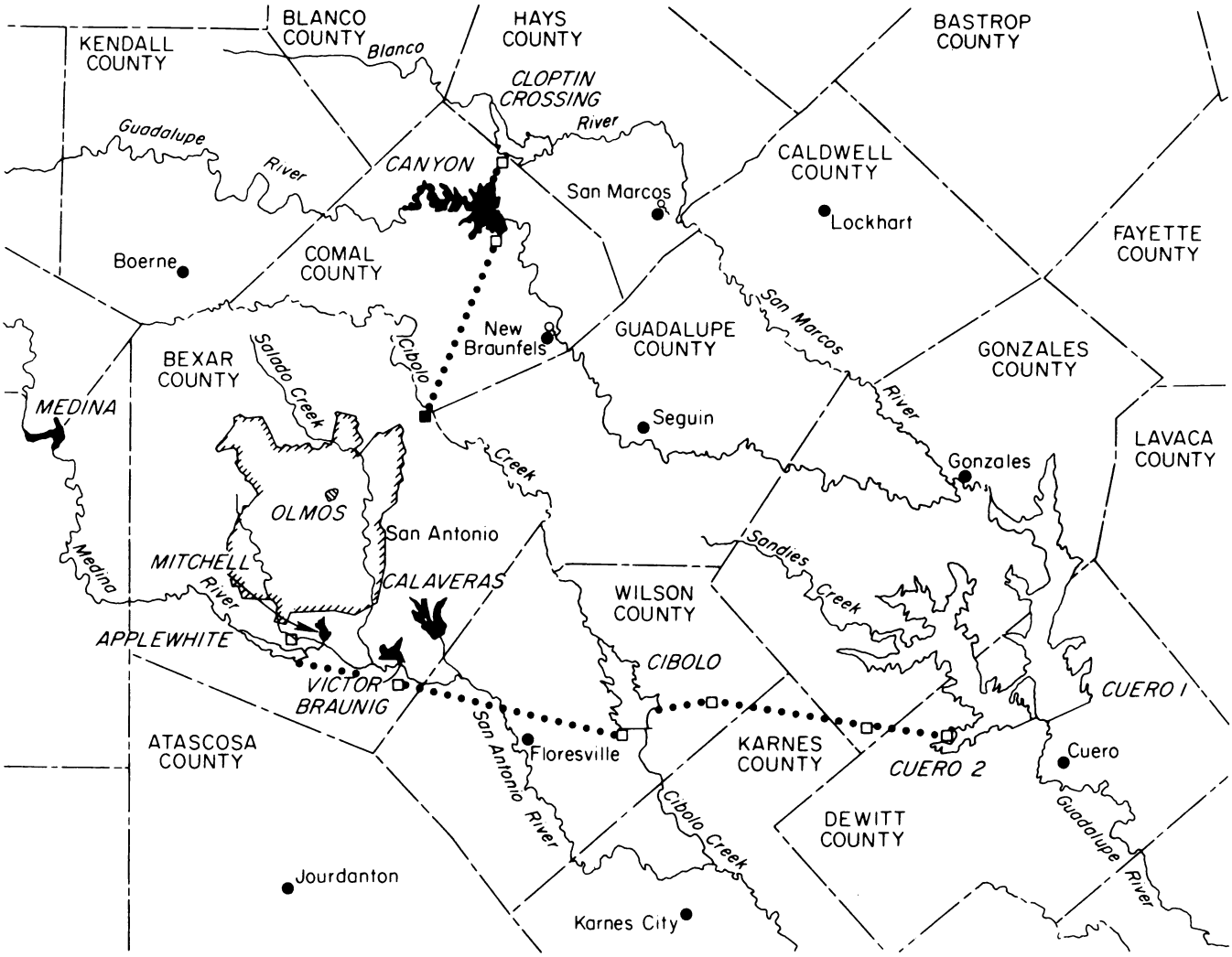
Water Supply Outlook and Problems in the San Antonio SMSA - Currently within the SMSA, approximately 89 percent of the water used for urban needs (municipal, manufacturing, steam-electric power generation, and mining purposes) is supplied by ground-water from the Edwards Aquifer (Figure 3). The remaining 11 percent is supplied by surface water resources; mainly from the Guadalupe River at New Braunfels and Seguin. In the year 2000, approximately 69 percent of the SMSA's projected urban water requirements are expected to be supplied by ground water from the Edwards Aquifer and approximately 31 percent by developed surface-water resources in and adjacent to the SMSA.

Many of the smaller yet growing urban water systems within the SMSA have been and will continue to be faced with problems related to physical conditions, facility costs, and water rights. Many of the smaller, growing systems are located in areas distant from reliable sources of supply. Under this condition, the cost of required delivery and treatment facilities to develop a reliable supply may be relatively high in relation to costs for other cities within the SMSA. Also, sufficient surface and ground-water rights to adequately fulfill the water needs of the smaller urban systems may not be readily available or may not be accessible through a larger system having water rights.

The City of San Antonio and other water systems in Bexar County are the largest users of water in the SMSA. Currently, most of the municipal and manufacturing water needs in the county are met by ground water from the Edwards (Balcones Fault Zone) Aquifer (Figure 3). Several small urban water systems in southern Bexar County use ground water from the Carrizo-Wilcox Aquifer (Figure 3). The City of San Antonio Municipal Water System is probably the largest such water system in the United States which relies entirely on ground water. Water for cooling purposes at steam-electric power plants operated by the City of San Antonio in Bexar County is obtained from Lakes Victor Brauning and Calaveras (Figure 25), and from the Edwards Aquifer. Lake Olmos (Figure 25) which is owned and operated by the city is used only for flood control. Also, the city owns and operates Mitchell Lake which is a holding reservoir for treated sewage effluent. Part of this effluent is used for irrigation in the immediate area of the lake.

The City of New Braunfels in Comal County relies entirely on ground water from the Edwards Aquifer. A textile mill in New Braunfels and the City of Seguin use water from the Guadalupe River. Most of the other smaller urban water systems in Comal and Guadalupe counties use water from the Edwards, Trinity Group, and Carrizo-Wilcox Aquifers. All of these systems in Comal and Guadalupe counties are expected to continue to receive their supply from these various sources through the year 2030.

The Nueces, San Antonio and Guadalupe River basins (generally from Kinney County to Hays County within the extent of the Edwards Aquifer, see Figures 2 and 3) are hydrologically connected in the subsurface by the Edwards Aquifer. During the drought of the 1950's when natural recharge was at its lowest, withdrawals from the Edwards Aquifer mainly for irrigation in Uvalde and Medina counties and for urban needs in Bexar County caused Comal Springs (Figure 25) to cease flowing, and San Marcos Springs (Figure 25) to flow at its lowest recorded rate. Consequently, the Texas Department of Water Resources made a comprehensive study of this problem. The results of the study indicate the advisability of instituting an Edwards Aquifer management program which would result in total pumpage from the aquifer not exceeding 425 thousand acre-feet annually in the Nueces, San Antonio and Guadalupe River basins. Such a management program necessitates coordinated use of ground- and surface-water supplies which would provide an annual minimum sustained flow of about 34 thousand acre-feet from San Marcos Springs, and would prevent the possibiiity of saline water encroachment along the aquifer's "bad water" line (southern extent on Figure 3). Such a management program would constrain annual ground-water withdrawals from the Edwards Aquifer to about 272 thousand acre-feet in Bexar County. Total projected urban water requirements in Bexar



EXPLANATION

- Existing Reservoir
- Proposed Reservoir
- Reservoir for Flood Control Only
- Approximate location of proposed pipeline
- Approximate location of proposed pump station
- Approximate location of proposed treatment plant
- Approximate location of spring

N

0 10 20 Miles

0 10 20 30 Kilometers

Figure 25

San Antonio SMSA Water Supply Projects

County are expected to be about 395 thousand acre-feet in the year 2000. Using the 272 thousand acre-feet as the necessary control withdrawal from the Edwards Aquifer, approximately 123 thousand acre-feet of surface water will be required to meet the total 2000 requirements in Bexar County. Approximately 30 thousand acre-feet of this requirement is for power plant cooling water which is expected to be supplied by Lakes Victor Brauning and Calveras (Figure 25) which under existing permits impound local runoff and return flows of the City of San Antonio pumped from the San Antonio River. The remaining 93 thousand acre-feet are 2000 surface-water requirements for expected municipal and manufacturing uses in Bexar County. To meet these municipal and manufacturing requirements in Bexar County, additional surface-water supplies will have to be developed by the year 2000. The following developments would provide supplies to meet the 93 thousand acre-feet annual requirement by the year 2000.

1. Staged construction of a pipeline (Figure 25) from Canyon Lake (Figure 25) in the Guadalupe River basin to water-treatment facilities (figure 25) in northeast San Antonio for the initial conveyance of 30 thousand acre-feet annually, followed by construction of the authorized Cloptin Crossing Lake (Figure 25) in the Guadalupe River basin and facilities (pipeline, etc. Figure 25) for conveyance of an additional 20 thousand acre-feet of water annually to Canyon Lake and thence to Bexar County.

2. Staged construction of Lake Applewhite on the Medina River in Bexar County (Figure 25), which will provide a dependable supply of 17.2

thousand acre-feet annually, followed by construction of the authorized Lake Cibolo on Cibolo Creek in Wilson County (Figure 25) with a pipeline (Figure 25) for conveyance of 26.9 thousand acre-feet of water annually from Lake Cibolo to Lake Applewhite and thence to a treatment plant for use in Bexar County.

The total dependable water supply from these proposed surface-water projects would be about 94 thousand acre-feet annually, and would be expected to meet the supplemental surface-water demand of Bexar County until about the year 2005.

Between the years 2000 and 2010 Bexar County's urban surface-water requirements will be such that additional supplies will be needed. These additional supplies can be made available by staged completion of Cuero 1 and Cuero 2 reservoirs and related pipelines (Figure 25).

Description of the Sherman-Denison SMSA - The SMSA is area No. 21 on Figure 1, and is composed of Grayson County which covers about 940 square miles in parts of the Red and Trinity River basins. Normal annual precipitation ranges from about 35 to 42 inches. Mean annual temperature is about 64°F. The principal cities are Sherman and Denison.

Economy of the Sherman-Denison SMSA - The area economy is characterized by diversified light manufacturing with a secondary emphasis on transportation. The food processing industry remains the most important source of manufacturing employment, which contributes 23.8 percent to the total personal income of the Sherman-Denison SMSA. The regional economic outlook is for the continuing of recent trends in expansion and location of manufacturing plants.

Water Quality Planning in the Sherman-Denison SMSA - A background discussion of the purpose, scope, goals, status, etc. of Section 208 (P.L. 92-500) water quality planning in Texas is given in the "Statewide Perspective" section of this report. The SMSA is located in the Red River Basin State Planning Area. Water quality planning for this area was developed by the Red River Authority of Texas in conjunction with the Texas Department of Water Resources. A primary purpose of water quality planning was to identify needs for expansion or new construction of wastewater facilities. Local agencies with adequate authority to implement provisions of the plan were identified. A preliminary analysis of the impact of pollutants from urban runoff, based on theoretical loadings, was developed and feasible control strategies were discussed. Generalized land use maps of Sherman and Denison were prepared. Additionally, water quality sampling studies were implemented. A study projected to begin in 1980

will examine potential water quality problems in the Lake Texoma area due to developmental pressures. This study will inventory existing physical and socio-economic features, develop criteria for effective septic tank operations in the area, project future conditions, identify problem areas, develop alternative solutions to the problems and identify the impacts of the alternatives. A local advisory group will review the findings and recommendations of this study. Additionally, wastewater facility needs for communities not addressed in the initial plan will be considered. This primarily includes smaller communities.

Floodplain Management Program in the Sherman-Denison SMSA - The Federal Emergency Management Agency has designated Grayson County and 10 incorporated cities in the Sherman-Denison SMSA as being subject to potential flooding problems from a 100-year flood event (Appendix B). Flood hazard boundary maps identifying flood-prone areas have been published for the county and for nine of the incorporated cities in the SMSA (Appendix B). Presently, only two cities in the SMSA have adopted local floodplain management programs (Appendix B) in compliance with the requirements regarding participation in the National Flood Insurance Program (NFIP). Participation in the NFIP makes flood insurance available to SMSA residents presently in the floodplain and will afford some degree of protection against monetary losses due to flooding. Enforcement of the local floodplain management programs would assure that future developments will be located so as to eliminate damage from the 100-year flood. Detailed Flood Insurance Rate Studies presently in various stages of completion will supply detailed 10-year, 50-year, 100-year, and 500-year flood event data for two cities in the SMSA (Appendix B).

Population and Employment in Sherman-Denison SMSA

Item	1960	1970	1980	1990	2000
			(thousands)		
Total Population	73.0	83.2	89.2	108.8	124.0
Urban Population	53.8	62.0	63.1	77.2	90.8
Other Population	19.2	21.2	26.1	31.6	33.2
Employment	24.8	31.5	37.1	44.0	49.3

Estimated Water Use and Projected Water Requirements Within the Sherman-Denison SMSA 1/

Demand Categories	Estimated Use	Projected Requirements	
	1980	1990	2000
	(Thousands of Acre-feet)		
Municipal 2/	18.9	23.7	27.5
Manufacturing 3/	4.0	4.4	5.2
Steam-Electric 4/	-0-	-0-	-0-
Mining 5/	0.1	0.1	0.1
SMSA Totals	23.0	28.2	32.8

Source: Texas Department of Water Resources projections of water required under drought conditions. One acre-foot of water is 325,851 gallons.

1/ Additional water for agriculture (irrigation and livestock watering) will be required within the SMSA. Total SMSA agricultural uses were estimated at 3.6 thousand acre-feet in 1980. Projected future irrigation water requirements for 1990 and 2000 are not presented because urban growth within the SMSA and the resulting potential for this growth to impinge on irrigation in the area has not been predicted. (See footnote 1/, Table 1 for estimated total statewide irrigation water requirements for 1980, 1990 and 2000).

2/ Includes water used in cities for household purposes, fire protection, drinking and sanitation in public and commercial establishments, lawn watering, car washes, and other uses.

