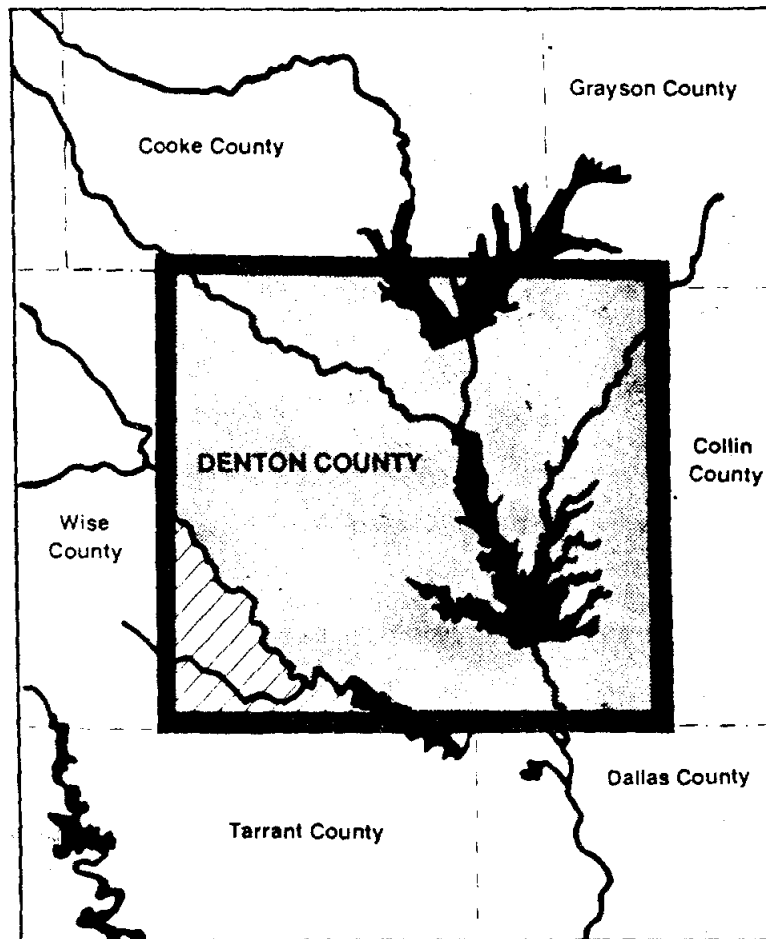


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# DENTON COUNTY WATER AND WASTEWATER STUDY REGIONAL MASTER PLAN FOR THE YEAR 2010



Prepared for:

**DENTON COUNTY  
COMMISSIONERS COURT  
AND PARTICIPATING AGENCIES**

Prepared by:



**ESPEY, HUSTON & ASSOCIATES, INC.**  
Engineering & Environmental Consultants

March 1988



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## EXECUTIVE SUMMARY

### DENTON COUNTY WATER AND WASTEWATER STUDY REGIONAL MASTER PLAN FOR YEAR 2010

In 1986, twenty-five agencies, including the County of Denton and the City of Dallas, joined together to document and plan for the future water and wastewater needs of the County. The project actually started several years earlier. Interest in a regional strategy to respond to continued growth began to gain momentum when construction started on Ray Roberts Lake. Most people are aware that three major water supply reservoirs (Grapevine, Lewisville and Ray Roberts) are located in Denton County. However, few people are aware that water rights from these reservoirs belong primarily to the City of Dallas. A more critical fact is that no regional entity has the responsibility to develop water supplies and deliver potable water to the various communities and utilities in Denton County.

The three major reservoirs in Denton County have an estimated dependable yield of 183.98 million gallons per day (MGD), of which the City of Denton holds rights to 24.06 MGD. The remaining rights belong to: Dallas, 150.71 MGD; City of Grapevine, 3.17 MGD and Park Cities MUD, 6.04 MGD. Within the study area (all of Denton County except for that portion south and west of Denton Creek), the estimated drought demand for water supply for the year 2010 is 137 MGD. The report that accompanies this summary documents the basis for the 137 MGD estimate and outlines alternative strategies for meeting the water needs of the Denton County area.

Naturally, one tends to assign a high priority to water supply. By contrast, one tends to assign a low priority to the need to plan for wastewater--especially in the rural areas and in the smaller communities. But, this plan addresses both water and wastewater needs. It addresses both with a conviction that an abundant water supply and an equally adequate wastewater system are necessary to sustain quality growth and to protect the environment.

The study was conducted under the general guidance of a 25-member Steering Committee consisting of one representative from each participating agency. The study began with seventeen entities; eight others joined during the study. The Texas Water Development Board participated and awarded a matching grant to help fund the project. The North Central Texas Council of Governments (NCTCOG) provided assistance and encouragement. The study was conducted and the master plan prepared by Espey, Huston & Associates, Inc. (EH&A); it was coordinated with the entities referenced above plus the Texas Water Commission and nearby regional utility agencies.

Specific findings and recommendations include the following:

1. Population for the study area was 139,986 in 1980 and is expected to increase at an average annual rate of 5.3%, achieving a population of 651,609 by the year 2010.
2. Of the 511,623 increase in population, 91% is expected to occur in towns and cities.
3. The present per capita use of water is approximately 153 gallons per day, but is expected to increase to 188 gallons per capita per day by the year 2010.

4. Total average daily water usage in 1986 was estimated to be 34.7 MGD.
5. By 2010, average water usage under normal conditions is projected to increase to 119 MGD.
6. A sustained drought would impose greater demands--estimated at 15% above normal. The 2010 demand under drought conditions is projected to be 137 MGD.
7. The Steering Committee and EH&A recommend that the regional system be planned and designed to provide an adequate supply of water during a drought equal to the drought of record (1950-1957).
8. Present per capita wastewater flows (including infiltration and inflow) were estimated to be 119 gallons per day. By 2010, wastewater flows are projected to increase to 131 gallons per capita per day.
9. Total average daily wastewater flow in 1986 was estimated to be 30 MGD and is projected to increase to 83 MGD by the year 2010.
10. Present usage of ground water in the study area is estimated to be 6 MGD; evidence of dropping water tables and estimated recharge rates indicate that the available dependable supply of ground water is being exceeded. Any increase in general water usage could pose a serious long-term problem. Therefore, new supplies to accommodate growth will need to be surface water supplies.
11. The Steering Committee and EH&A recommend that all water utilities convert to surface supplies as soon as feasible--and

specifically that the cities convert to surface water supplies no later than 2010; the limited supply of ground water would be reserved for peaking and back-up purposes and for use by those entities for whom conversion to surface supplies is not feasible, especially for small or remote rural systems.

12. Conservation of water is necessary but is not an alternative to development of new resources. The report recommends an aggressive water conservation program; a 15% saving is thought to be achievable without hardship.
13. The City of Dallas presently sells, under wholesale contracts, untreated and treated water to various Denton County cities. Dallas has expressed a willingness to assist Denton County in planning for future needs.
14. Based on present contractual commitments, it appears that approximately 90 MGD will be available from Dallas by 2010. Denton has rights to 24 MGD. An additional supply of 23 MGD is needed before 2010 to meet the total requirement of 137 MGD.
15. The report recommends that Denton County participate with others in the development of additional surface water supplies in East Texas and that planning for such supplies should begin within 5 years.



16. Alternative institutional strategies are available to manage the regional system needed in Denton County. The three most appropriate alternatives appear to be:
- o creation of a county-wide regional agency;
  - o wholesale contracts between cities, other public agencies and local utilities; and
  - o contracts with existing regional entities based outside Denton County.

It is expected that each of these three alternatives will be employed to some degree.

17. EH&A evaluated alternative infrastructure plans for responding to the projected needs of the participating entities. The recommended plan for water is referred to as the Tri-Regional Strategy, and projects the need for a new water plant in each of three areas. The service plan for the Tri-Regional Strategy is shown in Figure 6-1. By 2010, the estimated requirements are:
- o North Service Area - a 55 MGD plant near Ray Roberts Lake;
  - o East Service Area - a 23 MGD plant north of The Colony; and
  - o South Service Area - an 86 MGD plant west of Highland Village.
18. The cities of Lewisville and Denton operate water treatment plants of 12 MGD and 24 MGD, respectively. In addition to the new regional plants, it is expected that Lewisville will expand its plant to 18 MGD and Denton its plant to 30 MGD.

19. The recommended wastewater strategy is to treat the wastewater at new regional plants to high standards, and, to the extent environmentally feasible, return the treated effluent to local lakes for possible use as a future water supply resource. The alternative is to discharge the effluent downstream.
20. A new regional wastewater treatment plant is proposed in each of the North, Southeast and Southwest service areas. The service plan for wastewater is shown in Figure 7-1.
21. It is recommended that certain existing local wastewater treatment plants remain in service. Others could be abandoned when regional service is available.
22. Of special concern is the protection of the water supply reservoirs from potential sources of pollution including septic tanks and other point and non-point sources within the watersheds. A special program will be needed for each lake to protect water quality.
23. Projections of growth and demand indicate that the regional system will be needed by 1990.
24. For the water system, estimates of the basic cost (not including engineering, financing, rights-of-way and contingencies) are:

o	1990	\$45 million
o	2000	89 million
o	2010	<u>67 million</u>
	Total	\$201 million

25. For the wastewater system, estimates of the basic cost (not including engineering, financing, rights-of-way and contingencies) are:

o	1990	\$29 million
o	2000	32 million
o	2010	<u>41 million</u>
	Total	\$102 million

General recommendations include the following:

- A. Designate the cities of Lewisville and Denton to act in partnership as the interim regional agency to proceed with planning and implementation pending creation of a permanent regional agency. To assure that planning and implementation are pursued effectively and forthrightly, an interim manager (part- or full-time) will be needed.
- B. Appoint a Blue Ribbon Implementation Committee to assist the Steering Committee with the task of informing the public, the cities, elected officials and the Legislature as to the water needs and strategy for Denton County's future.
- C. Obtain state approval of the county-wide master plan.
- D. City Councils of all participating cities should adopt resolutions of support for the plan. Boards of Directors for other participating agencies should do likewise.