3/ Includes water used in the production processes and for cooling and heat exchange in manufacturing establishments.

4/ Estimated evaporation of cooling water used in steam-electric power plants. Additional water will be required for steam-electric power generation at plants outside the SMSA which supply electrical energy to users within the SMSA.

5/ Includes water used in the flooding of petroleum bearing formations to increase oil and gas production plus water used in sand and gravel and other mining activities.

Water Supply Outlook and Problems in the Sherman-Denison SMSA - Currently within the SMSA, approximately 67 percent of the water used for urban needs (municipal, manufacturing, steam-electric power generation, and mining purposes) is supplied by ground-water resources in the SMSA. The remaining 33 percent is supplied by surface-water resources. In the year 2000, approximately 84 percent of the SMSA's projected urban water requirements are expected to be supplied by developed surface-water resources, and approximately 16 percent by ground-water resources.

Many of the smaller yet growing urban water systems within the SMSA have been and will continue to be faced with problems related to physical conditions, facility costs, and water rights. Many of the smaller, growing systems are located in areas distant from reliable sources of supply. Under this condition, the cost of required delivery and treatment facilities to develop a reliable supply may be relatively high in relation to costs for other cities within the SMSA. Also, sufficient surface and ground-water rights to adequately fulfill the water needs of the smaller urban systems may not be readily available or may not be accessible through a larger system having water rights.

Currently, the City of Sherman receives its water supply from about 20 wells completed in the Trinity Group (Figure 3) and Woodbine (Figure 4) Aquifers. The City of Denison's supply is from Lakes Texoma and Randell (Figure 26) and wells completed in the Woodbine Aquifer. Most of Denison's supply is surface water from Lakes Texoma and Randell. The Cities of Howe, Whitesboro, Whitewright, Van Astyne and other smaller urban water systems in the SMSA obtain their supplies from the Trinity Group and Woodbine Aquifers.

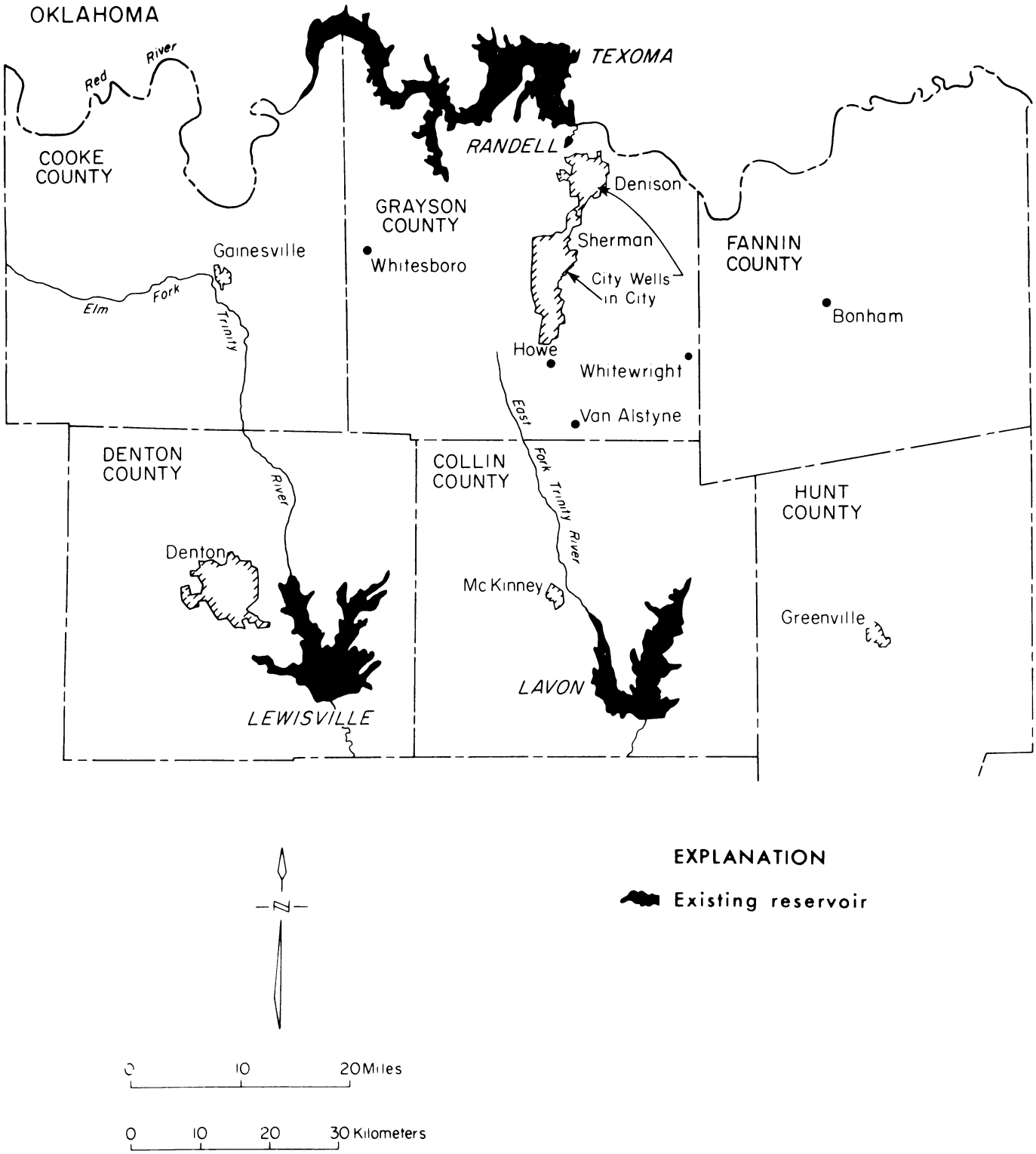


Figure 26

Sherman-Denison SMSA Water Supply Projects

Because of serious water-level declines and expected decreasing well yields, most of these urban water systems will eventually have to depend more and more on surface-water supplies. By the year 2000, the Cities of Denison and Sherman are expected to meet about 97 percent of their total water requirements with surface water. By 2000, the Cities of Howe, Whitesboro, Whitewright and others are expected to convert their entire supplies from ground water to surface water. The City of Van Alstyne is expected to remain on ground water through the year 2000 and beyond.

The major source for these additional, future urban, surface-water supplies is expected to be Lake Texoma (Figure 26). The Red River Compact between the States of Texas, Oklahoma, Arkansas, and Louisiana provides that 400 thousand acre-feet of water in Lake Texoma be allocated to conservation storage for urban water needs in Texas and Oklahoma. This conservation storage would be equally divided between Texas and Oklahoma; thus allowing Texas to have 200 thousand acre-feet annually from the reservoir. This dependable supply would be adequate to meet the urban surface-water needs of the SMSA to the year 2030 and beyond and also would provide supplies for adjacent areas of Texas. However at this time water supply is not a project purpose in Lake Texoma, although under specific authorization by Congress several entities have contracted with the U.S. Army Corps of Engineers for water supply storage in the reservoir.

The U.S. Army Corps of Engineers has recently completed a study to determine the advisability of a re-allocation of project purposes in Lake Texoma. The Corps' preliminary recommendation provides for allocation of storage sufficient to provide for 90 MGD for water supply. However, the Texas Department of

Water Resources analyses show that much higher demands, both in-basin and out-of-basin will materialize in the near future. Therefore, the Department has strongly suggested that, in accordance with the Red River Compact, an allocation of water supply storage sufficient to provide at least 200,000 acre-feet annually to Texas be recommended to Congress.

Description of the Texarkana SMSA - The SMSA is area No. 22 on Figure 1, and is composed of Bowie County which covers about 891 square miles in parts of the Red and Sulphur River basins. Normal annual precipitation is about 47 inches. Mean annual temperature is about 63°F. The principal city is Texarkana. The SMSA also includes Miller and Little River counties in Arkansas. This report does not provide information or data for the two counties in Arkansas.

Economy of the Texarkana SMSA - The area economy is characterized by high concentrations in the government, manufacturing and trade sectors. Increasingly diversified manufacturing industries produce tires, ammunition, railroad cars, and pulp and paper products. Manufacturing employment contributes 16.8 percent to the total personal income of the SMSA. The regional economic outlook is for continuing diversification and coordination with the State of Arkansas to further economic development.

Water Quality Planning in the Texarkana SMSA - A background discussion of the purpose, scope, goals, status, etc. of Section 208 (P.L. 92-500) water quality planning in Texas is given in the "Statewide Perspective" section of this report. In 1975, the governor Texas with concurrent action by the Governor of Arkansas designated the Ark-Tex Council of Governments as the Areawide Planning Agency for the Texarkana area. This designated area included portions of Bowie County, Texas and Miller County, Arkansas within the Texarkana SMSA, as well as a portion of Cass County, Texas which is outside the SMSA. The remainder of Bowie County is part of the Red River Basin and Sulphur River Basin State Planning area. The Texas Department of Water Resources is responsible for planning for the nondesignated portions of the state and delegated certain

responsibilities to the Red River Authority and Ark-Tex Council of Governments respectively in the Red and Sulphur River basins. The initial planning effort addressed in detail a number of issues, including identifying long-term wastewater facility needs and agencies with adequate authority to implement the proposed plan. Additionally, an assessment of potential nonpoint pollution sources and recommendations for future planning studies were included in the plan. In continuing planning studies currently underway, the emphasis is on water quality sampling to isolate contributions from the potential nonpoint sources of pollutants, primarily abandoned landfills and numerous septic tank areas. A management program for septic tank regulation is being developed. This will involve developing applicable ordinances for septic tank management and assisting counties in implementing the ordinances. A public participation program was devised to promote citizen involvement in an understanding of the water quality issues in the area. A similar committee was active in the initial planning process.

Floodplain Management Program in the Texarkana SMSA - The Federal Emergency Management Agency has designated Bowie County and seven incorporated cities in the Texarkana SMSA as being subject to potential flooding problems from a 100-year flood event (Appendix B). Flood hazard boundary maps identifying flood-prone areas have been published for the county and for the seven incorporated cities in the SMSA (Appendix B). Presently, only six cities in the SMSA have adopted local floodplain management programs (Appendix B) in compliance with the requirements regarding participation in the National Flood Insurance Program (NFIP). Participation in the NFIP makes flood insurance available to SMSA residents presently in the floodplain and will afford some degree of protection against monetary losses due to flooding. Enforcement of the local

floodplain and management programs would assure that future developments will be located so as to eliminate damage from the 100-year flood. Presently, only the City of Texarkana has completed a detailed Flood Insurance Rate Study within the SMSA (Appendix B). These type studies provide detailed 10-year, 50-year, 100-year, and 500-year flood event data.

Population and Employment in Texarkana SMSA

Item	1960	1970	1980	1990	2000
			(thousands)		
Total Population	60.0	68.9	74.9	81.3	89.8
Urban Population	40.3	45.1	47.4	52.6	62.2
Other Population	19.7	23.8	27.5	28.7	27.6
Employment	20.0	25.2	43.6	47.8	54.7

Estimated Water Use and Projected Water Requirements Within the Texarkana SMSA 1/

Demand Categories	Estimated Use 1980	Projected Requirements 1990	2000
	(Thousands of Acre-feet)		
Municipal 2/	19.8	22.3	25.4
Manufacturing 3/	3.3	3.9	4.9
Steam-Electric 4/	-0-	-0-	-0-
Mining 5/	0.4	0.4	0.5
SMSA Totals	23.5	26.6	30.8

Source: Texas Department of Water Resources projections of water required under drought conditions. One acre-foot of water is 325,851 gallons.

1/ Additional water for agriculture (irrigation and livestock watering) will be required within the SMSA. Total SMSA agricultural uses were estimated at 5.2 thousand acre-feet in 1980. Projected future irrigation water requirements for 1990 and 2000 are not presented because urban growth within the SMSA and the resulting potential for this growth to impinge on irrigation in the area has not been predicted. (See footnote 1/, Table 1 for estimated total statewide irrigation water requirements for 1980, 1990 and 2000).

2/ Includes water used in cities for household purposes, fire protection, drinking and sanitation in public and commercial establishments, lawn watering, car washes, and other uses.

3/ Includes water used in the production processes and for cooling and heat exchange in manufacturing establishments.

4/ Estimated evaporation of cooling water used in steam-electric power plants. Additional water will be required for steam-electric power generation at plants outside the SMSA which supply electrical energy to users within the SMSA.

5/ Includes water used in the flooding of petroleum bearing formations to increase oil and gas production plus water used in sand and gravel and other mining activities.

Water Supply Outlook and Problems in the Texarkana SMSA - Currently within the SMSA, approximately 80 percent of the water used for urban needs (municipal, manufacturing, steam-electric power generation, and mining purposes) is supplied by developed surface-water resources in and adjacent to the SMSA. The remaining 20 percent is supplied by ground-water resources. In the year 2000, approximately 97 percent of the SMSA's projected urban water requirements are expected to be supplied by developed surface-water resources, and approximately three percent by ground-water resources.

Many of the smaller yet growing urban water systems within the SMSA have been and will continue to be faced with problems related to physical conditions, facility costs, and water rights. Many of the smaller, growing systems are located in areas distant from reliable sources of supply. Under this condition, the cost of required delivery and treatment facilities to develop a reliable supply may be relatively high in relation to costs for other cities within the SMSA. Also, sufficient surface and ground-water rights to adequately fulfill the water needs of the smaller urban systems may not be readily available or may not be accessible through a larger system having water rights.

The City of Texarkana Water System obtains its supply from Lake Wright Patman (Figure 27). Other urban systems which use Lake Wright Patman within the SMSA (Bowie County) include DeKalb, New Boston, Hooks, Wake Village, Atlanta, and Maud (Figure 27). The Texarkana System and other urban water systems currently use about 30 thousand acre-feet annually from Lake Wright Patman. By the year 2000, other cities in and adjacent to the SMSA are expected to be using surface water from Lake Wright Patman. Some of these cities include Nash, Queen City, Naples, Bogata and Clarksville (Figure 27). Texarkana and other cities in and adjacent to the SMSA are expected to use about 63 and 162 thousand acre-feet from Lake Wright Patman in the years 2000 and 2030, respectively.