- E. Draft proposed legislation for consideration of the Legislature in 1989 for creation of a regional utility agency for Denton County.
- F. Proceed with a sense of urgency to implement the plan. Any significant delays in implementing the regional plan could force individual entities to develop less cost-effective strategies.
- G. Participating agencies should continue to share in the cost of planning and implementing the system until a self-sufficient regional agency can be established. Potential for grants and loans should be explored.
- H. Commence coordination efforts with other major water supply entities for development of water supply strategies.
- I. Develop a detailed water conservation plan as a guideline for the regional agency and participating entities.
- J. Develop detailed plans for managing and financing the system.

This master plan is based on what EH&A and the Steering Committee are convinced are optimistic but reasonable projections of economic development and improvements in quality of life for Denton County communities. If the trends change, appropriate adjustments in the implementation schedule and plan are recommended. We recommend a complete review of the plan in 1990 and at 5-year intervals thereafter.

## 1.0 INTRODUCTION

In 1986 the communities in Denton County and the City of Dallas joined together in an effort to identify and plan for the water and wastewater needs of the County. As a part of that effort, the communities formed a Steering Committee including cities, other water supply entities and the County. In February, 1987, the Denton County Commissioners Court contracted with Espey, Huston & Associates, Inc. (EH&A) to conduct, with guidance from the Steering Committee, a comprehensive water and wastewater study for Denton County. The study began with seventeen entities represented on the Steering Committee, and during the course of the Study eight additional entities joined the project. A list of the participating entities is included in the Appendix. Each entity represented on the Steering Committee shared in the cost of the study and contributed to the work effort. The Texas Water Development Board also participated in the study and awarded a matching grant to help fund the Project.

### 1.1 PURPOSE

The purpose of the Study is to formulate a successful regional plan for the development of water and wastewater systems to serve the communities in the study area, shown in Figure 1-1, to the year 2010. Objectives for the plan are:

1. To provide an instrument that will guide the efficient and orderly development of water and wastewater facilities.
2. To present data and information that will eliminate the overlap of efforts in providing water and wastewater service.
3. To indicate the use of current water resources and the potential new sources to supply the water needs of Denton County.
4. To facilitate implementation of regional utility service.

During the course of the nine-month study, EH&A gave special attention to client participation and consensus building. During the initial phase of the project, interviews were conducted with each participating agency to gain insight on local conditions, growth trends and community goals. After data was collected and after initial projections were developed, review sessions were held with each interested participant. In addition to interviews, workshop meetings were held with the Steering Committee during each phase of the project. EH&A also coordinated with various agencies that had information or were potentially affected by the Study. These agencies included the Texas Water Commission, the Texas Water Development Board, the North Central Texas Council of Governments, the City of Dallas, Trinity River Authority, North Texas Municipal Water District, Tarrant County Water Control and Improvement District and the City of Fort Worth. From these meetings, coordination activities and other separate data-gathering efforts, the project team compiled the various data and developed a regional water and wastewater plan.

The Denton County Water and Wastewater Study and supporting data is presented in eight sections and an appendix. Section 1.0 provides an introduction to the study. Section 2.0 presents population projections and the resulting water demand and wastewater flow. Section 3.0 describes the existing systems and is followed by an analysis of the water resource alternatives in Section 4.0. Section 5.0 contains an evaluation of institutional alternatives. Various service options for both water and wastewater facilities are discussed in Sections 6.0 and 7.0, respectively. Finally, Section 8.0 suggests a work program for implementation of the regional utility system.

The major conclusions that can be drawn from the planning effort are:

1. An urgent need exists for a regional water and wastewater service program.

2. Growth will continue and the difficulties of implementing a regional program will increase with time.
3. A reasonable response to the need has been developed; general strategies have been identified; both are presented in this report. However, this plan should be modified and revised, if necessary, to meet the changes in conditions that will occur in the future that cannot be foreseen at this time.

## 1.2 SCOPE OF WORK

In coordination with the Denton County Steering Committee, a scope of services was defined to study and develop a regional water and wastewater system. Included in the development of this regional plan were the following elements:

1. Analysis of previous studies with regard to population growth, water usage, and wastewater flow.
2. Population projections to the year 2010, using available NCTCOG data as a base.
3. Projecting per capita usage of water and per capita wastewater discharge.
4. Projection of anticipated normal and drought day water demands to the year 2010.
5. Projection of anticipated average day wastewater flow to the year 2010.
6. Determining the need for supplemental water resources.
7. Identification and evaluation of institutional alternatives.
8. Preparation of alternative infrastructure plans with implementation schedules and cost estimates.
9. Providing recommendations for financial and legal strategies for funding initial costs and annual operation and maintenance cost.

10. Providing estimates of potential customer rates for recommended alternatives.

A copy of the Scope of Services which outlines the detailed tasks involved in each phase of the project is included in the Appendix.

In summary, efforts have been made to develop a plan that will provide optimum utilization of all existing facilities and maximum coordination of planned facilities at the lowest possible cost.

### 1.3 STUDY AREA DESCRIPTION

#### 1.3.1 General Location and Physical Features

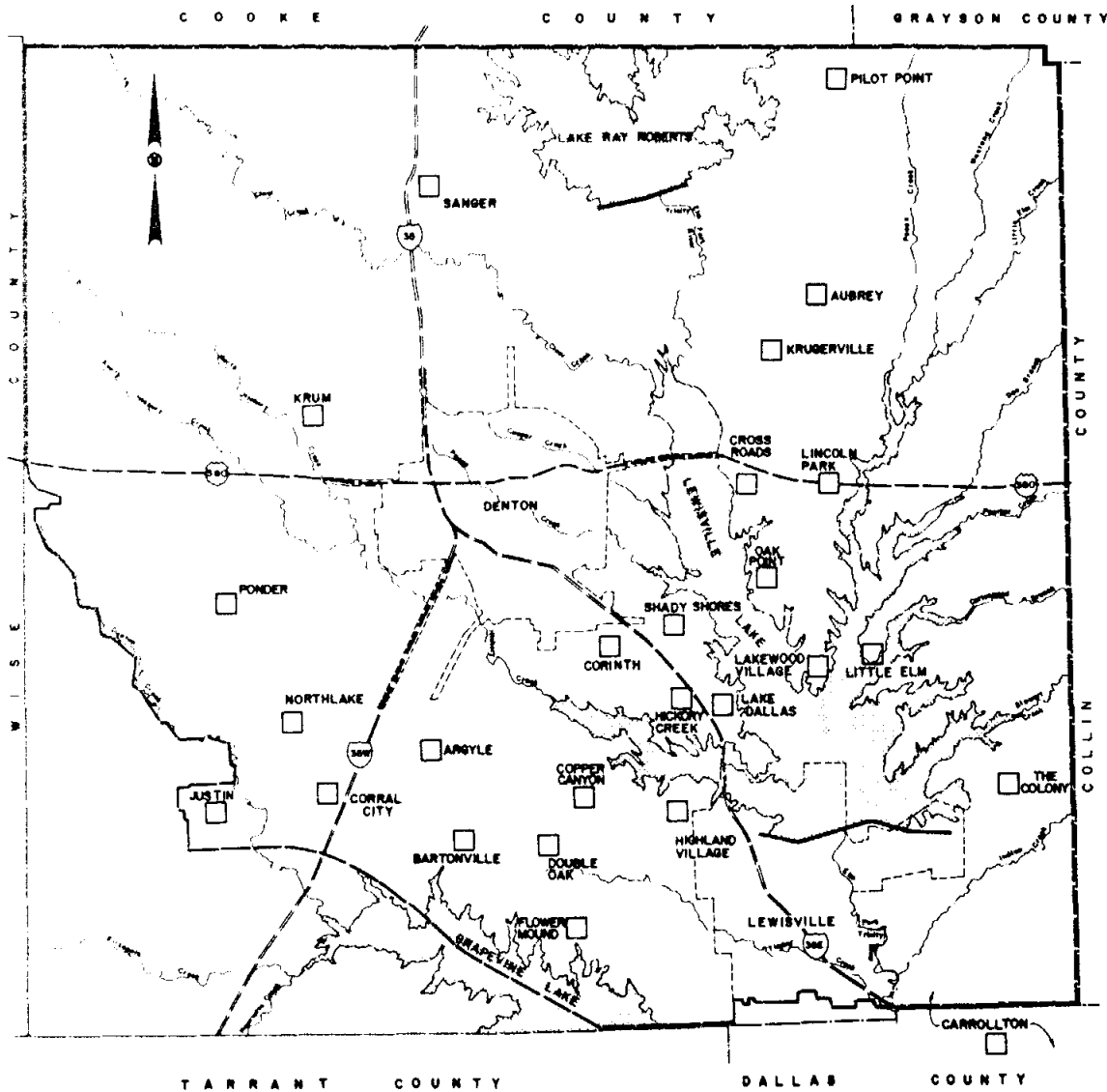
Figure 1-1 delineates the overall study area which encompasses approximately 806 square miles and includes 27 municipalities. The planning area is located in the Elm Fork of the Trinity River Basin. The geographic boundaries are defined by the Denton County Line with the exception of the area south and southwest of Denton Creek.

The major physical features in the study area are the three reservoirs: Grapevine Lake, Lake Lewisville and Lake Ray Roberts. The area is dissected by the Elm Fork of the Trinity River and its tributaries.

#### 1.3.2 Roadway Networks

Denton County is currently served by a network of highways and roadways including Interstate Highways, U.S. Highways, State Highways, Farm-to-Market roadways, County roadways and city streets. The major highways and roadways in the study area include I-35, I-35E, I-35W, U.S. 380, U.S. 377, U.S. 77, S.H. 121, S.H. 114, S.H. 387, S.H. 288, and 27 farm-to-market highways.