The Carrizo-Wilcox Aquifer (Figure 3) and the Nacatoch, Blossom and Queen City Aquifers (Figure 4) in and adjacent to the SMSA are capable of only supplying small quantities of ground water for urban needs. All of these aquifers when subjected to moderate to large pumpage experience serious water-level declines and decreasing well yields. The Carrizo-Wilcox and Queen City Aquifers, which are the most productive, have inherent ground-water quality problems; i.e.,

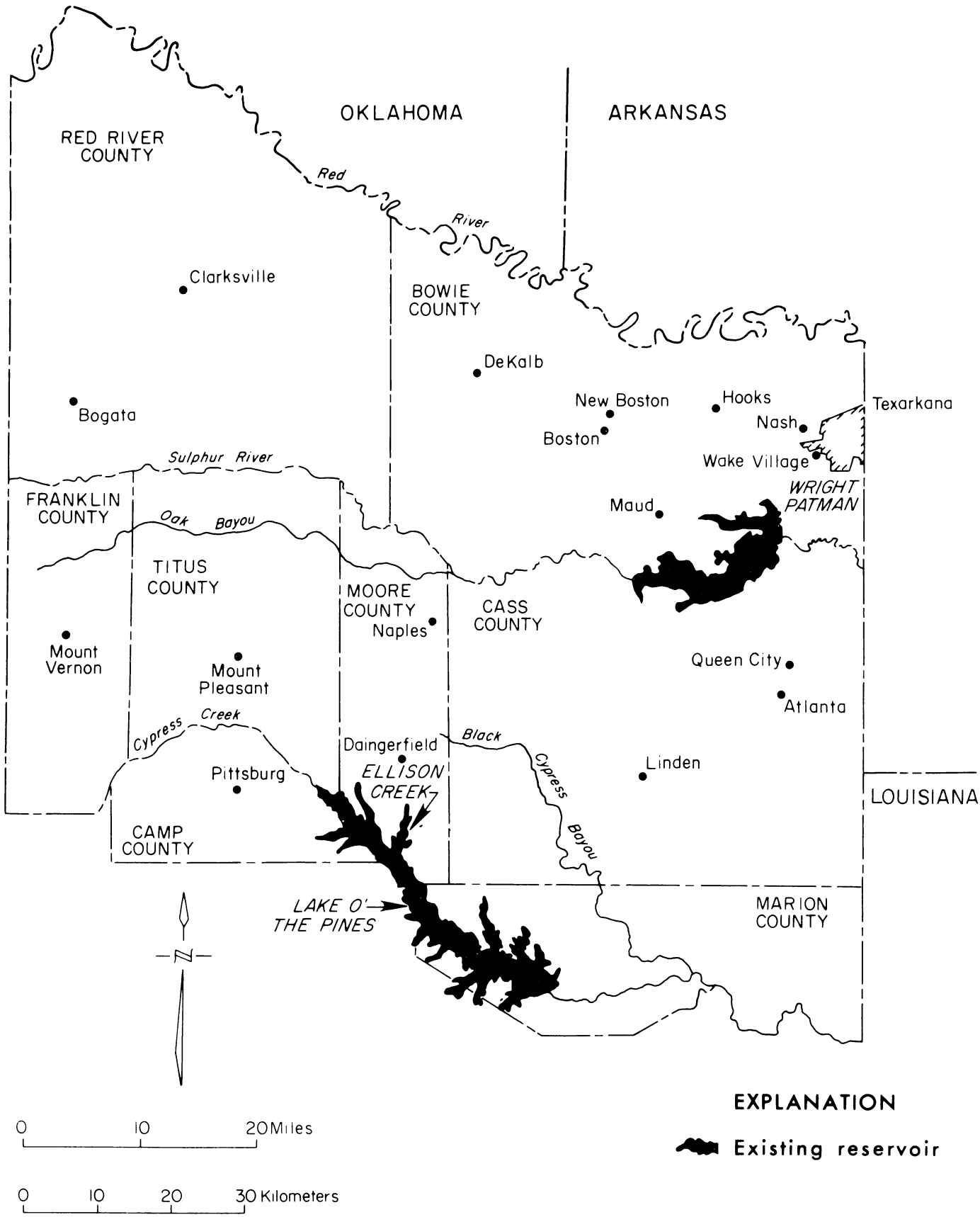


Figure 27

Texarkana SMSA Water Supply Projects

high concentrations of iron which may exceed 0.3 milligrams per liter and low pH values which may be less than 7.0.

Based on studies by the Texas Department of Water Resources, which assumed that 120.0 thousand acre-feet of flood-control storage will be reallocated from Lake Wright Patman to Cooper Lake (when completed in the 1980's - Figure 2), Lake Wright Patman is expected to have dependable yields of about 245 and 238 thousand acre-feet annually in the years 2000 and 2030, respectively. Without the reallocation of flood-control storage, Lake Wright Patman's dependable yields will be about 209 thousand acre-feet in 2000 and about 183 thousand acre-feet in about 2030. Comparison of these firm supplies with the 63 and 162 thousand acre-feet per year urban water requirements in 2000 and 2030, respectively indicates that the supply from Lake Wright Patman will be sufficient to meet the urban water needs of the SMSA and adjacent area through the year 2030 and beyond.

Description of the Tyler SMSA - The SMSA is area No. 23 on Figure 1, and is composed of Smith County which covers about 934 square miles in parts of the Sabine and Neches River basins. Normal annual precipitation is about 45 inches. Mean annual temperatures range from about 65°F to 66°F. The principal city is Tyler.

Economy of the Tyler SMSA - The area economy is characterized by concentrations of activity in the manufacturing, mining and service sectors. Diversified manufacturing employment contributes 22.3 percent to the total personal income of the SMSA. The regional economic outlook is for a continuing stable economic base to support development of the SMSA's available basic resources.

Water Quality Planning in the Tyler SMSA - A background discussion of the purpose, scope, goals, status, etc. of Section 208 (P.L. 92-500) water quality planning in Texas is given in the "Statewide Perspective" section of this report. The Tyler SMSA is composed of Smith County which is split by the Sabine-Neches basin divide. Consequently, the SMSA occurs in the Sabine Basin and the Upper Neches Basin State Planning Areas. The Texas Department of Water Resources is responsible for water quality planning in these non-designated portions of the State. The TDWR delegated certain planning responsibilities to the Sabine River Authority for the Sabine Basin State Planning Area and to the Angelina-Neches River Authority for the Upper Neches Basin State Planning Area. In these nondesignated areas, wastewater facility needs were evaluated with particular attention to a five year planning horizon. Appropriate management agencies with adequate authority to implement provisions of the plans were also identified. An initial assessment was made of non-

point source contributions to water quality problems. In future planning, facility needs of communities not evaluated in the initial plan will be considered. This includes numerous smaller communities. A study tentatively scheduled to be carried out by the Angelina-Neches River Authority will evaluate nonpoint sources, including urban runoff, in a stream segment downstream from Tyler. This will include rainfall runoff sampling and the effects of runoff on instream water quality. Local committees have been developed for both state planning areas to review all result of studies and planning recommendations.

Floodplain Management Program in the Tyler SMSA - The Federal Emergency Management Agency has designated Smith County and five incorporated cities in the SMSA as being subject to potential flooding problems from a 100-year flood event (Appendix B). Flood hazard boundary maps identifying flood-prone areas have been published for the county and for the five incorporated cities in the SMSA (Appendix B). Presently, the county and four cities in the SMSA have adopted local floodplain management programs (Appendix B) in compliance with the requirements regarding participation in the National Flood Insurance Program (NFIP). Participation in the NFIP makes flood insurance available to SMSA residents presently in the floodplain and will afford some degree of protection against monetary losses due to flooding. Enforcement of the local floodplain management programs would assure that future developments will be located so as to eliminate damage from the 100-year flood. Detailed Flood Insurance Rate Studies presently in various stages of completion will supply detailed 10-year, 50-year, 100-year, and 500-year flood event data for Smith County and the City of Tyler (Appendix B).

Population and Employment in Tyler SMSA

Item	1960	1970	1980	1990	2000
			(thousands)		
Total Population	86.4	97.1	127.2	152.8	179.7
Urban Population	55.0	62.4	77.0	95.8	120.1
Other Population	31.4	34.7	50.2	57.0	59.6
Employment	32.1	28.4	60.3	72.3	85.2

Estimated Water Use and Projected Water Requirements Within the Tyler SMSA 1/

Demand Categories	Estimated Use 1980	Projected Requirements 1990	2000
	(Thousands of Acre-feet)		
Municipal 2/	27.1	33.7	41.0
Manufacturing 3/	7.0	7.7	9.8
Steam-Electric 4/	-0-	-0-	-0-
Mining 5/	0.8	0.7	0.7
SMSA Totals	34.9	42.1	51.5

Source: Texas Department of Water Resources projections of water required under drought conditions. One acre-foot of water is 325,851 gallons.

1/ Additional water for agriculture (irrigation and livestock watering) will be required within the SMSA. Total SMSA agricultural uses were estimated at 1.9 thousand acre-feet in 1980. Projected future irrigation water requirements for 1990 and 2000 are not presented because urban growth within the SMSA and the resulting potential for this growth to impinge on irrigation in the area has not been predicted. (See footnote 1/, Table 1 for estimated total statewide irrigation water requirements for 1980, 1990 and 2000).

2/ Includes water used in cities for household purposes, fire protection, drinking and sanitation in public and commercial establishments, lawn watering, car washes, and other uses.

3/ Includes water used in the production processes and for cooling and heat exchange in manufacturing establishments.

4/ Estimated evaporation of cooling water used in steam-electric power plants. Additional water will be required for steam-electric power generation at plants outside the SMSA which supply electrical energy to users within the SMSA.

5/ Includes water used in the flooding of petroleum bearing formations to increase oil and gas production plus water used in sand and gravel and other mining activities.

Water Supply Outlook and Problems in the Tyler SMSA - Currently within the SMSA, approximately 61 percent of the water used for urban needs (municipal, manufacturing, steam-electric power generation, and mining purposes) is supplied by developed surface-water resources in the SMSA. The remaining 39 percent is supplied by ground-water resources. In the year 2000, approximately 84 percent of the SMSA's projected urban water requirements are expected to be supplied by developed surface-water resources, and approximately 16 percent by ground-water resources.

Many of the smaller yet growing urban water systems within the SMSA have been and will continue to be faced with problems related to physical conditions, facility costs, and water rights. Many of the smaller, growing systems are located in areas distant from reliable sources of supply. Under this condition, the cost of required delivery and treatment facilities to develop a reliable supply may be relatively high in relation to costs for other cities within the SMSA. Also, sufficient surface and ground-water rights to adequately fulfill the water needs of the smaller urban systems may not be readily available or may not be accessible through a larger system having water rights.

The City of Tyler Water System which is the largest in the SMSA (Smith County) presently obtains most of its water supply from Lakes Tyler and Bellwood (Figure 28). The remaining, small supply is ground water from the Carrizo-Wilcox Aquifer (Figure 3). The Tyler System began using surface water in the early 1950's, because the demand for water (pumpage) from the Carrizo-Wilcox Aquifer was causing serious water-level declines. From 1937 to 1950, the Carrizo-Wilcox Aquifer in the Tyler area experienced about eight feet of water-level decline per year because of heavy, concentrated ground-water withdrawals. Also, the ground water from the Carrizo-Wilcox Aquifer in the SMSA as well as most of east Texas has an inherent high concentration of iron

which often exceeds 0.3 milligrams per liter. The cities of Lindale, Overton, Troup, Whitehouse and other small urban water systems in the SMSA currently use ground water from the Carrizo-Wilcox Aquifer and the Queen City Aquifer (Figure 4). The Queen City Aquifer also is not a reliable source of supply and has inherent problems with high concentrations of iron.

By the year 2000, all of the urban water systems previously mentioned, except the Troup System, are expected to obtain all or part of their water supplies from developed surface-water resources in and adjacent to the SMSA. The City of Lindale's supply will be obtained from Lake Fork reservoir (Figure 28) when completed in the early 1980's. The City of Overton's supply will be provided by Lake Kilgore 2 (Figure 28). Whitehouse is expected to obtain its surface-water supply from Lake Tyler through the City of Tyler.

The Tyler Water System and other smaller systems via the Tyler System, by the year 2000, are expected to obtain practically all of their water supplies from Lakes Tyler, and Bellwood (Figure 28). The City of Tyler will probably keep their wells operative only for emergency needs, and perhaps for peak demands during extreme droughts. The expected surface-water requirements for the Tyler Water System will be about 41 and 91 thousand acre-feet annually in the years 2000 and 2030, respectively. The dependable supply from Lakes Tyler and Bellwood in the year 2000 will be about 39 thousand acre-feet per year. Therefore, in about the year 2000, the Tyler Water System will need an additional surface-water supply. The City of Tyler presently has a contractual permit with the Upper Neches River Municipal Water Authority, which owns 46.27 percent of the storage in Lake Palestine. However, pumping and

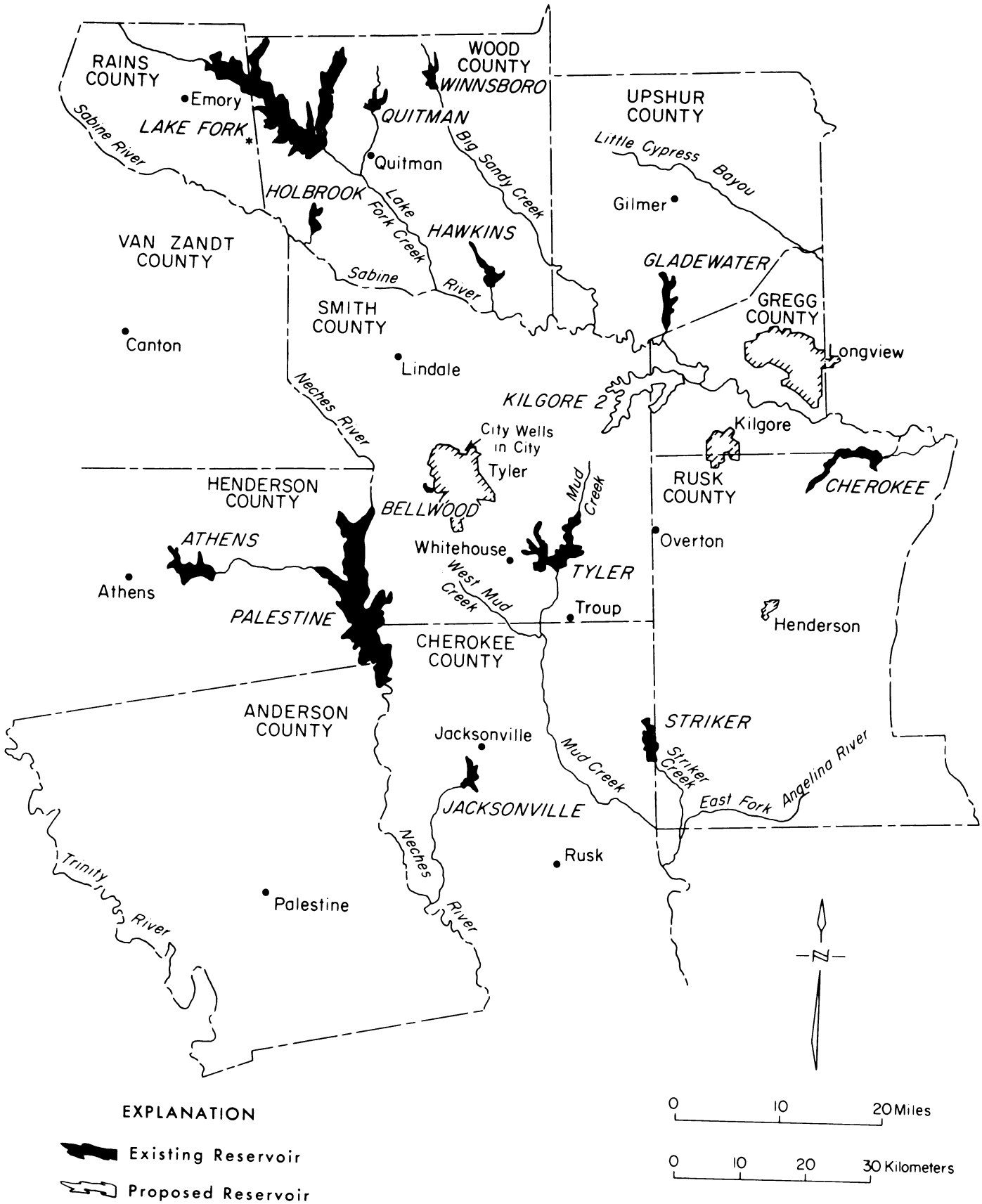


Figure 28

Tyler SMSA Water Supply Projects

conveyance facilities will have to be constructed before water from Lake Palestine is delivered to the Tyler System. The dependable supplies of Lakes Tyler, Bellwood, and Palestine (currently available to the Tyler System) should be sufficient surface-water supplies to meet the expected urban water needs of the Tyler System through the year 2030 and beyond.

Description of the Waco SMSA - The SMSA is area No. 24 on Figure 1, and is composed of McLennan County which covers about 1,000 square miles in the Brazos River basin. Normal annual precipitation ranges from about 32 to 36 inches. Mean annual temperatures range from about 66°F to 67°F. The principal city is Waco.

Economy of the WACO SMSA - The area economy is characterized by diversification with a concentration of federal civilian employment. Diversified industry remains the most important source of manufacturing employment, which contributes 16.9 percent to the total personal income of the Waco SMSA. The regional economic outlook is for continuing economic development based on Waco's favorable climate and location.

Water Quality Planning in the Waco SMSA - A background discussion of the purpose, scope, goals status, etc. of Section 208 (P.L. 92-500) water quality planning in Texas is given in the "Statewide Perspective" section of this report. The Waco SMSA is located entirely in the Brazos Basin State Planning Area (nondesignated area). The Brazos River Authority, at the request of the Texas Department of Water Resources, serves as the basin planning agency. The most important activity performed during the initial planning was the identification of those entities which potentially had wastewater treatment needs within five years. For those areas so identified, the sewage treatment needs were determined for a 20-year period. With respect to continuing planning, the SMSA has not been identified for special studies. Therefore, the major planning activity will be the continued assessment of sewage treatment needs within a 20 year time frame, and the designation of sewage treatment and collection management agencies. Intensive public participation activities were carried out during the initial

planning and will be continued during the continuing planning process. A water quality advisory committee has been established in the Brazos Basin planning area. The committee is composed of essentially balanced representation of four groups: public officials, economic interests, public interests, and private citizens. The committee will review and make recommendations on planning outputs.

Floodplain Management Program in the Waco SMSA - The Federal Emergency Management Agency has designated McLennan County and 20 incorporated cities in the SMSA as being subject to potential flooding problems from a 100-year flood event (Appendix B). Flood hazard boundary maps identifying flood-prone areas have been published for the county and for 19 of the incorporated cities in the SMSA (Appendix B). Presently, only 10 cities in the SMSA have adopted local floodplain management programs (Appendix B) in compliance with the requirements regarding participation in the National Flood Insurance Program (NFIP). Participation in the NFIP makes flood insurance available to SMSA residents presently in the floodplain and will afford some degree of protection against monetary losses due to flooding. Enforcement of the local floodplain management programs would assure that future developments will be located so as to eliminate damage from the 100-year flood. Detailed Flood Insurance Rate Studies presently in various stages of completion will supply detailed 10-year, 50-year, 100-year, and 500-year flood event data for McLennan County and 12 cities in the SMSA (Appendix B).

Population and Employment in Waco SMSA

Item	1960	1970	1980	1990	2000
			(thousands)		
Total Population	150.1	147.6	170.6	190.4	197.2
Urban Population	121.2	128.5	143.8	163.4	171.7
Other Population	28.9	19.1	26.8	27.0	25.5
Employment	52.5	46.6	75.5	83.4	85.0

Estimated Water Use and Projected Water Requirements Within the Waco SMSA 1/

Demand Categories	Estimated Use	Projected Requirements	
	1980	1990	2000
	(Thousands of Acre-feet)		
Municipal 2/	47.4	53.8	56.7
Manufacturing 3/	5.3	5.3	6.1
Steam-Electric 4/	14.0	14.0	14.0
Mining 5/	1.6	2.0	2.6
SMSA Totals	68.3	75.1	79.4

Source: Texas Department of Water Resources projections of water required under drought conditions. One acre-foot of water is 325,851 gallons.

1/ Additional water for agriculture (irrigation and livestock watering) will be required within the SMSA. Total SMSA agricultural uses were estimated at 7.2 thousand acre-feet in 1980. Projected future irrigation water requirements for 1990 and 2000 are not presented because urban growth within the SMSA and the resulting potential for this growth to impinge on irrigation in the area has not been predicted. (See footnote 1/, Table 1 for estimated total statewide irrigation water requirements for 1980, 1990 and 2000).

2/ Includes water used in cities for household purposes, fire protection, drinking and sanitation in public and commercial establishments, lawn watering, car washes, and other uses.

3/ Includes water used in the production processes and for cooling and heat exchange in manufacturing establishments.

4/ Estimated evaporation of cooling water used in steam-electric power plants. Additional water will be required for steam-electric power generation at plants outside the SMSA which supply electrical energy to users within the SMSA.

5/ Includes water used in the flooding of petroleum bearing formations to increase oil and gas production plus water used in sand and gravel and other mining activities.

Water Supply Outlook and Problems in the Waco SMSA - Currently within the SMSA, approximately 84 percent of the water used for urban needs (municipal, manufacturing, steam-electric power generation, and mining purposes) is supplied by developed surface-water resources in and adjacent to the SMSA. The remaining 16 percent is supplied by ground-water resources. In the year 2000, approximately 94 percent of the SMSA's projected urban water requirements are expected to be supplied by developed surface-water resources, and approximately six percent by ground-water resources.

Many of the smaller yet growing urban water systems within the SMSA have been and will continue to be faced with problems related to physical conditions, facility costs, and water rights. Many of the smaller, growing systems are located in areas distant from reliable sources of supply. Under this condition, the cost of required delivery and treatment facilities to develop a reliable supply may be relatively high in relation to costs for other cities within the SMSA. Also, sufficient surface and ground-water rights to adequately fulfill the water needs of the smaller urban systems may not be readily available or may not be accessible through a larger system having water rights.

The City of Waco Water System and the City of Beverly Hills (through the Waco System) currently receive their water supplies from Lake Waco (Figure 29). The City of Bellmead's current supply is from the Waco System and the Trinity Group Aquifer (Figure 3). Other smaller yet growing water systems within the SMSA (McLennan County) receive their current supply from the Trinity Group Aquifer (Figure 3). Some of these smaller urban systems include Lacy-Lakeview, McGregor, Mart, Moddy, Robinson, West, Woodway, Bruceville, Eddy, Riesel, Axtell, Elm Mott, Lorena, and Crawford (Figure 29). Because of extreme water-level declines, the Trinity Group Aquifer will not be capable of sustaining present or future levels of pumpage. Also, the aquifer contains water having high concentrations of

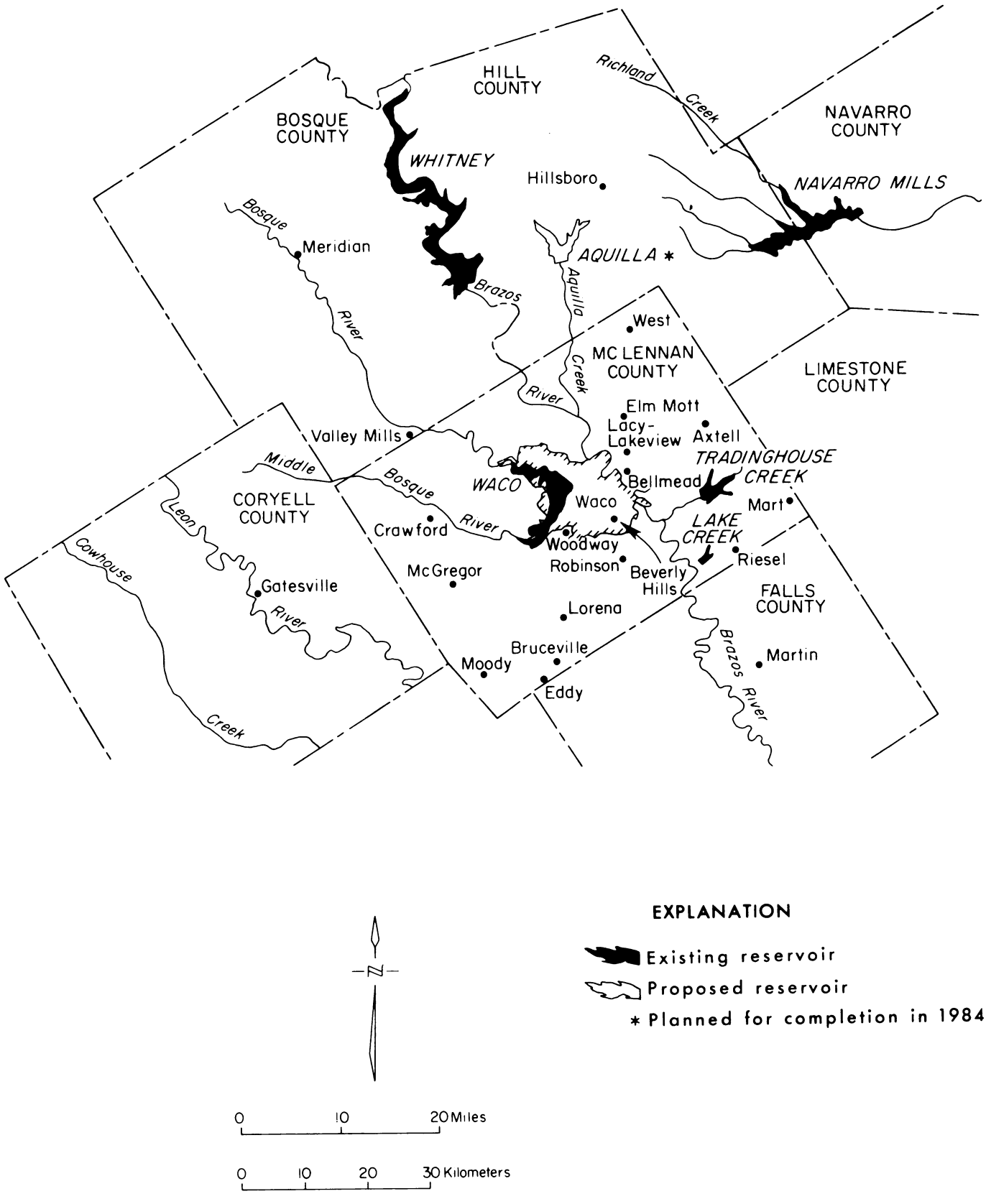


Figure 29

Waco SMSA Water Supply Projects

fluoride which exceed the Environmental Protection Agency and Texas State Health Department fluoride standard of 1.6 milligrams per liter for the SMSA. A recent Texas Department of Water Resources (TDWR) study indicated about 20 community ground-water systems in the SMSA had fluoride concentrations exceeding 1.6 milligrams per liter.

Lake Tradinghouse Creek and Lake Creek Lake currently supply cooling water for power plants within the SMSA. These Lakes are expected to provide sufficient water supplies for steam-electric power generation within the SMSA through the year 2030.

By the year 2000, the Texas Department of Water Resources expects the following cities to be obtaining all of their water supply from Lake Waco through the Waco Water System: Bellmead, Beverly Hills, Lacy-Lakeview, Robinson, Woodway, Lorena, Bruceville, Eddy, Moody, Riesel, Mart, Axtell, and Elm Mott. The City of West will be supplied by Lake Aquilla (Figure 29), which is expected to be completed in the mid-1980's. The Cities of McGregor and Crawford (Figure 29) are expected to remain on ground water from the Trinity Group Aquifer through the year 2030.