**LEGEND**

- MUNICIPALITY
- SERVICE AREA BOUNDARY

**eh** ESPEY, HUSTON & ASSOCIATES, INC.  
 ENGINEERING & ENVIRONMENTAL CONSULTANTS

DENTON COUNTY WATER &  
 WASTEWATER STUDY  
 STUDY AREA  
 FIGURE 1-1

## 2.0 PLANNING FOR SERVICE NEEDS

### 2.1 GENERAL PLANNING METHODOLOGY

Population, per capita water usage and per capita wastewater flow are the basic components used in determining the future water demand and wastewater flow. These flows are then used to identify facility requirements that will meet the needs of the planning area for the design year. The planning horizon for this project was set at 2010, with projections at the milestone years of 1990, 1995, 2000 and 2005. In this study, water demand projections were determined for both normal weather and drought weather conditions.

### 2.2 DATA GATHERING AND EVALUATION

The necessary first step in a study of this nature is a preliminary assessment of existing and projected service needs. In order to properly accomplish a preliminary assessment and build a foundation for the entire study, reliable and accurate data and basic information must be gathered and evaluated.

#### 2.2.1 Data Sources

Data pertaining to population, demand projections, existing facilities, planned facilities, land use plans, and community concerns were collected from a variety of sources including questionnaires; water, wastewater, and other related studies; one-on-one interviews; and government agencies including the North Central Texas Council of Governments, the Dallas Water Utilities Department, and the Texas Department of Water Resources.

Within Denton County, EH&A identified approximately 80 agencies that hold permits from the State or who render water or wastewater utility service.

Most are private utilities or non-profit corporations. Early in the study, questionnaires were prepared and distributed to these eighty agencies. The questionnaires requested information pertaining to population, water usage, wastewater flow, existing facilities and planned construction. Thirty-four questionnaires were returned, including all the participating entities.

Numerous reports which include vital information concerning population, demand projections and other background information pertaining to this study were reviewed. A list of these documents is included in the Appendix.

Individual interviews were conducted with each agency participating in the study. From these interviews, information was collected on current and anticipated growth, specific developments, system adequacy, service area policies and institutional preferences. These interviews were valuable in understanding the goals and needs of each participating entity. A brief synopsis of the responses from these individual interviews is included in the Appendix.

#### 2.2.2 Coordination With Nearby Agencies

The Engineer met with all major water supply and wastewater treatment agencies on the boundary of the study area. All were very interested in the planning effort and in coordinating their plans with those of Denton County. Following are summaries of those discussions.

- o North Texas Municipal Water District (NTMWD). NTMWD is interested in coordinating with Denton County to determine the best approach for providing water and wastewater services along common boundaries. Would be willing to consider the feasibility of a regional water treatment plant to serve all or a portion of the area east of Lake Lewisville and west of the City of McKinney. Expressed general agreement with the concept of introducing

water from Cooper Reservoir into Denton County and in return receive an equal amount of water from the east side of the Dallas system near Sunnyvale.

- o Trinity River Authority (TRA). Is proceeding with feasibility studies for providing wholesale wastewater services to the south side of Grapevine Lake. Is willing to plan for service to the southwest corner of Denton County if cities in the area express such desire. Also willing to cooperate with other entities in Denton County for water and wastewater service--especially to provide for adequate wastewater service in the southern portion of the County. TRA had already planned to provide for wastewater needs in Carrollton northward to Indian Creek.
  
- o Tarrant County Water Control and Improvement District (TCWCID). Because the southwest corner of Denton County has a significant community of interest with Fort Worth and Tarrant County, TCWCID appears willing to plan for a raw water supply.
  
- o City of Fort Worth. Is developing plans to serve a portion of the southwest corner of the county (especially south of Highway 114) with treated water. In addition, they expect that Fort Worth's interest will increase and extend to Denton Creek as development in the area materializes.
  
- o City of Dallas. Several discussions with representatives of Dallas Water Utilities (DWU) indicate they continue to have a strong commitment to the water supply needs of the study area. Will honor existing contracts and willing to assist in planning for additional needs. They prefer to provide raw water services rather than expand their treated water system further into Denton County. They

expect that wastewater effluent discharged into water supplies will need to be treated to high standards to assure protection of the critical water supplies previously developed in Denton County. Like NTMWD, DWU expressed general agreement with the three-way exchange concept for water from Cooper Reservoir.

## 2.3 DEVELOPMENT OF POPULATION PROJECTIONS

Anticipated population growth is the basis for planning future water and wastewater systems. Specific future needs to be addressed include: water supply, water treatment, water distribution, wastewater collection and wastewater treatment. Various existing sources of regional and local information were explored for the Denton County plan, including input from representatives of study participants. Steering Committee members adopted estimates of future populations for planning purposes--not only for participating entities, but also for the entire study area.

### 2.3.1 Population Data Sources

EH&A and the study participants contractually agreed to use regional population projections published by the North Central Texas Council of Governments (NCTCOG) as the initial basis for utility planning. Concurrent with this study, however, NCTCOG personnel were in the process of revising earlier forecasts (published in 1984); the results of these updated projections were not available for EH&A to incorporate into the water and wastewater plan. Thus, EH&A planners examined other available data sources--both regional and local--and evaluated existing NCTCOG data for appropriate inclusion in planning activities. This section discusses the primary data sources.

### 2.3.1.1 Regional Sources

#### NCTCOG

EH&A examined the 1984 population projections produced by NCTCOG, as well as subsequent documents to determine their adequacy for the Denton County plan. Several problems with using the 1984 projections were apparent:

- (1) No population projections were available for the northern portion of the county.
- (2) At the city level, there were discrepancies between NCTCOG's estimate of 1980 population and actual population (derived from U.S. Census reports).
- (3) The NCTCOG had published population estimates for 1985 and 1986 which were a more recent (and likely more accurate) indication of population growth. These were frequently different from the 1984 projections and suggested that revisions to the earlier projections were necessary.

Nevertheless, it was determined that NCTCOG projections had useful qualities. NCTCOG had performed estimates of 1980 population and projections of future population for small subareas of the county for the regional transportation plan. Population estimates for these small areas--"traffic survey zones" (TSZ's)--gave an indication not only of the magnitude of population growth but of the expected distribution of that growth, particularly in the rural areas. Thus, it was determined that NCTCOG's traffic survey zone projections would be an appropriate basis for distributing regional growth, particularly in rural areas.

Another important source of information from NCTCOG was the regional transportation study which indicated the general alignments of major highway improvements. EH&A used this information and other data to make general

assumptions about the rate and timing of growth for cities in those transportation corridors.

#### U.S. Bureau of the Census

EH&A used the 1980 Census of Population and Housing and 1984 estimates of population for several purposes:

- (1) To establish actual historical population trends;
- (2) As one indicator of intercensal (1984) population;
- (3) To describe the socioeconomic characteristics of various areas of the county, as they might relate to utility use (e.g., household size, size of institutional population, etc.); and
- (4) To determine the proportion of the population utilizing centralized versus individual water/sewer systems.

#### Texas Water Development Board

The Texas Water Development Board (TWDB) prepared high and low population projections for larger communities and for counties for use in the state water plan. These 1983 projections have recently been revised at the county level (Wright, 1987) to reflect recent Census estimates.

#### 2.3.1.2 Local Sources

##### Local Planning and Engineering Studies

Many of the participating cities and service providers have conducted utility planning studies which have included population projections. The results and methodological approach of each of these was examined for reasonableness and insight into local development and growth patterns.

## Participant Surveys and Interviews

In addition to collecting regionally-based sources of projections, EH&A also coordinated closely with local officials to solicit insight into local growth patterns, known development activity, future industrial locations, expected land use patterns, etc. Each participant provided locally-derived population projections in a survey of participants and, in follow-up interviews, responded to projections presented by EH&A staff.

### 2.3.2 Evaluation of Various Approaches

Although there were variations from one community to another, some general patterns emerged for the study area.

- (1) Regionally-based forecasts were typically lower than locally-derived projections.
- (2) State projections (both low- and high-range) were the lowest.
- (3) Projections by NCTCOG were higher than state projections and lower than local projections. In general, NCTCOG projections have somewhat underestimated recent population; nevertheless, preliminary updated (1987) projections seem to indicate a slower rate of growth than projected earlier. Also, these preliminary updates reflect different distribution of population growth (with relatively more growth in the vicinity of Denton and immediately to the south and southwest).
- (4) Projections by the cities and their consultants tend to be the highest. This may occur because cities have better knowledge of local conditions, or conversely, because each city fails to take into account competitive regional forces and thus overestimates its own growth relative to others.



- (5) While 1980 census figures were used by all parties, the 1984 Estimates of Population by the U.S. Bureau of the Census are of questionable reliability, primarily because they indicate that the two largest cities in the county (Denton and Lewisville) are losing population.

### 2.3.3 Technical Approach

#### 2.3.3.1 Urban Population

Given the data discussed above, EH&A prepared population projections for planning purposes based on the following:

- (a) The 1980 Census figures were adopted.
- (b) The 1986 population estimates were derived from City estimates, where available; otherwise, NCTCOG estimates were used.
- (c) Planning population was projected based on general development trends and transportation improvements revealed in local surveys and interviews. These projections were generally somewhat lower than city-derived forecasts to compensate for the possible over-estimation discussed above.
- (d) The planning populations were reviewed with participants and the Steering Committee as a group and requested adjustments were made.

#### 2.3.3.2 Rural Population

Rural population projections were derived from the NCTCOG 1984 projections through a series of adjustments made to accommodate more recent NCTCOG population data. These projections were reviewed by participants which serve rural portions of the study area.