In the next 10 to 20 years, expansion of distribution facilities will be needed in the SMSA to convey treated water from Lake Waco to the expected Waco Water System customer cities described above. The Waco System and its customer cities are expected to have surface-water requirements of 59 and 84 thousand acre-feet per year in the years 2000 and 2030, respectively. The dependable supplies from Lake Waco are expected to be about 75 and 68 thousand acre-feet annually in 2000 and 2030, respectively. Therefore, supply-demand comparison indicates that the Waco System and its customer cities will need an additional firm surface-water supply between the years 2015 and 2020.

WICHITA FALLS SMSA

Description of the Wichita Falls SMSA - The SMSA is area No. 25 on Figure 1, and is composed of Wichita and Clay counties which cover about 1,713 square miles in the Red and Trinity River basins. Normal annual precipitation ranges from about 26 to 30 inches. Mean annual temperature is about 64°F. The principal city is Wichita Falls.

Economy of the Wichita Falls SMSA - The area economy is characterized by significant concentrations in the mining and federal military sectors. Industrial plants for large national corporations are the most important source of manufacturing employment, which contributes 9.6 percent to the total personal income of the SMSA. The regional economic outlook is for rapid growth in the manufacturing sector and continuing importance of the oil industry.

Water Quality Planning in Wichita Falls SMSA - A background discussion of the purpose, scope, goals, status, etc. of Section 208 (P.L. 92-500) water quality planning in Texas is given in the "Statewide Perspective" section of this report. The Wichita Falls SMSA is within the Red River Basin State Planning Area except for a small portion of southern Clay County that lies within the Trinity River Basin State Planning Area. The Texas Department of Water Resources was responsible for planning in the nondesignated areas of the State and delegated certain planning responsibilities to the Red River Authority of Texas for the Red River basin and to the Trinity River Authority for the Trinity River basin. The 208 Water Quality Plan prepared for the Red River basin recommended long-term wastewater facility improvement needs

for the area as well as recommending appropriate management agencies to implement the plan. Generalized land use maps were prepared for Wichita Falls, and a water quality sampling program was implemented in streams in the Wichita Falls area. A preliminary assessment of the contributions of urban runoff in Wichita Falls based on theoretical loadings was prepared. In future years, verification of the contributions of urban runoff will be undertaken through a rainfall runoff sampling program, contingent upon availability of funding for this study from the Environmental Protection Agency. Additional planning is scheduled to determine wastewater facility needs for communities not addressed in the initial planning process; primarily small communities. This information will be developed in both the Red River and Trinity River Basins. Local committees have been formed to review all results of studies and planning recommendations.

Floodplain Management Program in the Wichita Falls SMSA - The Federal Emergency Management Agency has designated both counties and six incorporated cities in the SMSA as being subject to potential flooding problems from a 100-year flood event (Appendix B). Flood hazard boundary maps identifying flood-prone areas have been published for Wichita County and for six of the incorporated cities in the SMSA (Appendix B). Presently, only five cities in the SMSA have adopted local floodplain management programs (Appendix B) in compliance with the requirements regarding participation in the National Flood Insurance Program (NFIP). Participation in the NFIP makes flood insurance available to SMSA residents presently in the floodplain and will afford some degree of protection against monetary losses due to flooding. Enforcement of the local floodplain management programs would assure that future developments will be located so as to eliminate damage from the 100-year flood. Detailed

Flood Insurance Rate Studies presently in various stages of completion will supply detailed 10-year, 50-year, 100-year, and 500-year flood event data for Wichita County and four cities in the SMSA (Appendix B).

Population and Employment in Wichita Falls SMSA

Item	1960	1970	1980	1990	2000
			(thousands)		
Total Population	131.9	128.6	129.9	139.0	156.6
Urban Population	120.5	118.1	117.3	124.7	140.3
Other Population	11.4	10.5	12.6	14.3	16.3
Employment	43.0	42.2	57.2	61.6	72.8

Estimated Water Use and Projected Water Requirements Within the Wichita Falls SMSA 1/

Demand Categories	Estimated Use 1980	Projected Requirements 1990	2000
	(Thousands of Acre-feet)		
Municipal 2/	31.7	34.6	39.8
Manufacturing 3/	3.1	3.2	4.0
Steam-Electric 4/	-0-	-0-	-0-
Mining 5/	0.7	0.7	0.8
SMSA Totals	35.5	38.5	44.6

Source: Texas Department of Water Resources projections of water required under drought conditions. One acre-foot of water is 325,851 gallons.

1/ Additional water for agriculture (irrigation and livestock watering) will be required within the SMSA. Total SMSA agricultural uses were estimated at 32.8 thousand acre-feet in 1980. Projected future irrigation water requirements for 1990 and 2000 are not presented because urban growth within the SMSA and the resulting potential for this growth to impinge on irrigation in the area has not been predicted. (See footnote 1/, Table 1 for estimated total statewide irrigation water requirements for 1980, 1990 and 2000).

2/ Includes water used in cities for household purposes, fire protection, drinking and sanitation in public and commercial establishments, lawn watering, car washes, and other uses.

3/ Includes water used in the production processes and for cooling and heat exchange in manufacturing establishments.

4/ Estimated evaporation of cooling water used in steam-electric power plants. Additional water will be required for steam-electric power generation at plants outside the SMSA which supply electrical energy to users within the SMSA.

5/ Includes water used in the flooding of petroleum bearing formations to increase oil and gas production plus water used in sand and gravel and other mining activities.

Water Supply Outlook and Problems in the Wichita Falls SMSA - Currently within the SMSA, approximately 88 percent of the water used for urban needs (municipal, manufacturing steam-electric power generation, and mining purposes) is supplied by developed surface-water resources in and adjacent to the SMSA. The remaining 12 percent is supplied by ground-water resources. In the year 2000, approximately 98 percent of the SMSA's projected urban water requirements are expected to be supplied by developed surface-water resources, and approximately two percent by ground-water resources.

Many of the smaller yet growing urban water systems within the SMSA have been and will continue to be faced with problems related to physical conditions, facility costs, and water rights. Many of the smaller, growing systems are located in areas distant from reliable sources of supply. Under this condition, the cost of required delivery and treatment facilities to develop a reliable supply may be relatively high in relation to costs for other cities within the SMSA. Also, sufficient surface and ground-water rights to adequately fulfill the water needs of the smaller urban systems may not be readily available or may not be accessible through a larger system having water rights. rights.

The Wichita Falls Water System will continue to provide water to the City of Wichita Falls and a number of surrounding municipalities, including Burk-burnett, Iowa Park , and Holliday (Figure 30). The City of Electra currently obtains its water supply from Lake Electra (Figure 30) and the Seymour Aquifer. However, by the year 2000, Electra, Henrietta, and Archer City (Figure 30) are expected to be obtaining all or part of their water supplies from the Wichita Falls System.

Lakes Buffalo Creek, Kickapoo, Arrowhead, Kemp, Diversion, and Electra (Figure 30) will be capable of providing a dependable water supply for the Wichita Falls System, other urban water needs in and adjacent to the SMSA, and irrigation in Wichita County (Lakes Kemp and Diversion) through the year 2030. The potential urban and irrigation water requirements for these reservoirs are expected to be about 74 and 99 thousand acre-feet annually in the years 2000 and 2030, respectively. The reservoirs will be capable of providing a total annual dependable supply of about 189 thousand acre-feet in2000 and 182 thousand acre-feet in 2030.

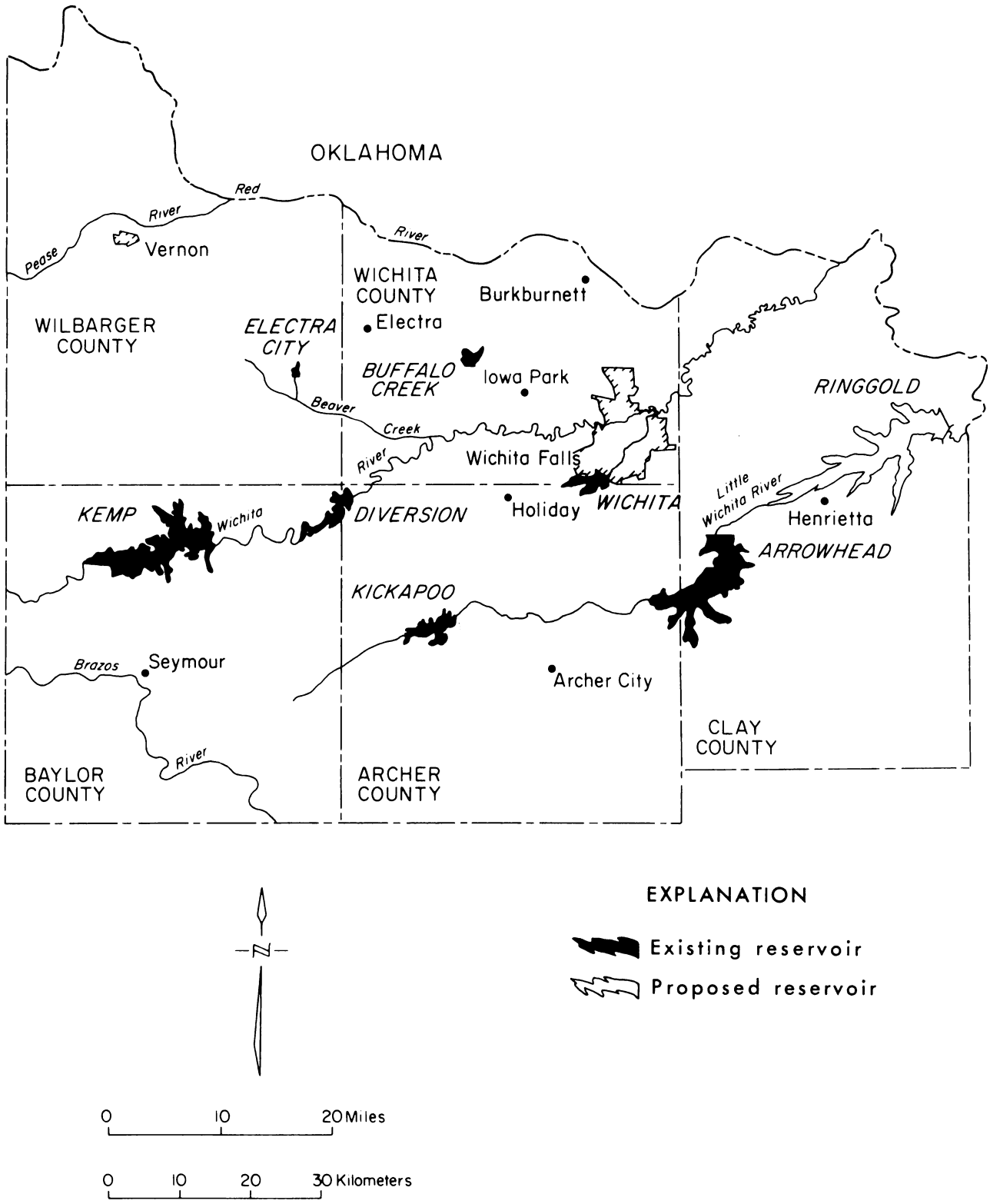


Figure 30

Wichita Falls SMSA Water Supply Projects

A potential reservoir which could supplement existing water supplies and meet currently unexpected, long-range water requirements within and adjacent to the SMSA is Lake Ringgold (Figure 30). This reservoir could be operated as an integral part of the Wichita Falls Water System.

APPENDIX A

CURRENT WORDING OF SECTION 208 OF THE FEDERAL WATER POLLUTION CONTROL ACT (P.L. 92-500) AS AMENDED BY THE CLEAN WATER ACT OF 1977 (P.L. 95-219)

(The italic words are those amended in 1977. Bracketed words are those deleted in 1977.)

AREAWIDE WASTE TREATMENT MANAGEMENT

SEC. 208. (a) For the purpose of encouraging and facilitating the development and implementation of areawide waste treatment management plans—

(1) The Administrator, within ninety days after the date of enactment of this Act and after consultation with appropriate Federal, State, and local authorities, shall by regulation publish guidelines for the identification of those areas which, as a result of urban-industrial concentrations or other factors, have substantial water quality control problems.

(2) The Governor of each State, within sixty days after publication of the guidelines issued pursuant to paragraph (1) of this subsection, shall identify each area within the State which, as a result of urban-industrial concentrations or other factors, has substantial water quality control problems. Not later than one hundred and twenty days following such identification and after consultation with appropriate elected and other officials of local governments having jurisdiction in such areas, the Governor shall designate (A) the boundaries of each such area, and (B) a single representative organization, including elected officials from local governments or their designees, capable of developing effective areawide waste treatment management plans for such area. The Governor may in the same manner at any later time identify any additional area (or modify an existing area) for which he determines areawide waste treatment management to be appropriate, designate the boundaries of such area, and designate an organization capable of developing effective areawide waste treatment management plans for such area.

(3) With respect to any area which, pursuant to the guidelines published under paragraph (1) of this subsection, is located in two or more States, the Governors of the respective States shall consult and cooperate in carrying out the provisions of paragraph (2), with a view toward designating the boundaries of the interstate area having common water quality control problems and for which areawide waste treatment management plans would be most effective, and toward designating, within one hundred and eighty days after publication of guidelines issued pursuant to paragraph (1) of this subsection, of a single representative organization capable of developing effective areawide waste treatment management plans for such area.

(4) If a Governor does not act, either by designating or determining not to make a designation under paragraph (2) of this subsection, within the time required by such paragraph, or if, in the case of an interstate area, the Governors of the States involved do not designate a planning organization within the time required by paragraph (3) of this subsection, the chief elected officials of local governments within an area may by agreement designate (A) the boundaries for such an area, and (B) a single representative organization including elected officials from such local governments, or their designees, capable of developing an areawide waste treatment management plan for such area.

(5) Exiting regional agencies may be designated under paragraphs (2), (3), and (4) of this subsection.

(6) The State shall act as a planning agency for all portions of such State which are not designated under paragraphs (2), (3), or (4) of this subsection.

(7) Designations under this subsection shall be subject to the approval of the Administrator.

(b)(1)(*A*) Not later than one year after the date of designation of any organization under subsection (a) of this section such organization shall have in operation a continuing areawide waste treatment management planning process consistent with section 201 of this Act. Plans prepared in accordance with this process shall contain alternatives for waste treatment management, and be applicable to all wastes generated within the area involved. The initial plan prepared in accordance with such process shall be certified by the Governor and submitted to the Administrator not later than two years after the planning process is in operation.

(*B*) *For any agency designated after 1975 under subsection (a) of this section and for all portions of a State for which the State is required to act as the planning agency in accordance with subsection (a)(6), the initial plan prepared in accordance with such process shall be certified by the Governor and submitted to the Administrator not later than three years after the receipt of the initial grant award authorized under subsection (f) of this section.*

(2) Any plan prepared under such process shall include, but not be limited to—

(A) the identification of treatment works necessary to meet the anticipated municipal and industrial waste treatment needs of the area over a twenty-year period, annually updated (including an analysis of alternative waste treatment systems), including any requirements for the acquisition of land for treatment purposes; the necessary waste water collection and urban storm water runoff systems; and a program to provide the necessary financial arrangements for the development of such treatment works, *and an identification of open space and recreation opportunities that can be expected to result from improved water quality, including consideration of potential use of lands associated with treatment works and increased access to water-based recreation*;

(B) the establishment of construction priorities for such treatment works and time schedules for the initiation and completion of all treatment works;

(C) the establishment of a regulatory program to—

(i) implement the waste treatment management requirements of section 201(c),

(ii) regulate the location, modification, and construction of any facilities within such area which may result in any discharge in such area, and

(iii) assure that any industrial or commercial waste discharged into any treatment works in such area meet applicable pretreatment requirements;

(D) the identification of those agencies necessary to construct, operate, and maintain all facilities required by the plan and otherwise to carry out the plan;

(E) the identification of the measures necessary to carry out the plan (including financing), the period of time necessary to carry out the plan, the costs of carrying out the plan within such time, and the economic, social, and environmental impact of carrying out the plan within such time;

(F) a process to (i) identify, if appropriate, agriculturally and silviculturally related nonpoint sources of pollution, including *return flows from irrigated agriculture, and their cumulative effects*, runoff from manure disposal areas, and from land used for livestock and crop production, and (ii) set forth procedures and methods (including land use requirements) to control to the extent feasible such sources;

(G) a process of (i) identify, if appropriate, mine-related sources of pollution including new, current, and abandoned surface and underground mine runoff, and (ii) set forth procedures and methods (including land use requirements) to control to the extent feasible such sources;

(H) a process to (i) identify construction activity related sources of pollution, and (ii) set forth procedures and methods (including land use requirements) to control to the extent feasible such sources;

(I) a process to (i) identify, if appropriate, salt water intrusion into rivers, lakes, and estuaries resulting from reduction of fresh water flow from any cause, including irrigation, obstruction, ground water extraction, and diversion, and (ii) set forth procedures and methods to control such intrusion to the extent feasible where such procedures and methods are otherwise a part of the waste treatment management plan;

(J) a process to control the disposition of all residual waste generated in such area which could affect water quality; and

(K) a process to control the disposal of pollutants on land or in subsurface excavations within such area to protect ground and surface water quality.

(3) Areawide waste treatment management plans shall be certified annually by the Governor or his designee (or Governors or their designees, where more than one State is involved) as being consistent with applicable basin plans and such areawide waste treatment management plans shall be submitted to the Administrator for his approval.

(4) (*A*) Whenever the Governor of any State determines (and notifies the Administrator) that consistency with a statewide regulatory program under section 303 so requires, the requirements of clauses (F) through (K) of paragraph (2) of this subsection shall be developed and submitted by the Governor [to the Administrator for application to all regions within such State] *to the Administrator for approval for application to a class or category of activity throughout such State.*

(B) Any program submitted under subparagraph (A) of this paragraph which, in whole or in part, is to control the discharge or other placement of dredged or fill material into the navigable waters shall include the following:

(i) A consultation process which includes the State agency with primary jurisdiction over fish and wildlife resources.

(ii) A process to identify and manage the discharge or other placement of dredged or fill material which adversely affects navigable waters, which shall complement and be coordinated with a State program under section 404 conducted pursuant to this Act.

(iii) A process to assure that any activity conducted pursuant to a best management practice will comply with the guidelines established under section 404(b)(1), and sections 307 and 403 of this Act.

(iv) A process to assure that any activity conducted pursuant to a best management practice can be terminated or modified for cause including, but not limited to, the following:

(I) violation of any condition of the best management practice;

(II) change in any activity that requires either a temporary or permanent reduction or elimination of the discharge pursuant to the best management practice.

(v) A process to assure continued coordination with Federal and Federal-State water-related planning and reviewing processes, including the National Wetlands Inventory.

(C) If the Governor of a State obtains approval from the Administrator of a statewide regulatory program which meets the requirements of subparagraph (B) of this paragraph and if such State is administering a permit program under section 404 of this Act, no person shall be required to obtain an individual permit pursuant to such section, or to comply with a general permit issued pursuant to such section, with respect to any appropriate activity within such State for which a best management practice has been approved by the Administrator under the program approved by the Administrator pursuant to this paragraph.

(D) (i) Whenever the Administrator determines after public hearing that a State is not administering a program approved under this section in accordance with the requirements of this section, the Administrator shall so notify the State, and if appropriate corrective action is not taken within a reasonable time, not to exceed ninety days, the Administrator shall withdraw approval of such program. The Administrator shall not withdraw approval of any such program unless he shall first have notified the State, and made public, in writing, the reasons for such withdrawal.

(ii) In the case of a State with a program submitted and approved under this paragraph, the Administrator shall withdraw approval of such program under this subparagraph only for a substantial failure of the State to administer its program in accordance with the requirements of this paragraph.

(c) (1) The Governor of each State, in consultation with the planning agency designated under subsection (a) of this section, at the time a plan is submitted to the Administrator, shall designate one or more waste treatment management agencies (which may be an existing or newly created local, regional or State agency or potential subdivision) for each area designated under subsection (a) of this section and submit such designations to the Administrator.

(2) The Administrator shall accept any such designation, unless, within 120 days of such designation, he finds that the designated management agency (or agencies) does not have adequate authority—

(A) to carry out appropriate portions of an areawide waste treatment management plan developed under subsection (b) of this section;

(B) to manage effectively waste treatment works and related facilities serving such area in conformance with any plan required by subsection (b) of this section;

(C) directly or by contract, to design and construct new works, and to operate and maintain new and existing works as required by any plan developed pursuant to subsection (b) of this section;

(D) to accept and utilize grants, or other funds from any source, for waste treatment management purposes;

(E) to raise revenues, including the assessment of waste treatment charges;

(F) to incur short- and long-term indebtedness;

(G) to assure in implementation of an areawide waste treatment management plan that each participating community pays its proportionate share of treatment costs;

(H) to refuse to receive any wastes from any municipality or subdivision thereof, which does not comply with any provisions of an approved plan under this section applicable to such area; and

(I) to accept for treatment industrial wastes.

(d) After a waste treatment management agency having the authority required by subsection (c) has been designated under such subsection for an area and a plan for such area has been approved under subsection (b) of this section, the Administrator shall not make any grant for construction of a publicly owned treatment works under section 201(g)(1) within such area except to such designated agency and for works in conformity with such plan.

(e) No permit under section 402 of this Act shall be issued for any point source which is in conflict with a plan approved pursuant to subsection (b) of this section.

(f)(1) The Administrator shall make grants to any agency designated under subsection (a) of this section for payment of the reasonable costs of developing and operating a continuing areawide waste treatment management planning process under subsection (b) of this section.

[(2) The amount granted to any agency under paragraph (1) of this subsection shall be 100 per centum of the costs of developing and operating a continuing areawide waste treatment management planning process under subsection (b) of this section for each of the fiscal years ending on June 30, 1973, June 30, 1974, and June 30, 1975, and shall not exceed 75 per centum of such costs in each succeeding fiscal year.]

(2) For the two-year period beginning on the date the first grant is made under paragraph (1) of this subsection to an agency, if such first grant is made before October 1, 1977, the amount of each such grant to such agency shall be 100 per centum of the costs of developing and operating a continuing areawide waste treatment management planning process under subsection (b) of this section, and thereafter the amount granted to such agency shall not exceed 75 per centum of such costs in each succeeding one-year period. In the case of any other grant made to an agency under such paragraph (1) of this subsection, the amount of such grant shall not exceed 75 per centum of the costs of developing and operating a continuing areawide waste treatment management planning process in any year.

(3) Each applicant for a grant under this subsection shall submit to the Administrator for his approval each proposal for which a grant is applied for under this subsection. The Administrator shall act upon such proposal as soon as practicable after it has been submitted, and his approval of that proposal shall be deemed a contractual obligation of the United States for the payment of its contribution to such proposal, *subject to such amounts as are provided in appropriation Acts.* There is authorized to be appropriated to carry out this subsection not to exceed $50,000,000 for the fiscal year ending June 30, 1973, not to exceed $100,000,000 for the fiscal year ending June 30, 1974, and not to exceed $150,000,000 *per fiscal year* for the fiscal [year] *years* ending June 30, 1975, *September 30, 1977, September 30, 1978, September 30, 1979, and September 30, 1980.*

(g) The Administrator is authorized, upon request of the Governor or the designated planning agency, and without reimbursement, to consult with, and provide technical assistance to, any agency designated under subsection (a) of this section in the development of areawide waste treatment management plans under subsection (b) of this section.

(h)(1) The Secretary of the Army, acting through the Chief of Engineers, in cooperation with the Administrator is authorized and directed, upon request of the Governor or the designated planning organization, to consult with, and provide technical assistance to, any

agency designed under subsection (a) of this section in developing and operating a continuing areawide waste treatment management planning process under subsection (b) of this section.

(2) There is authorized to be appropriated to the Secretary of the Army, to carry out this subsection, not to exceed $50,000,000 per fiscal year for the fiscal years ending June 30, 1973, and June 30, 1974.

(i) (1) The Secretary of the Interior, acting through the Director of the United States Fish and Wildlife Service, shall, upon request of the Governor of a State, and without reimbursement, provide technical assistance to such State in developing a statewide program for submission to the Administrator under subsection (b) (4) (B) of this section and in implementing such program after its approval.

(2) There is authorized to be appropriated to the Secretary of the Interior $6,000,000 to complete the National Wetlands Inventory of the United States, by December 31, 1981, and to provide information from such Inventory to States as it becomes available to assist such States in the development and operation of programs under this Act.

(j) (1) The Secretary of Agriculture, with the concurrence of the Administrator, and acting through the Soil Conservation Service and such other agencies of the Department of Agriculture as the Secretary may designate, is authorized and directed to establish and administer a program to enter into contracts, subject to such amounts as are provided in advance by appropriation acts, of not less than five years nor more than ten years with owners and operators having control of rural land for the purpose of installing and maintaining measures incorporating best management practices to control nonpoint source pollution for improved water quality in those States or areas for which the Administrator has approved a plan under subsection (b) of this section where the practices to which the contracts apply are certified by the management agency designated under subsection (c) (1) of this section to be consistent with such plans and will result in improved water quality. Such contracts may be entered into during the period ending not later than September 31, 1988. Under such contracts the land owner or operator shall agree—

(i) to effectuate a plan approved by a soil conservation district, where one exists, under this section for his farm, ranch, or other land substantially in accordance with the schedule outlined therein unless any requirement thereof is waived or modified by the Secretary;

(ii) to forfeit all rights to further payments or grants under the contract and refund to the United States all payments and grants received thereunder, with interest, upon his violation of the contract at any stage during the time he has control of the land if the Secretary, after considering the recommendations of the soil conservation district, where one exists, and the Administrator, determines that such violation is of such a nature as to warrant termination of the contract, or to make refunds or accept such payment adjustments as the Secretary may deem appropriate if he determines that the violation by the owner or operator does not warrant termination of the contract;

(iii) upon transfer of his right and interest in the farm, ranch, or other land during the contract period to forfeit all rights

to further payments or grants under the contract and refund to the United States all payments or grants received thereunder, with interest, unless the transferee of any such land agrees with the Secretary to assume all obligations of the contract;

(iv) not to adopt any practice specified by the Secretary on the advice of the Administrator in the contract as a practice which would tend to defeat the purposes of the contract;

(v) to such additional provisions as the Secretary determines are desirable and includes in the contract to effectuate the purposes of the program or to facilitate the practical administration of the program.

(2) In return for such agreement by the landowner or operator the Secretary shall agree to provide technical assistance and share the cost of carrying out those conservation practices and measures set forth in the contract for which he determines that cost sharing is appropriate and in the public interest and which are approved for cost sharing by the agency designated to implement the plan developed under subsection (b) of this section. The portion of such cost (including labor) to be shared shall be that part which the Secretary determines is necessary and appropriate to effectuate the installation of the water quality management practices and measures under the contract, but not to exceed 50 per centum of the total cost of the measures set forth in the contract; except the Secretary may increase the matching cost share where he determines that (1) the main benefits to be derived from the measures are related to improving offsite water quality, and (2) the matching share requirement would place a burden on the landowner which would probably prevent him from participating in the program.

(3) The Secretary may terminate any contract with a landowner or operator by mutual agreement with the owner or operator if the Secretary determines that such termination would be in the public interest, and may agree to such modification of contracts previously entered into as he may determine to be desirable to carry out the purposes of the program or facilitate the practical administration thereof or to accomplish equitable treatment with respect to other conservation, land use, or water quality programs.

(4) In providing assistance under this subsection the Secretary will give priority to those areas and sources that have the most significant effect upon water quality. Additional investigations or plans may be made, where necessary, to supplement approved water quality management plans, in order to determine priorities.

(5) The Secretary shall, where practicable, enter into agreements with soil conservation districts, State soil and water conservation agencies, or State water quality agencies to administer all or part of the program established in this subsection under regulations developed by the Secretary. Such agreements shall provide for the submission of such reports as the Secretary deems necessary, and for payment by the United States of such portion of the costs incurred in the administration of the program as the Secretary may deem appropriate.