#### 2.3.4 Adopted Planning Population

##### 2.3.4.1 Alternative Population Projections

Table 2-1 and Figures 2-1 and 2-2 show three alternative population projections for the study area. As discussed above, projections made by the cities and their consultants are considerably higher than those derived from NCTCOG. The NCTCOG-derived projections shown in the figures are based on 1984 published projections which have been adjusted for more recently published population estimates. The EH&A projections proposed for planning purposes fall between City- and NCTCOG-based figures, but lie closer to City projections. Although the EH&A projections were utilized for the plan formulation, it was determined that the range of population forecasts shown in these figures represented a reasonable broad range of possible future populations; thus any sensitivity analysis of the feasibility of regional utility system in Denton County would examine the possibility of growth at the City-estimated rate and the NCTCOG-derived rate as a reasonable range of possible growth.

##### 2.3.4.2 Plan Population

Table 2-2 shows the population projections adopted by the Steering Committee for planning purposes. The projections indicate a growth pattern from the south and southeast portions of the county toward Denton. This can be explained by the continued expansion of the Metroplex population into Denton County, which will be facilitated by roadway improvements in the southern portion of the county and immediately to the east of the Collin County line. The northern portions of the county are also expected to grow, although at a slower rate; this northern growth is expected to be encouraged by the recreational and economic attraction of Lake Ray Roberts as it fills.

Both urban and rural areas are expected to experience continued growth, with slightly faster growth rates for incorporated cities than for rural areas. Similar to the geographic distribution of urban growth, rural growth is expected to be highest in the southeast and southwest portions of the study area (5.0% and 9.0% annual growth respectively), with slower growth in the northeast (3.0%) and northwest (2.0%). As shown in Figures 2-1 and 2-2, overall growth is expected to increase once roadway improvements are completed in the early 1990's, with steady growth thereafter. Throughout the study period, however, growth rates for most areas are quite high, representing considerable challenges for communities to provide utility and other services in pace with demand.

## 2.4 PROJECTIONS FOR WATER DEMAND AND WASTEWATER FLOW

Formulation of a successful regional plan for development of water and wastewater systems can be achieved only if reasonable estimates of future requirements are made. The population forecasts presented in the previous section provide the basis for determining a reasonable estimate of water and wastewater requirements.

### 2.4.1 Water Demand

Increased water demand due to growth in the communities of Denton County has created the need for commensurate development of adequate water supplies. The scheduling of improvements to water supply, treatment and distribution systems is dictated by the demands of the users. Because of the time required for construction, increasing demands must be anticipated and improvement made in advance to avoid a shortage of water.

This study provides estimates of average and peak day water demands under scenarios of normal and drought weather conditions from 1986 to 2010. The information used to make the estimates included historical water demand,

interviews with participants in this study, and prior engineering and planning studies concerning the study area.

Estimates of water demand are based on the population forecasts presented in the preceding section, per capita consumption, peaking factors and drought factors. The resulting water use projections are discussed in the following paragraphs.

#### 2.4.1.1 Gallons Per Capita Per Day Water Usage

Per capita use (gpcd) factors and population projections provide the foundation for determining average daily demand. Rather than use a county-wide gpcd factor for water demand, it was determined that a gpcd factor should be identified and utilized for each entity, i.e., communities, water supply corporations, and rural areas. This determination was reached due to the wide diversity between the water users in the County, considering the differences in domestic uses, commercial uses, irrigation, industrial use, and water loss factors.

To determine representative gpcd factors, each entity was requested to provide historical and projected water use information on the questionnaire form distributed in the early stages of the project. Additional data was collected during the first round of interviews with each entity. Additional data was gathered from engineering reports provided by the entities and other sources. Historical trend data for cities that have experienced growth patterns similar to those anticipated for some Denton County cities was examined and compared to trend patterns projected for the Denton County cities.

All the data gathered was closely reviewed and evaluated and per capita usage projections were made. Per capita usage projections were distributed, each entity receiving projections specific to the entity. After a review period, a second round of interviews was conducted with interested entities. Appropriate

adjustments were made to the projections. They were presented to and adopted by the Steering Committee as a whole in the meeting of April 22, 1987. A summary table of the per capita use factors adopted by the Steering Committee is presented in Tables 2-3 and 2-4.

The per capita factors adopted by the Steering Committee are used for the balance of the study. There is a wide variation of gallons per capita per day (gpcd) levels among the cities and water purveyors. This reflects the special nature of each community. As mentioned above, considerations in developing per capita use factors include historical patterns, domestic uses, irrigation, commercial use, industrial use and water loss factors. The per capita data also indicates a gradual increase over the 25-year planning period as economic development occurs and as the standard of living increases in Denton County.

#### 2.4.1.2 Projected Average Day Water Demand

The basic methodology for estimating average daily demand is by multiplying area population and gallons per capita per day factors. Table 2-5 summarizes the average water demand projections for the cities within the study area under normal and drought weather conditions. These projections were based on the adopted population projections (Table 2-2) and adopted per capita use factors (Table 2-3). The normal demand for the study area for 1986 is 34.7 MGD and is projected to increase to 119.1 MGD by 2010.

Table 2-6 summarizes the average daily water demand projections for the special water supply agencies (not cities) participating in this study. These agencies provide service to certain cities and to rural areas within Denton County.

Drought weather is defined to be a period of high temperatures and low rainfall. Experience in the region suggests that drought weather conditions would create an impact of 15 to 20% over demands under normal weather conditions. For

purposes of this study, the Steering Committee adopted the drought water demand strategy that allows for a 15% drought impact factor. The adopted strategy is included in the Appendix. In accordance with this strategy, the average demands under drought conditions were estimated by increasing the average demands under normal weather by 15 percent. Under drought weather the 1986 and 2010 demands are estimated to be 39.9 MGD and 137.0 MGD, respectively. The average daily water demand under drought weather conditions for the cities within the study area and water supply agencies participating in this study are presented in Tables 2-7 and 2-8, respectively.

#### 2.4.1.3 Peak Day Water Demand

Peak demands are estimated by multiplying the average day demand by an appropriate "Peak Factor". This factor represents the ratio of peak day demand to average day demand and has been determined to be 2.10. This factor was determined on the basis of an analysis of water demand information provided in the questionnaire. The peak day water demand for cities within the study area and water supply agencies participating in this study are presented in Tables 2-9 and 2-10, respectively. The demands shown in these tables are based on average daily demands under normal weather conditions as estimated in Tables 2-5 and 2-6.

#### 2.4.1.4 Alternative Water Demand Projections

Although EH&A projections were utilized for the plan formulation, alternative projections were made for the study area. The projected water demands shown in Table 2-11 are based on alternative population projections in Table 2-1, where City, EH&A and derived-NCTCOG correspond to high, medium and low, respectively.

#### 2.4.1.5 Water Conservation

Population and economic growth invariably lead to increased demands for water resources and for investment capital needed to develop the resource for use. With growth also come opportunities to significantly reduce those demands through conservation strategies specifically aimed at new residential and commercial development. These opportunities arise from the ability to incorporate improved water use efficiency into the planning, design and construction of the new development. In addition to conservation strategies aimed at new development, other programs to improve water use efficiency include:

- o the adoption of utility rate programs that reflect the true cost of water and that promote conservation;
- o a continuing customer information program that informs citizens of the need for and how to conserve water;
- o implementation of a strategy for gradual replacement of wasteful water fixtures through a retrofitting program; and
- o load management techniques, including rules on outside watering.

For the Denton County Plan, all of these techniques are applicable. They will be more fully considered for implementation once there is a regional agency with proper authority.

The potential benefits of water conservation are substantial. Reduced water use and wastewater flows resulting from conservation measures can potentially reduce utility costs by allowing for more optimal sizing of water and wastewater facilities and by favorably impacting the timing and sizing of future facility expansions.

During the course of this study, a strategy for water conservation was presented to the Steering Committee. It stated that each water utility should have

flexibility in development and implementation of its own conservation program. In addition, it was determined that a reasonable and achievable goal for conservation would be a 15% reduction in demand by 1995. This 15% reduction would decrease average daily demand in the study area by approximately 10 MGD in 1995 and 18 MGD in 2010. On the following page is the adopted conservation resolution.

The Texas Water Development Board has promulgated financial assistance rules which specify water conservation planning requirements. The nine principal water conservation methods to be examined and considered in preparing a water conservation plan that will meet the Board's regulations are as follows:

1. Education and information;
2. Plumbing codes or ordinances for water-conserving devices in new construction;
3. Retrofit programs to improve water-use efficiency in existing buildings;
4. Conservation-oriented water rate structure;
5. Universal metering and meter repair and replacement;
6. Water conserving landscaping;
7. Leak detection and repair;
8. Recycling and reuse; and
9. Means of implementation and enforcement.

Each of these methods appears to have merit for the circumstances in Denton County. In particular, the cornerstone of the wastewater master plan is recycling--to recycle treated effluent through the local lakes for reuse in Denton County. These water conservation methods are more fully described in the Appendix.

Due to the potential benefits resulting from conservation measures, it is recommended in Section 8.0 under Conditions of Service that the regional system



ADOPTED STRATEGY  
FOR  
WATER CONSERVATION

Whether the cities should plan for water conservation has been an issue in the past. But, it is no longer an issue. Conservation is a necessity. On the other hand, it is not an alternative to development and acquisition of an adequate water supply. Planning for future water supply needs and promoting conservation of the supply go together.

For Denton County cities and water supply entities, it appears that a reasonable and achievable goal for conservation would be a 15% reduction in demands. Programs to achieve the reduction can include:

- o The adoption of utility rate programs that reflect the true cost of water and that promotes conservation.
- o A continuing customer information program that informs citizens of the need for and how to conserve water.
- o Adoption of city ordinances that require the installation of water conserving fixtures in new homes and businesses as part of the plumbing code.
- o Implementation of a strategy for gradual replacement of wasteful water fixtures through a retrofitting program.
- o Load management techniques, including rules on outside watering.
- o Other techniques applicable to local circumstances.

Each water utility agency should have flexibility in the development and implementation of its own program.

For the purposes of this planning study, it appears prudent to expect that conservation efforts are already underway or will begin soon. The schedule for achieving the entire 15% reduction could be short or long, depending on the urgency and the desires of the parties. For planning purposes, a 1995 target date appears reasonable for achieving the goal.

Recommended by:

Espey, Huston & Associates, Inc.  
April 29, 1987

Accepted by Project Steering Committee  
April 29, 1987

require all customer entities to adopt water conservation programs. In addition, the regional entity will assist in promoting conservation, develop conservation guidelines, and maintain example plans and ordinances. The regional agency will also maintain model drought contingency plans.

An effective conservation program is a high priority objective of this plan. It is the intention of the regional system to practice water conservation, thereby reducing water demand. The goal is to achieve an overall 15% reduction. This reduction should produce substantial economic benefits to the participating agencies and delay plant improvements otherwise required.

Another condition of service is expected to be that entities requiring wholesale service will support their request with engineering and economic studies concerning need. These master plans should consider the impact conservation has on water use and make appropriate adjustments to projections. In addition, projections will also be investigated and adjusted during the design phase, thus possibly reducing the size of water and wastewater facilities.

#### 2.4.2 Wastewater Flow

As the water consumption in Denton County increases, there is a corresponding increase in wastewater flow. The scheduling of improvements to wastewater treatment and collection systems is dictated by the wastewater flow. Because of the time required for construction, increasing flow must be anticipated and improvements made in advance.

This study forecasts average wastewater flow from 1986 to 2010. The information upon which these projections are based include historical wastewater flow, interviews with participants in this study, and prior engineering and planning studies concerning the study area.

#### 2.4.2.1 Gallons Per Capita Per Day Wastewater Flow

Estimates of wastewater flow are based on population forecasts presented in Section 2.3 of this report and per capita flow. The product of per capita flow and population results in a forecast of average daily flow for any service area. The gpcd flows used in this study are based on information obtained from questionnaires, from previous engineering reports, from interviews and from analysis. A process similar in scope and intensity to that followed in determining per capita water usage was followed in order to determine per capita wastewater flow.

A summary of the per capita flows used in this study is presented in Tables 2-12 and 2-13. The special nature of each community is reflected in the wide variation of gallons per capita per day (gpcd) flows. Considerations in developing per capita factors include historical patterns, age and condition of each community system and the mix of the customer base. The flow rates include residential, commercial and industrial contributions and allowances for infiltration and inflow. The calculated flow is the estimated amount to be received at the end of the pipe, at the treatment plant.

The per capita flow figures presented in Tables 2-12 and 2-13 were presented to and adopted by the Steering Committee in the meeting of April 22, 1987.

#### 2.4.2.2 Projected Average Daily Wastewater Flow

The basic methodology for estimating average daily demand is by multiplying area population and gallons per capita per day factors. Table 2-14 summarizes the average daily amount of wastewater expected to be generated by the cities within the study area. Table 2-15 summarizes the average daily wastewater flow for other agencies participating in this study. It is recognized that some of the wastewater generated will be treated and disposed of through septic tank

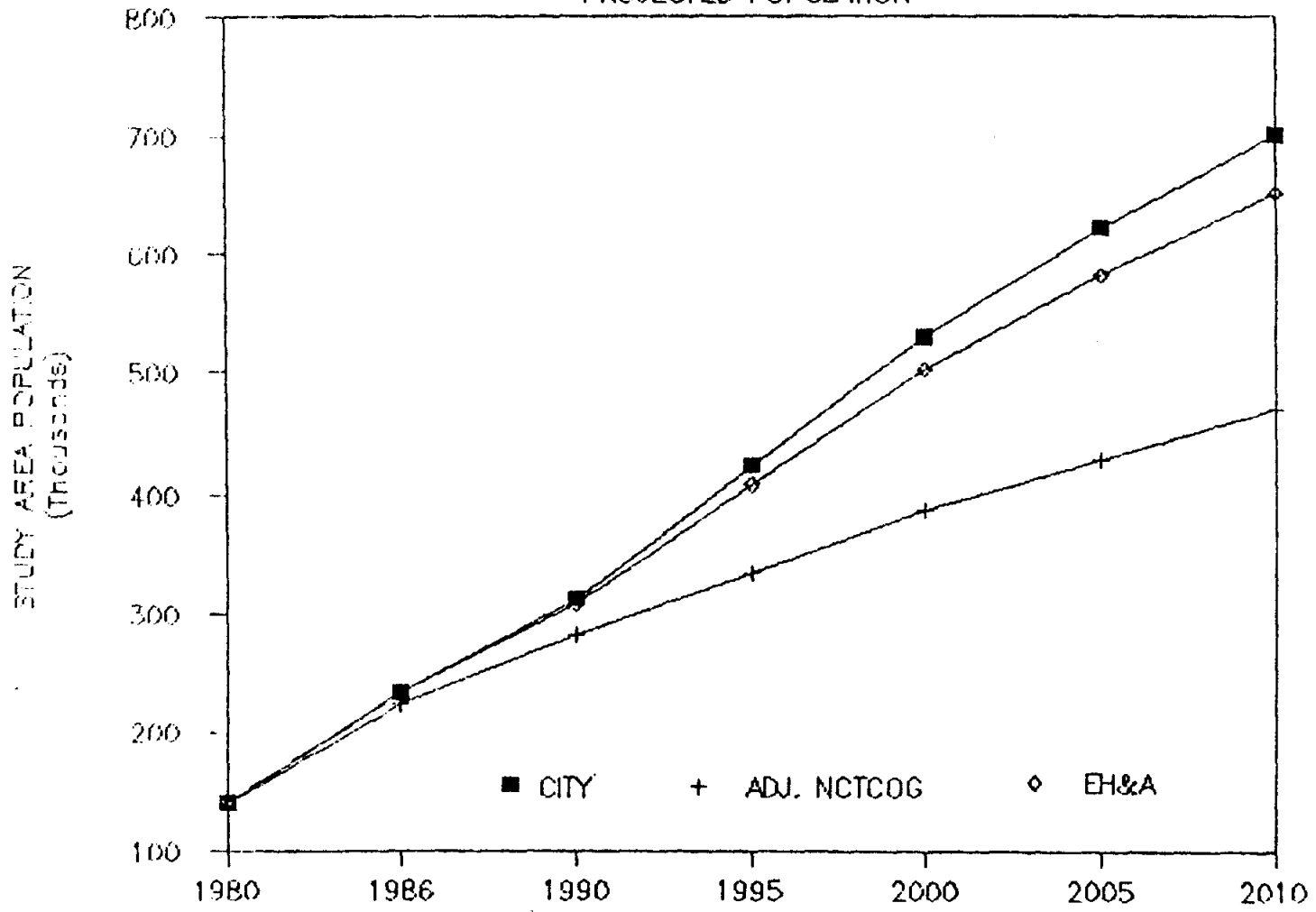
systems. Therefore, the total flows indicated will not be received at a treatment plant. Later discussion will determine those flows for which treatment capacity will need to be planned. The flow for the study area in 1986 is 26.9 MGD and is projected to increase to 83.1 MGD by 2010.

#### 2.4.2.3 Alternative Wastewater Flow Projections

Although EH&A projections were utilized for the plan formulation, alternative projections were made for the study area. The projected wastewater flows shown in Table 2-16 are based on alternative population projections in Table 2-1, where City, EH&A and derived-NCTCOG correspond to high, medium and low, respectively.