(6) The contracts under this subsection shall be entered into only in areas where the management agency designated under subsection (c)(1) of this section assures an adequate level of participation by

owners and operators having control of rural land in such areas. Within such areas the local soil conservation district, where one exists, together with the Secretary of Agriculture, will determine the priority of assistance among individual land owners and operators to assure that the most critical water quality problems are addressed.

(7) The Secretary, in consultation with the Administrator and subject to section 304(k) of this Act, shall, not later than September 30, 1978, promulgate regulations for carrying out this subsection and for support and cooperation with other Federal and non-Federal agencies for implementation of this subsection.

(8) This program shall not be used to authorize or finance projects that would otherwise be eligible for assistance under the terms of Public Law 83-566.

(9) There are hereby authorized to be appropriated to the Secretary of Agriculture $200,000,000 for fiscal year 1979 and $400,000,000 for fiscal year 1980, to carry out this subsection. The program authorized under this subsection shall be in addition to, and not in substitution of, other programs in such area authorized by this or any other public law.

APPENDIX B

FLOODPLAIN MANAGEMENT PROGRAM

County/City Designated by FEMA	Published Flood Hazard Boundary Map Available	Adopted Floodplain Management Program	Detailed Flood Insurance Rate Studies in Progress or Completed
ABILENE SMSA			
Callahan	No	No	No
Baird	Yes	No	No
Clyde	No	Yes	No
Cross Plains	Yes	No	No
Putnam	Yes	No	No
Jones	No	No	No
Anson	No	Yes	No
Hamlin	Yes	Yes	No
Hawley	Yes	No	No
Lueders	Yes	No	No
Stamford	No	Yes	No
Taylor	Yes	No	No
Abilene	Yes	Yes	Yes 1/
Buffalo Gap	Yes	No	No
Impact	Yes	No	No
Lawn	Yes	No	No
Merkel	Yes	No	No
Trent	Yes	No	No
Tuscola	Yes	Yes	No
Tye	Yes	No	No
AMARILLO SMSA			
Potter	Yes	No	No
Amarillo	Yes	Yes	Yes
Randall	Yes	Yes	Yes
Canyon	Yes	Yes	Yes
Lake Tanglewood	Yes	Yes	Yes
AUSTIN SMSA			
Hays	Yes	No	No
Kyle	Yes	Yes	No
San Marcos	Yes	Yes	Yes

1/ Study complete as of March 17, 1980.

FLOODPLAIN MANAGEMENT PROGRAM

County/City Designated by FEMA	Published Flood Hazard Boundary Map Available	Adopted Floodplain Management Program	Detailed Flood Insurance Rate Studies in Progress or Completed
AUSTIN (cont'd)			
Travis	Yes	Yes	Yes
Austin	Yes	Yes	Yes
Lakeway	Yes	Yes	Yes
Manor	No	Yes	No
Pflugerville	Yes	Yes	Yes 1/
Rollingwood	Yes	Yes	Yes 1/
San Leanna	Yes	No	Yes 1/
Sunset Valley	Yes	Yes	Yes
West Lake Hills	Yes	Yes	Yes 1/
Williamson	Yes	No	No
Bartlett	No	Yes	Yes
Cedar Park	Yes	No	No
Florence	Yes	Yes	No
Georgetown	Yes	Yes	No
Granger	Yes	Yes	No
Leander	Yes	Yes	No
Round Rock	Yes	Yes	No
Taylor	Yes	Yes	Yes
BEAUMONT-PORT ARTHUR-ORANGE SMSA			
Hardin	Yes	Yes	Yes 1/
Kountze	Yes	No	No
Lumberton	Yes	Yes	Yes
Roje Hill Acres	Yes	Yes	Yes
Silsbee	Yes	Yes	Yes 1/
Sour Lake	No	Yes	No
Jefferson	Yes	Yes	Yes 1/
Beaumont	Yes	Yes	Yes
Bevil Oaks	Yes	Yes	Yes
China	No	No	Yes
Griffing Park	Yes	Yes	Yes
Groves	Yes	Yes	Yes
Lakeview	Yes	Yes	Yes
Nederland	Yes	Yes	Yes
Nome	Yes	No	Yes
Pear Ridge	Yes	Yes	Yes
Port Arthur	Yes	Yes	Yes
Port Neches	Yes	Yes	Yes

1/ Study complete as of March 17, 1980.

FLOODPLAIN MANAGEMENT PROGRAM

County/City Designated by FEMA	Published Flood Hazard Boundary Map Available	Adopted Floodplain Management Program	Detailed Flood Insurance Rate Studies in Progress or Completed
BEAUMONT-PORT ARTHUR-ORANGE (cont'd)			
Orange	Yes	Yes	Yes 1/
Bridge City	Yes	Yes	Yes 1/
Orange	Yes	Yes	Yes 1/
Pine Forest	Yes	Yes	Yes
Pinehurst	No	Yes	Yes
Rose City	Yes	No	Yes
Vidor	Yes	Yes	Yes 1/
West Orange	Yes	Yes	Yes 1/
BROWNSVILLE-HARLINGEN-SAN BENITO SMSA			
Cameron	Yes	Yes	Yes
Bayview	Yes	Yes	Yes
Brownsville	Yes	Yes	No
Combes	Yes	Yes	Yes
Harlingen	Yes	Yes	Yes
LaFeria	Yes	Yes	Yes
Laguna Vista	Yes	Yes	Yes
Los Fresnos	Yes	Yes	No 1/
Port Isabel	Yes	Yes	Yes 1/
Primera	Yes	No	No
Rangerville	No	No	No
Rio Hondo	Yes	Yes	Yes
San Benito	Yes	Yes	Yes
Santa Rosa	Yes	No	Yes
South Padre Island	Yes	Yes	Yes
BRYAN-COLLEGE STATION SMSA			
Brazos	Yes	No	No
Bryan	Yes	Yes	Yes
College Station	Yes	Yes	Yes
CORPUS CHRISTI SMSA			
Nueces	Yes	Yes	Yes 1/
Agua Dulce	Yes	Yes	Yes 1/
Bishop	Yes	Yes	Yes
Corpus Christi	Yes	Yes	Yes
Driscoll	Yes	Yes	Yes

1/ Study complete as of March 17, 1980.

County/City Designated by FEMA	Published Flood Hazard Boundary Map Available	Adopted Floodplain Management Program	Detailed Flood Insurance Rate Studies in Progress or Completed
CORPUS CHRISTI (cont'd)			
Nueces (cont'd)			
Port Aransas	Yes	Yes	Yes 1/
Robstown	Yes	Yes	Yes 1/
San Patricio	Yes	Yes	Yes
Aransas Pass	Yes	Yes	Yes
Gregory	Yes	Yes	Yes
Ingleside	Yes	Yes	Yes
Mathis	Yes	Yes	No
Odem	Yes	Yes	Yes
Portland	Yes	Yes	Yes
San Patricio	Yes	No	Yes 1/
Sinton	Yes	Yes	Yes 1/
DALLAS-FORT WORTH SMSA			
Collin	Yes	No	Yes 1/
Allen	Yes	Yes	Yes 1/
Altoga	Yes	No	Yes 1/
Celina	Yes	Yes	Yes 1/
Fairview	Yes	Yes	Yes 1/
Frisco	Yes	Yes	Yes 1/
Josephine	Yes	No	Yes 1/
Lavon	Yes	No	Yes
Lucas	No	Yes	No
McKinney	Yes	Yes	Yes
Murphy	Yes	Yes	Yes
New Hope	No	No	No 1/
Parker	Yes	Yes	Yes 1/
Plano	Yes	Yes	Yes 1/
Prosper	Yes	No	No
Renner	Yes	Yes	Yes
Saint Paul	Yes	No	No
Westminster	Yes	No	Yes
Weston	Yes	No	Yes
Wylie	Yes	Yes	Yes
Dallas	Yes	Yes	Yes
Addison	Yes	No	Yes
Balch Springs	Yes	Yes	Yes
Buckingham	No	No	Yes
Carrollton	Yes	Yes	Yes

1/ Study complete as of March 17, 1980.

County/City Designated by FEMA	Published Flood Hazard Boundary Map Available	Adopted Floodplain Management Program	Detailed Flood Insurance Rate Studies in Progress or Completed
DALLAS-FORT WORTH (cont'd)			
Dallas (cont'd)			
Cedar Hill	Yes	Yes	Yes
Cockrell Hill	Yes	No	Yes
Coppell	Yes	Yes	Yes
Dallas	Yes	Yes	Yes
DeSota	Yes	Yes	Yes
Duncanville	Yes	Yes	Yes 1/
Farmers Branch	Yes	Yes	Yes 1/
Garland	Yes	Yes	Yes 1/
Glenn Heights	Yes	No	Yes 1/
Grand Prairie	Yes	Yes	Yes 1/
Highland Park	Yes	Yes	Yes 1/
Hutchins	Yes	Yes	Yes
Irving	Yes	Yes	Yes
Kleberg	Yes	Yes	Yes
Lancaster	Yes	Yes	Yes
Mesquite	Yes	Yes	Yes 1/
Richardson	Yes	Yes	Yes 1/
Rowlett	Yes	Yes	Yes 1/
Sachse	Yes	Yes	Yes 1/
Seagoville	Yes	Yes	Yes 1/
Sunnyvale	Yes	Yes	Yes 1/
University Park	Yes	Yes	Yes 1/
Wilmer	Yes	Yes	Yes
Denton	Yes	Yes	No
Argyle	Yes	No	No
Aubrey	Yes	No	No
Bartonville	Yes	No	No
Copper Canyon	Yes	No	No
Corinth	Yes	Yes	No
Cross Roads	Yes	No	No
Denton	Yes	Yes	Yes 1/
Double Oak	Yes	No	No
Eastvale	Yes	No	No
Flower Mound	Yes	Yes	No
Hebron	Yes	No	No
Hickory Creek	Yes	No	No
Highland Village	Yes	Yes	No
Justin	Yes	No	No
Lake Dallas	Yes	Yes	No
Lewisville	Yes	Yes	No
Lincoln Park	No	No	No

1/ Study complete as of March 17, 1980.

County/City Designated by FEMA	Published Flood Hazard Boundary Map Available	Adopted Floodplain Management Program	Detailed Flood Insurance Rate Studies in Progress or Completed
DALLAS-FORT WORTH (cont'd)			
Denton (cont'd)			
Little Elm	Yes	No	No
Northlake	No	No	No
Roanoke	Yes	No	No
Sanger	Yes	Yes	No
Shady Shores	Yes	Yes	No
Ellis	Yes	Yes	No
Alma	Yes	No	No
Bardwell	Yes	No	No
Ennis	Yes	Yes	No
Ferris	Yes	Yes	No
Garrett	No	No	No
Maypearl	Yes	No	No
Midlothian	Yes	No	No
Ovilla	Yes	Yes	Yes 1/
Palmer	Yes	No	No
Waxahachie	Yes	Yes	Yes
Hood	Yes	Yes	No
Granbury	Yes	Yes	No
Lipan	Yes	No	No
Tolar	Yes	No	No
Johnson	Yes	No	No
Alvarado	Yes	Yes	No
Briar Oaks	Yes	No	No
Burleson	Yes	Yes	Yes
Cleburne	Yes	Yes	Yes 1/
Godley	Yes	No	No
Joshua	Yes	No	No
Keene	Yes	No	No
Rio Vista	No	No	No
Kaufman	No	No	No
Combine	Yes	No	No
Crandell	Yes	No	No
Forney	Yes	Yes	No
Kaufman	Yes	Yes	No
Kemp	Yes	No	Yes
Mabank	Yes	Yes	No
Oak Grove	Yes	No	No
Oak Ridge	Yes	No	No
Terrell	Yes	Yes	Yes

1/ Study complete as of March 17, 1980.

County/City Designated by FEMA	Published Flood Hazard Boundary Map Available	Adopted Floodplain Management Program	Detailed Flood Insurance Rate Studies in Progress or Completed
DALLAS-FORT WORTH (cont'd)			
Parker	Yes	Yes	No
Reno	Yes	No	No
Sanctuary	Yes	No	No
Springtown	Yes	Yes	No
Weatherford	Yes	Yes	No
Willow Park	Yes	Yes	No
Rockwall	Yes	No	Yes
Fate	Yes	No	No
Heath	Yes	Yes	Yes 1/
McLendon-Chisholm	Yes	No	No
Royse City	Yes	Yes	Yes
Rockwall	Yes	Yes	Yes
Tarrant	Yes	Yes	Yes
Arlington	Yes	Yes	Yes
Azle	Yes	Yes	No
Bedford	Yes	Yes	Yes 1/
Benbrook	Yes	Yes	Yes 1/
Blue Mound	Yes	Yes	Yes
Briar	Yes	No	No
Colleyville	Yes	Yes	Yes
Crowley	Yes	Yes	Yes
Dalworthington Gardens	Yes	Yes	Yes
Edgecliff	Yes	Yes	No
Euless	Yes	Yes	No
Everman	Yes	Yes	Yes
Forest Hill	Yes	Yes	Yes 1/
Fort Worth	Yes	Yes	Yes
Grapevine	Yes	Yes	Yes
Haltom City	Yes	Yes	Yes 1/
Haslet	Yes	No	No
Hurst	Yes	Yes	Yes
Keller	Yes	Yes	Yes
Kennedale	Yes	Yes	No
Lake Worth	Yes	No	No
Lakeside	No	Yes	No
Mansfield	Yes	Yes	No
North Richland Hills	Yes	Yes	Yes
Pantego	Yes	Yes	Yes
Richland Hills	Yes	Yes	Yes 1/
River Oaks	Yes	Yes	No

1/ Study complete as of March 17, 1980.