# DENTON COUNTY REGIONAL STUDY AREA

## PROJECTED POPULATION



2-20

FIGURE 2-1

# DENTON COUNTY REGIONAL STUDY AREA

## PROJECTED POPULATION GROWTH RATES

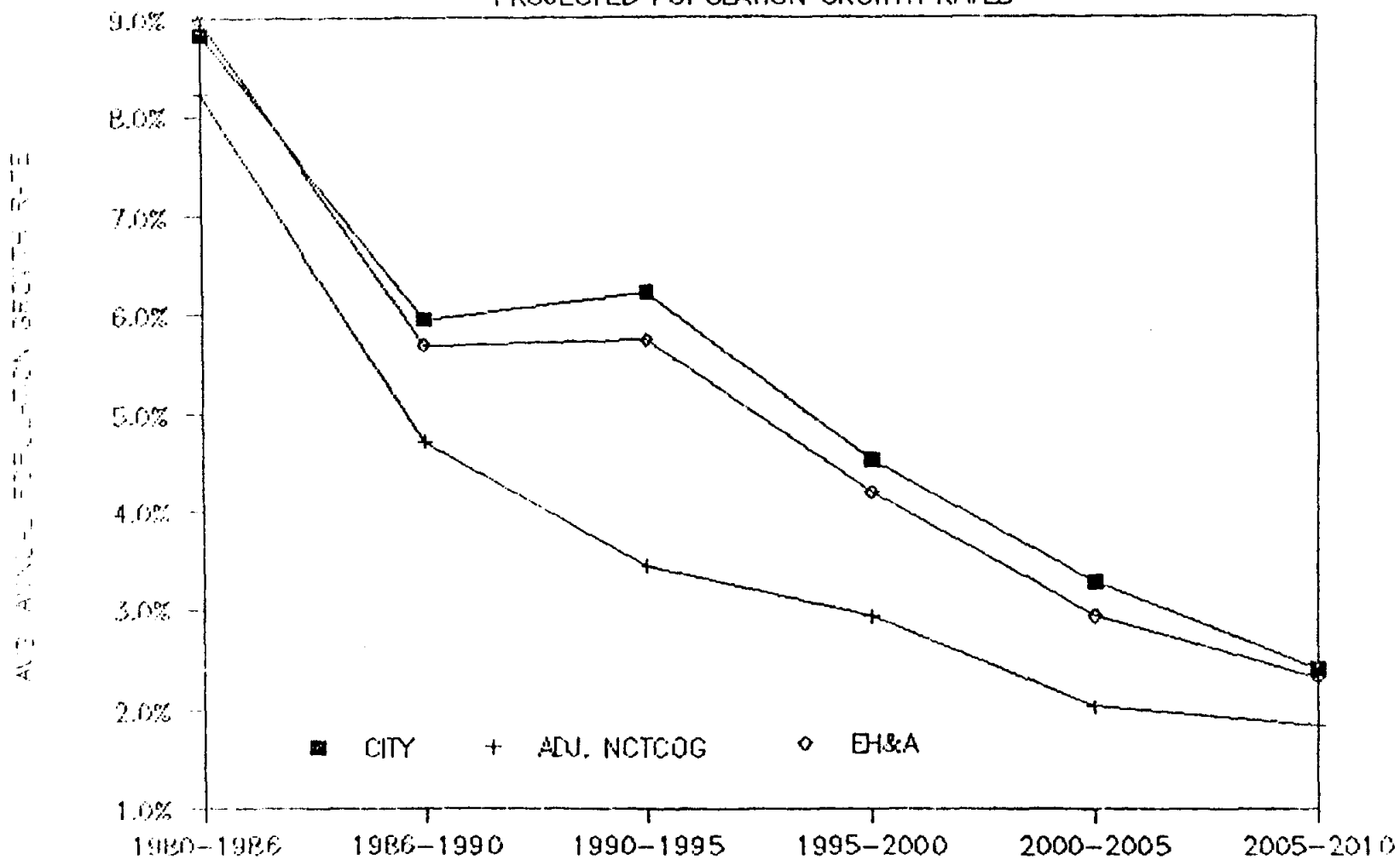


FIGURE 2-2

TABLE 2-1

ALTERNATIVE POPULATION PROJECTIONS FOR  
THE DENTON COUNTY REGIONAL STUDY AREA

	1986	1990	1995	2000	2005	2010
Total Study Area						
City (High)*	234,800	313,520	424,012	529,133	621,757	700,378
EH&A (Medium)	234,529	309,448	409,168	502,530	580,716	651,609
Derived-NCTCOG (Low)**	224,953	283,249	335,431	387,612	428,717	469,826

\* Where City projections were not provided, EH&A projections were used.

\*\* Projections shown for NCTCOG are derived from projections published in 1984 for traffic survey zones and have been adjusted to reflect actual 1980 Census figures, NCTCOG estimates for 1986 urban population and NCTCOG 1987 projections for rural areas. They do not reflect updated urban population projections currently under revision by NCTCOG staff.

TABLE 2-2  
ADOPTED PLANNING POPULATIONS

City/Area	1980	1986	1990	1995	2000	2005	2010	1980-2010	
								Increase	Average Annual Change
Argyle	1,111	1,781	2,248	3,304	4,421	5,379	6,236	5,125	5.9%
Aubrey	948	1,300	1,550	1,886	2,295	2,725	3,160	2,212	4.1
Bartonville	441	805	1,095	1,764	2,592	3,468	4,220	3,779	7.8
Carrollton (Denton Co. Only)	13,742	29,934	40,725	57,119	72,900	88,694	102,820	89,078	6.9
Copper Canyon	465	888	1,397	2,355	3,460	4,630	5,633	5,168	8.7
Corinth	1,264	3,500	6,604	10,635	15,626	20,912	25,442	24,178	10.5
Corral City	85	108	122	134	141	148	156	71	2.0
Cross Roads	302	380	445	541	658	801	974	672	4.0
Dallas (Denton Co. Only)	101	4,973	7,743	8,410	9,076	9,583	10,091	9,990	16.6
Denton	48,063	64,053	74,933	88,997	103,172	116,729	128,879	80,816	3.3
Double Oak	836	1,600	2,137	2,727	3,085	3,324	3,670	2,834	5.1
Eastvale <sup>1</sup>	503	545	0	0	0	0	0	-503	NA
Flower Mound	4,402	14,000	22,029	38,823	51,954	63,210	71,516	67,114	9.7
Frisco (Denton Co. Only)	85	77	150	298	447	560	672	587	7.1
Hackberry	81	268	532	607	682	739	796	715	7.9
Hebron	385	111	35	0	0	0	0	-385	NA
Hickory Creek	1,422	2,379	3,483	5,118	6,849	9,165	12,265	10,843	7.4
Highland Village	3,246	6,500	9,691	14,239	18,173	20,065	21,088	17,842	6.4

2-23



TABLE 2-2 (Cont'd)

City/Area	1980	1986	1990	1995	2000	2005	2010	1980-2010	
								Increase	Average Annual Change
Justin	920	1,100	1,399	1,858	2,487	3,488	4,892	3,972	5.7
Krugerville	469	701	836	1,067	1,298	1,579	1,921	1,452	4.8
Krum	917	1,250	1,407	1,592	1,801	2,038	2,362	1,445	3.2
Lake Dallas	3,177	4,178	4,348	4,569	4,685	4,803	4,924	1,747	1.5
Lakewood Village	165	197	222	270	328	380	420	255	3.2
Lewisville	24,273	37,500	51,970	76,361	97,458	107,601	115,917	91,644	5.3
Lincoln Park	39	450	464	569	696	843	1,022	983	11.5
Little Elm	926	1,150	1,345	1,560	1,898	2,309	2,946	2,020	3.9
Northlake	143	169	198	258	330	382	433	290	3.8
Oak Point	387	853	1,037	1,231	1,360	1,501	1,657	1,270	5.0
Pilot Point	2,211	2,550	2,926	3,824	4,881	5,939	6,884	4,673	3.9
Plano (Denton Co. Only)	2	5	6	95	184	252	319	317	18.4
Ponder	297	350	402	454	514	582	642	345	2.6
Sanger	2,574	3,929	5,150	7,056	9,006	11,494	14,669	12,095	6.0
Shady Shores	813	1,219	1,426	1,653	1,825	1,918	2,016	1,203	3.1
The Colony <sup>1</sup>	11,586	19,500	22,560	25,577	28,662	31,695	34,993	23,407	3.8
<b>Rural Areas:</b>									
Northwest	4,726	5,625	6,523	7,208	7,894	8,414	8,934	4,208	2.1
Southwest	1,974	10,875	19,776	21,832	23,888	25,456	27,023	25,049	9.1
Southeast	3,445	5,622	7,798	9,581	11,364	12,719	14,075	10,630	4.8
Northeast	3,460	4,104	4,747	5,595	6,443	7,191	7,940	4,480	2.8

TABLE 2-2 (Concluded)

City/Area	1980	1986	1990	1995	2000	2005	2010	1980-2010	
								Increase	Average Annual Change
<b>Total Study Area</b>									
Urban	126,381	208,303	270,604	364,952	452,941	526,935	593,637	467,256	5.3
Rural	13,605	26,226	38,844	44,216	49,589	53,780	57,972	44,367	4.0
Total	139,986	234,529	309,448	409,168	502,530	580,715	651,609	511,623	5.3

<sup>1</sup> When this study began, separate projections were made for Eastvale and The Colony because Eastvale had not yet been incorporated into The Colony. However, Eastvale was incorporated into The Colony on August 11, 1987 and projections were combined. Projections for The Colony include projections previously estimated for Eastvale.

TABLE 2-3  
ADOPTED PER CAPITA WATER CONSUMPTION  
(GPCD)  
CITIES AND RURAL AREAS

Organization	1986	1990	1995	2000	2005	2010
Argyle	110	115	121	127	134	140
Aubrey	98	104	107	109	110	111
Bartonville	150	204	240	266	286	300
Carrollton	185	193	198	200	200	200
Copper Canyon	150	195	218	235	245	250
Corinth	117	140	163	185	195	200
Corral City	110	113	116	119	122	125
Cross Roads	110	113	116	119	122	125
Denton	155	165	172	176	179	180
Double Oak	150	195	218	235	245	250
Eastvale <sup>1</sup>	110	-	-	-	-	-
Flower Mound	133	140	150	160	170	181
Hebron	110	113	116	119	122	125
Hickory Creek	92	114	126	133	138	140
Highland Village	150	208	250	275	275	275
Justin	104	106	112	118	124	130
Krugerville	110	113	116	119	122	125
Krum	110	113	116	119	122	125
Lake Dallas	92	100	105	108	109	110
Lakewood Village	110	113	116	119	122	125
Lewisville	186	200	209	216	221	225
Lincoln Park	110	113	116	120	122	125
Little Elm	110	113	116	119	122	125

TABLE 2-3 (Cont'd)

Organization	1986	1990	1995	2000	2005	2010
Northlake	110	113	116	119	122	125
Oak Point	110	113	116	119	122	125
Pilot Point	110	113	116	119	122	125
Ponder	110	113	116	119	122	125
Sanger	115	126	136	142	147	150
Shady Shores	92	100	105	108	109	110
The Colony <sup>1</sup>	125	129	133	137	141	145
Other Cities & Towns	110	113	116	119	122	125
Rural Areas	110	110	110	110	110	110
Weighted Average	152.90	166.31	175.35	182.08	185.66	188.10

<sup>1</sup> When this study began, separate projections were made for Eastvale and The Colony because Eastvale had not yet been incorporated into The Colony. However, Eastvale was incorporated into The Colony on August 11, 1987 and projections were combined. The per capita projections previously made for The Colony are assumed to apply to what was formerly Eastvale. However, recognizing the probable accuracy of the estimates, no revision was made in the total projected demand.

TABLE 2-4  
ADOPTED PER CAPITA WATER CONSUMPTION  
(GPCD)  
SPECIAL PARTICIPATING AGENCIES

Organization	1986	1990	1995	2000	2005	2010
Bartonville Water Supply	145	147	218	238	251	258
Blackrock Water Supply	110	110	110	110	110	110
Bolivar Water Supply	80	90	100	110	110	110
Lake Cities Municipal Utility Authority	92	104	111	115	118	119
Mustang Water Supply	88	96	101	105	108	110
T.S.W. Water Company	110	110	110	110	110	110
Wren Water Supply	90	97	102	106	109	110

TABLE 2-5  
AVERAGE DAILY WATER DEMAND  
(GPD)  
CITIES AND RURAL AREAS

Organization	1986	1990	1995	2000	2005	2010
Argyle	195,910	258,574	399,753	561,486	720,787	873,004
Aubrey	127,400	161,229	201,818	250,132	299,803	350,714
Bartonville	120,750	223,419	423,317	689,374	991,901	1,265,874
Carrollton	5,537,790	7,859,901	11,309,512	14,579,920	17,738,703	20,564,018
Copper Canyon	133,200	272,471	513,282	812,993	1,134,264	1,408,169
Corinth	409,500	924,499	1,733,523	2,890,896	4,077,788	5,088,464
Corral City	11,880	13,736	15,568	17,785	18,086	19,476
Cross Roads	41,800	50,234	62,740	78,306	97,674	121,757
Denton	9,928,215	12,363,937	15,307,456	18,158,224	20,894,552	23,198,152
Double Oak	240,000	416,666	594,507	725,083	814,359	917,468
Eastvale <sup>1</sup>	59,950	0	0	0	0	0
Flower Mound	1,862,000	3,084,098	5,823,465	8,312,651	10,745,712	12,944,467
Hebron	12,210	3,969	0	0	0	0
Hickory Creek	218,868	397,073	644,844	910,888	1,264,800	1,717,117
Highland Village	975,000	2,015,700	3,559,764	4,997,588	5,517,741	5,799,201
Justin	114,400	147,205	208,144	293,465	432,529	635,998
Krugerville	77,110	94,463	123,762	154,470	192,674	240,182
Krum	137,500	158,978	184,644	214,311	248,586	295,266
Lake Dallas	384,376	434,764	479,789	505,958	523,538	541,682
Lakewood Village	21,670	25,055	31,292	39,057	46,419	52,510
Lewisville	6,975,000	10,393,940	15,959,353	21,050,831	23,779,823	26,081,291
Lincoln Park	49,500	52,432	66,004	83,520	102,846	127,750
Little Elm	126,500	152,023	180,915	225,804	281,651	368,305
Northlake	18,590	22,341	29,974	39,244	46,642	54,068
Oak Point	93,830	117,161	142,845	161,792	183,134	207,167
Pilot Point	280,500	330,638	443,584	580,839	724,558	860,500
Ponder	38,500	45,385	52,712	61,181	70,965	80,278
Sanger	451,835	648,915	959,631	1,278,792	1,689,567	2,200,371
Shady Shores	112,148	142,606	173,585	197,128	209,102	221,784
The Colony <sup>1</sup>	2,437,500	2,900,531	3,389,160	3,910,294	4,448,972	5,050,836
Other Cities & Towns	585,530	952,703	1,091,560	1,236,291	1,358,348	1,484,750
Rural Areas	2,884,860	4,272,840	4,863,760	5,454,790	5,915,800	6,376,920
Total for Study Area	34,663,822	48,937,485	68,970,262	88,472,092	104,571,322	119,147,540
Drought Demand	39,863,395	56,278,108	79,315,801	101,742,906	120,257,020	137,019,670

<sup>1</sup> When this study began, separate projections were made for Eastvale and The Colony because Eastvale had not yet been incorporated into The Colony. However, Eastvale was incorporated into The Colony on August 11, 1987 and projections for The Colony include projections previously estimated for Eastvale.

TABLE 2-6  
 AVERAGE DAILY WATER DEMAND<sup>1</sup> (GPD)  
 FOR THE DENTON COUNTY WATER AND WASTEWATER PLAN  
 SPECIAL PARTICIPATING AGENCIES

Organization	1986	1990	1995	2000	2005	2010
Bartonville Water Supply	560,570	809,823	1,692,334	2,397,612	3,105,874	3,736,872
Blackrock Water Supply	88,000	99,000	132,000	176,000	198,000	220,000
Bolivar Water Supply	293,280	376,650	483,400	603,240	674,630	746,020
Lake Cities Municipal Utility Authority	722,752	870,272	997,224	1,085,600	1,158,760	1,214,633
Mustang Water Supply	172,392	230,400	264,620	298,200	330,480	360,800
T.S.W. Water Company	89,100	104,940	124,850	144,760	164,560	184,470
Wren Water Supply	36,000	48,500	56,100	63,600	65,400	66,000
Total	1,962,094	2,539,585	3,750,528	4,769,012	5,697,704	6,528,795
Drought Demand	2,256,408	2,920,523	4,313,107	5,484,364	6,552,360	7,508,114

<sup>1</sup> Quantities shown in this table are also contained with the quantities noted in Table 2-5 for cities and rural areas.

TABLE 2-7

WATER DEMAND - DROUGHT WEATHER CONDITIONS (GPD)  
FOR CITIES AND RURAL AREAS

Organization	1986	1990	1995	2000	2005	2010
Argyle	225,296	297,360	459,716	645,709	828,905	1,003,955
Aubrey	146,510	185,413	232,090	287,651	344,774	403,321
Bartonville	138,863	256,932	486,814	792,780	1,140,687	1,455,755
Carrollton	6,368,458	9,038,886	13,005,938	16,766,909	20,399,508	23,648,621
Copper Canyon	153,180	313,341	590,275	934,941	1,304,404	1,619,394
Corinth	470,925	1,063,174	1,993,551	3,324,530	4,689,456	5,851,734
Corral City	13,662	15,796	17,903	19,303	20,799	22,398
Cross Roads	48,070	57,769	72,151	90,052	112,325	140,020
Denton	11,417,447	14,218,527	17,603,575	20,881,958	24,028,735	26,677,875
Double Oak	276,000	479,166	683,683	833,845	936,513	1,055,088
Eastvale <sup>1</sup>	68,943	0	0	0	0	0
Flower Mound	2,141,300	3,546,713	6,696,985	9,559,549	12,357,568	14,886,137
Hebron	14,041	4,564	0	0	0	0
Hickory Creek	251,698	456,634	741,570	1,047,521	1,454,519	1,974,685
Highland Village	1,121,250	2,318,055	4,093,729	5,747,226	6,345,402	6,669,081
Justin	131,560	169,286	239,365	377,485	497,409	731,398
Krugerville	88,677	108,632	142,326	177,640	221,575	276,209
Krum	158,125	182,825	212,341	246,458	285,874	339,556
Lake Dallas	442,032	499,979	551,757	581,852	602,068	622,934
Lakewood Village	24,920	28,813	35,986	44,915	53,382	60,387
Lewisville	8,021,250	11,953,031	18,353,256	24,208,456	27,346,797	29,993,484
Lincoln Park	56,925	60,297	75,905	96,048	118,273	146,913
Little Elm	145,475	174,827	208,053	259,674	323,898	423,550



TABLE 2-7 (Concluded)

Organization	1986	1990	1995	2000	2005	2010
Northlake	21,379	25,692	34,470	45,131	53,638	62,179
Oak Point	107,904	134,736	164,272	186,060	210,604	238,242
Pilot Point	322,575	380,234	510,122	667,965	833,242	989,575
Ponder	44,275	52,192	60,618	70,358	81,610	92,320
Sanger	519,610	746,252	1,103,575	1,470,611	1,943,002	2,530,427
Shady Shores	128,970	163,997	199,623	226,697	240,467	255,052
The Colony <sup>1</sup>	2,803,125	3,335,612	3,897,533	4,496,839	5,116,317	5,808,461
Other Cities and Towns	673,360	1,095,608	1,255,294	1,421,735	1,562,100	1,707,462
Rural Areas	<u>3,317,589</u>	<u>4,913,766</u>	<u>5,593,324</u>	<u>6,273,008</u>	<u>6,803,170</u>	<u>7,333,458</u>
Total for Study Area	39,863,395	56,278,108	79,315,801	101,742,906	120,257,020	137,019,670

<sup>1</sup> When this study began, separate projections were made for Eastvale and The Colony because Eastvale had not yet been incorporated into The Colony. However, Eastvale was incorporated into The Colony on August 11, 1987 and projections were combined. Projections for The Colony include projections previously estimated for Eastvale.

TABLE 2-8  
 AVERAGE DAILY WATER DEMAND<sup>1</sup> - DROUGHT WEATHER CONDITIONS(GPD)  
 SPECIAL PARTICIPATING AGENCIES

Organization	1986	1990	1995	2000	2005	2010
Bartonville Water Supply	644,656	931,296	1,946,184	2,757,254	3,571,755	4,297,403
Blackrock Water Supply	101,200	113,850	151,800	202,400	227,700	253,000
Bolivar Water Supply	337,272	433,147	555,910	693,726	775,824	857,923
Lake Cities Municipal Utility Authority	831,165	1,000,813	1,146,808	1,248,440	1,332,574	1,396,828
Mustang Water Supply	198,251	264,960	304,313	342,930	380,052	414,920
T.S.W. Water Company	102,465	120,681	143,578	166,474	189,244	212,140
Wren Water Supply	41,400	55,775	64,515	73,140	75,210	75,900
<b>Total for Study Area</b>	<b>2,256,408</b>	<b>2,920,523</b>	<b>4,313,107</b>	<b>5,484,364</b>	<b>6,552,360</b>	<b>7,508,114</b>

<sup>1</sup> Quantities shown in this table are also contained with the quantities noted in Table 2-7 for cities and rural areas.