FLOODPLAIN MANAGEMENT PROGRAM

County/City Designated by FEMA	Published Flood Hazard Boundary Map Available	Adopted Floodplain Management Program	Detailed Flood Insurance Rate Studies in Progress or Completed
DALLAS-FORT WORTH (cont'd)			
Tarrant (cont'd)			
Saginaw	Yes	Yes	Yes
Sansom Park Village	Yes	No	No
Southlake	Yes	Yes	Yes
Watauga	Yes	Yes	Yes
Westlake	Yes	No	No
Westover Hills	Yes	Yes	No
Westworth Village	Yes	Yes	No
White Settlement	Yes	Yes	No
Wise	Yes	No	No
Auroro	Yes	No	No
Boyd	Yes	Yes	No
Bridgeport	Yes	Yes	No
Chico	Yes	No	No
Decatur	Yes	Yes	No
Rhome	No	No	No
EL PASO SMSA			
El Paso	Yes	Yes	No
Anthony	Yes	Yes	No
Clint	Yes	Yes	No
El Paso	Yes	Yes	Yes
La Isla	No	No	No
Vinton	Yes	No	No
GALVESTON-TEXAS CITY SMSA			
Galveston	Yes	Yes	Yes
Clear Lake Shores	Yes	Yes	Yes[1/]
Crystal Beach	Yes	Yes	Yes[1/]
Dickinson	No	No	Yes[1/]
Friendswood	Yes	Yes	Yes[1/]
Galveston	Yes	Yes	Yes[1/]
Hitchcock	Yes	Yes	Yes
Jamaica Beach	Yes	Yes	Yes
Kemah	Yes	Yes	Yes
La Marque	Yes	Yes	Yes
League City	Yes	Yes	Yes
Santa Fe	Yes	No	Yes
Texas City	Yes	Yes	Yes

1/ Study complete as of March 17, 1980.

FLOODPLAIN MANAGEMENT PROGRAM

County/City Designated by FEMA	Published Flood Hazard Boundary Map Available	Adopted Floodplain Management Program	Detailed Flood Insurance Rate Studies in Progress or Completed
	HOUSTON SMSA		
Brazoria	Yes	Yes	Yes[1/]
Alvin	Yes	Yes	Yes[1/]
Angleton	Yes	Yes	Yes
Bailey's Prairie	Yes	No	Yes
Bonney	Yes	Yes	Yes
Brazoria	Yes	Yes	Yes
Brookside Village	Yes	Yes	Yes[1/]
Clute	Yes	Yes	Yes[1/]
Danbury	Yes	Yes	Yes
Freeport	Yes	Yes	Yes[1/]
Hillcrest Village	Yes	Yes	Yes[1/]
Iowa Colony	Yes	Yes	Yes
Jones Creek	Yes	Yes	Yes
Lake Jackson	Yes	Yes	Yes
Liverpool	Yes	Yes	Yes
Mawel	Yes	Yes	Yes
Oyster Creek	Yes	Yes	Yes
Pearland	Yes	Yes	Yes
Quintana	Yes	Yes	Yes[1/]
Richwood	Yes	Yes	Yes[1/]
Surfside Beach	Yes	Yes	Yes
Sweeny	Yes	Yes	Yes
West Columbia	Yes	Yes	Yes
Fort Bend	Yes	No	Yes
Ft. Bend Co. LID #2	No	Yes	Yes
Ft. Bend Co. MUD #2	Yes	Yes	Yes
Fulsher	No	No	Yes
Katy	Yes	Yes	Yes
Kendleton	Yes	No	No
Missouri City	Yes	Yes	Yes
Needville	No	No	No
Pecan Grove MUD #1	Yes	Yes	Yes
Richmond	Yes	Yes	Yes
Rosenberg	Yes	Yes	Yes
Stafford	No	Yes	Yes
Sugar Land	Yes	Yes	Yes
Harris	Yes	Yes	Yes
Baytown	Yes	Yes	Yes
Bellaire	Yes	Yes	Yes
Bunker Hill Village	Yes	Yes	Yes

1/ Study complete as of March 17, 1980.

FLOODPLAIN MANAGEMENT PROGRAM

County/City Designated by FEMA	Published Flood Hazard Boundary Map Available	Adopted Floodplain Management Program	Detailed Flood Insurance Rate Studies in Progress or Completed
HOUSTON (cont'd)			
Harris (cont'd)			
Deer Park	Yes	Yes	Yes
El Lago	Yes	Yes	Yes
Galena Park	Yes	Yes	Yes
Hedwig Village	No	Yes	No
Hilshire Village	No	Yes	No
Houston	Yes	Yes	Yes
Humble	Yes	Yes	Yes
Hunters Creek Village	Yes	Yes	Yes
Jacinto City	Yes	Yes	Yes
Jesey Village	Yes	Yes	Yes
La Porte	Yes	Yes	Yes
Lomax	Yes	Yes	Yes
Morgans Point	Yes	Yes	Yes
Nassau Bay	Yes	Yes	Yes
Pasadena	Yes	Yes	Yes
Piney Point Village	Yes	Yes	Yes
Seabrook	Yes	Yes	Yes
Shoreacres	Yes	Yes	Yes
South Houston	Yes	Yes	Yes
Southside Place	No	Yes	No
Spring Valley	Yes	Yes	Yes
Taylor Lake	Yes	Yes	Yes
Tomball	Yes	Yes	Yes
Webster	Yes	Yes	Yes[1/]
West University Place	No	Yes	No
Liberty	Yes	Yes	No
Cleveland	Yes	Yes	No
Daisetta	Yes	Yes	No
Dayton	Yes	Yes	No
Devers	Yes	No	No
Hardin	No	Yes	No
Kenefick	Yes	No	No
Liberty	Yes	Yes	No
North Cleveland	Yes	No	No
Plum Grove	Yes	Yes	No
Montgomery	Yes	Yes	Yes
Conroe	Yes	Yes	Yes

1/ Study complete as of March 17, 1980.

County/City Designated by FEMA	Published Flood Hazard Boundary Map Available	Adopted Floodplain Management Program	Detailed Flood Insurance Rate Studies in Progress or Completed
HOUSTON (cont'd)			
Montgomery (cont'd)			
Cut & Shoot	Yes	No	Yes
Magnolia	Yes	No	Yes
Montgomery	Yes	No	Yes
Oak Ridge North	No	Yes	Yes
Panorama Village	Yes	Yes	Yes
Patton Village	Yes	No	Yes
Roman Forest	No	Yes	Yes
Shenandoah	No	Yes	No
Splendora	Yes	No	Yes
Stagecoach	No	No	Yes
Willis	Yes	No	Yes
Woodbranch Village	Yes	Yes	Yes
Woodloch	Yes	Yes	Yes
Waller	Yes	Yes	Yes
Brookshire	Yes	Yes	Yes
Hempstead	Yes	No	Yes
Pattison	Yes	No	Yes
Waller	Yes	Yes	Yes 1/
	KILLEEN-TEMPLE SMSA		
Bell	Yes	Yes	Yes
Belton	Yes	Yes	Yes
Harker Heights	Yes	Yes	Yes
Holland	Yes	Yes	Yes
Killeen	Yes	Yes	Yes
Morgans Point Resort	Yes	No	Yes
Nolanville	Yes	Yes	Yes
Rogers	Yes	Yes	Yes
Temple	Yes	Yes	Yes
Troy	Yes	Yes	Yes
Coryell	Yes	Yes	Yes
Copperas Cove	Yes	Yes	Yes
Gatesville	Yes	Yes	Yes
Oglesby	Yes	No	Yes

1/ Study complete as of March 17, 1980

FLOODPLAIN MANAGEMENT PROGRAM

County/City Designated by FEMA	Published Flood Hazard Boundary Map Available	Adopted Floodplain Management Program	Detailed Flood Insurance Rate Studies in Progress or Completed
LAREDO SMSA			
Webb	Yes	No	No
Laredo	Yes	Yes	No
LONGVIEW SMSA			
Gregg	Yes	No	No
Clarksville	Yes	No	No
Easton	Yes	No	No
Gladewater	Yes	Yes	Yes
Kilgore	Yes	Yes	Yes
Longview	Yes	Yes	Yes[1/]
Warren City	Yes	No	No
White Oak	Yes	No	No
Harrison	Yes	No	No
Hallsville	Yes	No	No
Marshall	Yes	Yes	Yes
Scottsville	Yes	No	No
Uncertain	No	Yes	No
Waskom	Yes	No	No
LUBBOCK SMSA			
Lubbock	Yes	No	No
Idalou	Yes	Yes	No
Lubbock	Yes	Yes	No
New Deal	Yes	No	No
Slaton	Yes	Yes	No
Wolfforth	No	No	No
MCALLEN-PHARR-EDINBURG SMSA			
Hidalgo	Yes	Yes	Yes
Alamo	Yes	Yes	Yes
Donna	Yes	Yes	No
Edcouch	No	Yes	No
Edinburg	Yes	Yes	Yes
Elsa	No	Yes	No
Hidalgo	Yes	Yes	No
La Joya	Yes	Yes	Yes

1/ Study complete as of March 17, 1980

FLOODPLAIN MANAGEMENT PROGRAM

County/City Designated by FEMA	Published Flood Hazard Boundary Map Available	Adopted Floodplain Management Program	Detailed Flood Insurance Rate Studies in Progress or Completed
MCALLEN-PHARR-EDINBURG (cont'd)			
Hidalgo (cont'd)			
La Villa	Yes	Yes	Yes
McAllen	Yes	Yes	Yes
Mercedes	Yes	Yes	Yes
Mission	Yes	Yes	Yes
Pharr	Yes	Yes	Yes
San Juan	No	Yes	No
Weslaco	Yes	Yes	Yes
MIDLAND SMSA			
Midland	Yes	Yes	No
Midland	Yes	Yes	No
ODESSA SMSA			
Ector	Yes	No	No
Goldsmith	No	No	No
Odessa	Yes	No	No
SAN ANGELO SMSA			
Tom Green	Yes	Yes	No
San Angelo	Yes	Yes	Yes
SAN ANTONIO SMSA			
Bexar	Yes	Yes	Yes
Alamo Heights	Yes	Yes	Yes 1/
Balcones Heights	Yes	Yes	Yes 1/
Castle Hills	Yes	Yes	Yes
China Grove	Yes	Yes	Yes
Converse	Yes	Yes	Yes
Elmendorf	Yes	No	Yes
Grey Forest	Yes	Yes	Yes
Hill Country Village	Yes	No	No
Hollywood Park	Yes	Yes	Yes

1/ Study complete as of March 17, 1980

County/City Designated by FEMA	Published Flood Hazard Boundary Map Available	Adopted Floodplain Management Program	Detailed Flood Insurance Rate Studies in Progress or Completed
SAN ANTONIO (cont'd)			
Bexar (cont'd)			
Kirby	Yes	Yes	Yes[1/]
Leon Valley	Yes	Yes	Yes[1/]
Live Oak	Yes	Yes	Yes[1/]
San Antonio	Yes	Yes	Yes
Selma	Yes	Yes	Yes
Shavano Park	Yes	Yes	Yes
Somerset	Yes	No	No
Terrell Hills	Yes	Yes	Yes[1/]
Universal City	Yes	Yes	Yes[1/]
Windcrest	Yes	Yes	Yes[1/]
Comal	Yes	Yes	Yes[1/]
Garden Ridge	Yes	Yes	Yes[1/]
New Braunfels	Yes	Yes	Yes[1/]
Guadalupe	Yes	Yes	Yes[1/]
Cibolo	Yes	Yes	Yes
Marion	Yes	Yes	No
Schertz	Yes	Yes	Yes[1/]
Seguin	Yes	Yes	Yes[1/]
SHERMAN-DENISON SMSA			
Grayson	Yes	No	No
Bells	Yes	No	No
Collinsville	No	No	No
Denison	Yes	Yes	Yes
Dorchester	Yes	No	No
Gunter	Yes	No	No
Howe	Yes	No	No
Sadler	Yes	No	No
Sherman	Yes	Yes	Yes[1/]
Southmayd	Yes	No	No
Whitewright	Yes	No	No
TEXARKANA SMSA			
Bowie	Yes	No	No

1/ Study complete as of March 17, 1980

FLOODPLAIN MANAGEMENT PROGRAM

County/City Designated by FEMA	Published Flood Hazard Boundary Map Available	Adopted Floodplain Management Program	Detailed Flood Insurance Rate Studies in Progress or Completed
TEXARKANA (cont'd)			
Bowie (cont'd)			
Hooks	Yes	Yes	No
Leary	Yes	No	No
Maud	Yes	Yes	No
Nash	Yes	Yes	No
New Boston	Yes	Yes	No
Texarkana	Yes	Yes	Yes 1/
Wake Village	Yes	Yes	No
TYLER SMSA			
Smith	Yes	Yes	Yes
Bullard	Yes	Yes	No
Troup	Yes	Yes	No
Tyler	Yes	Yes	Yes
Whitehouse	Yes	Yes	No
Winoa	Yes	No	No
WACO SMSA			
McLennan	Yes	No	Yes 1/
Bellmead	Yes	Yes	Yes 1/
Beverly Hills	Yes	Yes	Yes 1/
Bruceville-Eddy	Yes	No	Yes
Crawford	No	No	No
Gholson	Yes	No	No
Golinda	Yes	No	No
Hallsburg	Yes	No	No
Hewitt	Yes	Yes	Yes
Lacy-Lakeview	Yes	Yes	Yes 1/
Leroy	Yes	No	Yes 1/
Lorena	Yes	No	Yes 1/
Mart	Yes	Yes	Yes 1/
McGregor	Yes	Yes	Yes 1/
Moody	Yes	No	No
Northcrest	Yes	Yes	No
Riesel	Yes	No	No
Robinson	Yes	Yes	Yes 1/

1/ Study complete as of March 17, 1980

FLOODPLAIN MANAGEMENT PROGRAM

County/City Designated by FEMA	Published Flood Hazard Boundary Map Available	Adopted Floodplain Management Program	Detailed Flood Insurance Rate Studies in Progress or Completed
WACO (cont'd)			
McLennan (cont'd)			
Ross	Yes	No	No
Waco	Yes	Yes	Yes[1/]
Woodway	Yes	Yes	Yes[1/]
WICHITA SMSA			
Clay	No	No	No
Henrietta	Yes	Yes	No
Petrolia	Yes	No	No
Wichita	Yes	No	Yes
Burkburnett	Yes	Yes	Yes
Iowa Park	Yes	Yes	Yes
Pleasant Valley	Yes	Yes	Yes[1/]
Wichita Falls	Yes	Yes	Yes[1/]

1/ Study complete as of March 17, 1980.