TABLE 2-9  
PEAK DAY WATER DEMAND (GPD)  
CITIES AND RURAL AREAS

Organization	1986	1990	1995	2000	2005	2010
Argyle	411,411	543,006	839,481	1,179,121	1,513,653	1,833,309
Aubrey	267,540	338,580	423,817	525,276	629,587	736,499
Bartonville	253,575	469,181	888,965	1,447,685	2,082,993	2,658,335
Carrollton	11,629,359	16,505,792	23,749,975	30,617,833	37,251,275	43,184,438
Copper Canyon	279,720	572,188	1,077,893	1,707,284	2,381,954	2,957,155
Corinth	859,950	1,941,448	3,640,398	6,070,881	8,563,355	10,685,775
Corral City	24,948	28,845	32,693	35,249	37,981	40,900
Cross Roads	87,780	105,491	131,753	164,443	205,114	255,690
Denton	20,849,252	25,964,267	32,145,658	38,132,271	43,878,559	48,716,120
Double Oak	504,000	874,999	1,248,464	1,522,676	1,710,154	1,926,682
Eastvale <sup>1</sup>	125,895	0	0	0	0	0
Flower Mound	3,910,200	6,476,606	12,229,277	17,456,567	22,565,995	27,183,380
Hebron	25,641	8,334	0	0	0	0
Hickory Creek	459,623	833,853	1,354,172	1,912,865	2,656,079	3,605,946
Highland Village	2,047,500	4,232,969	7,475,505	10,494,934	11,587,256	12,178,322
Justin	240,240	309,130	437,102	616,277	908,311	1,335,596
Krugerville	161,931	198,372	259,900	324,386	404,615	504,381
Krum	288,750	333,854	387,753	450,053	522,031	620,058
Lake Dallas	807,190	913,005	1,007,556	1,062,513	1,099,429	1,137,532
Lakewood Village	45,507	52,615	65,714	82,019	97,480	110,272
Lewisville	14,647,500	21,827,275	33,514,642	44,206,745	49,937,629	54,770,711
Lincoln Park	103,950	110,107	138,608	175,392	215,977	268,275
Little Elm	265,650	319,249	379,922	474,188	591,466	773,440

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TABLE 2-9 (Concluded)

Organization	1986	1990	1995	2000	2005	2010
Northlake	39,039	46,916	62,945	82,413	97,948	113,544
Oak Point	197,043	246,039	299,975	339,762	384,582	435,051
Pilot Point	589,050	694,340	931,526	1,219,762	1,521,572	1,807,050
Ponder	80,850	95,308	110,695	128,480	149,028	168,584
Sanger	948,854	1,362,721	2,015,224	2,685,464	3,548,091	4,620,779
Shady Shores	235,511	299,472	364,529	413,968	439,113	465,747
The Colony <sup>1</sup>	5,118,750	6,091,117	7,117,234	8,211,618	9,342,839	10,606,756
Other Cities and Towns	1,229,613	2,000,676	2,292,276	2,596,211	2,852,531	3,117,975
Rural Areas	<u>6,058,206</u>	<u>8,972,964</u>	<u>10,213,896</u>	<u>11,455,059</u>	<u>12,423,180</u>	<u>13,391,532</u>
Total for Study Area	72,794,026	102,768,720	144,837,550	185,791,394	219,599,776	250,209,833

<sup>1</sup> When this study began, separate projections were made for Eastvale and The Colony because Eastvale had not yet been incorporated into The Colony. However, Eastvale was incorporated into The Colony on August 11, 1987 and projections were combined. Projections for The Colony include projections previously estimated for Eastvale.

TABLE 2-10  
PEAK DAY WATER DEMAND<sup>1</sup> (GPD)  
SPECIAL PARTICIPATING AGENCIES

Organization	1986	1990	1995	2000	2005	2010
Bartonville Water Supply	1,177,197	1,700,628	3,553,901	5,034,985	6,522,335	7,847,431
Blackrock Water Supply	184,800	207,900	277,200	369,600	415,800	462,000
Bolivar Water Supply	615,888	790,965	1,015,140	1,266,804	1,416,723	1,566,642
Lake Cities Municipal Utility Authority	1,517,779	1,827,571	2,094,170	2,279,760	2,433,396	2,550,729
Mustang Water Supply	362,023	483,840	555,702	626,220	694,008	757,680
T.S.W. Water Company	187,110	220,374	262,185	303,996	345,576	387,387
Wren Water Supply	<u>75,600</u>	<u>101,850</u>	<u>117,810</u>	<u>133,560</u>	<u>137,340</u>	<u>138,600</u>
<b>Total</b>	<b>4,120,397</b>	<b>5,333,129</b>	<b>7,876,109</b>	<b>10,014,925</b>	<b>11,965,178</b>	<b>13,710,470</b>

<sup>1</sup> Quantities shown in this table are also contained within the quantities noted in Table 2-9 for cities and rural areas.

TABLE 2-11  
ALTERNATIVE WATER DEMAND PROJECTIONS (MGD)

	1986	1990	1995	2000	2005	2010
<b>Average Daily Demand<sup>1</sup></b> (Normal Weather Conditions)						
High	38.18	54.57	78.73	102.65	123.41	141.15
Medium	34.66	48.94	68.97	88.47	104.57	119.15
Low	33.26	44.69	56.31	68.01	77.01	85.78
<b>Peak Day Demand<sup>2</sup></b> (Normal Weather Conditions)						
High	80.18	114.60	165.33	215.57	259.16	296.42
Medium	72.79	102.77	144.84	185.79	219.60	250.22
Low	69.85	93.85	118.25	142.82	161.72	180.14
<b>Average Daily Demand<sup>3</sup></b> (Drought Weather Conditions)						
High	43.91	62.76	90.54	118.05	141.92	162.32
Medium	39.86	56.28	79.32	101.74	120.26	137.02
Low	38.26	51.39	64.76	78.21	88.56	98.65
<b>Peak Day Demand<sup>4</sup></b> (Drought Weather Conditions)						
High	92.20	131.79	190.13	247.90	298.04	340.88
Medium	83.70	118.19	166.56	213.66	252.54	287.75
Low	80.32	107.93	135.99	164.24	185.98	207.16

<sup>1</sup> Average daily demands were computed by multiplying high, medium and low population estimates from Table 2-1 and the weighted average per capita water consumption from Table 2-3. In addition, per capita consumption was increased 10% for the high estimate.

<sup>2</sup> Peak day demand is estimated to be 2.1 times average day demand.

<sup>3</sup> Average daily demand under drought weather conditions is estimated to be 15% greater than average daily demands.

<sup>4</sup> Peak day demand under drought weather conditions is estimated to be 2.42 times average daily demand.

TABLE 2-12  
ADOPTED PER CAPITA WASTEWATER FLOW  
(GPCD)  
CITIES AND RURAL AREAS

Organization	1986	1990	1995	2000	2005	2010
Argyle	77	81	85	89	94	98
Aubrey	78	79	81	83	85	88
Bartonville	110	111	112	113	114	115
Carrollton	148	149	149	150	150	150
Copper Canyon	105	108	111	113	114	115
Corinth	82	96	111	124	129	130
Corral City	77	79	81	83	85	88
Cross Roads	77	79	81	83	85	88
Denton	135	136	137	138	139	140
Double Oak	105	108	111	113	114	115
Eastvale <sup>1</sup>	77	-	-	-	-	-
Flower Mound	95	100	105	110	115	120
Hebron	77	79	81	83	85	88
Hickory Creek	84	90	94	96	97	98
Highland Village	90	99	106	110	113	115
Justin	82	83	84	85	88	91
Krugerville	77	79	81	83	85	88
Krum	77	79	81	83	85	88
Lake Dallas	84	88	91	93	94	95
Lakewood Village	77	79	81	83	85	88
Lewisville	143	148	151	154	156	158
Lincoln Park	77	79	81	83	85	88
Little Elm	75	78	81	83	85	88

TABLE 2-12 (Concluded)

Organization	1986	1990	1995	2000	2005	2010
Northlake	77	79	81	83	85	88
Oak Point	77	79	81	83	85	88
Pilot Point	77	79	81	83	85	88
Ponder	77	79	81	83	85	88
Sanger	100	102	103	104	105	105
Shady Shores	84	85	86	87	88	88
The Colony <sup>1</sup>	75	84	93	96	99	102
Other Cities & Towns	77	79	81	83	85	88
Rural Areas	77	77	77	77	77	77
Weighted Average	118.81	123.38	126.06	128.47	130.00	131.26

<sup>1</sup> When this study began, separate projections were made for Eastvale and The Colony because Eastvale had not yet been incorporated into The Colony. However, Eastvale was incorporated into The Colony on August 11, 1987 and projections were combined. The per capita projections previously made for The Colony are assumed to apply to what was formerly Eastvale. However, recognizing the probable accuracy of the estimates, no revision was made in the total projected demand.



TABLE 2-13  
ADOPTED PER CAPITA WASTEWATER FLOW  
(GPCD)  
SPECIAL PARTICIPATING AGENCIES

Organization	1986	1990	1995	2000	2005	2010
Bartonville Water Supply	--	--	--	--	--	--
Blackrock Water Supply	--	--	--	--	--	--
Bolivar Water Supply	--	--	--	--	--	--
Lake Cities Municipal Utility Authority	84	88	91	92	93	94
Mustang Water Supply	--	--	--	--	--	--
T.S.W. Water Company	--	--	--	--	--	--
Wren Water Supply	--	--	--	--	--	--

TABLE 2-14  
AVERAGE DAILY WASTEWATER FLOW  
(GPD)  
CITIES AND RURAL AREAS

Organization	1986	1990	1995	2000	2005	2010
Argyle	137,137	182,126	280,818	393,483	505,627	611,103
Aubrey	101,400	122,472	152,778	190,467	231,666	278,043
Bartonville	88,550	121,566	197,548	292,854	395,373	485,252
Carrollton	4,430,232	6,068,007	8,510,693	10,934,940	13,304,027	15,423,014
Copper Canyon	93,240	150,907	261,350	390,928	527,780	647,758
Corinth	287,000	633,942	1,180,497	1,937,681	2,697,614	3,307,502
Corral City	8,316	9,603	10,871	11,707	12,601	13,711
Cross Roads	29,260	35,119	43,810	54,617	68,051	85,717
Denton	8,647,155	10,190,881	12,192,567	14,237,698	16,225,378	18,043,007
Double Oak	168,000	230,769	302,708	348,657	378,926	422,035
Eastvale <sup>1</sup>	41,965	0	0	0	0	0
Flower Mound	1,330,000	2,202,927	4,076,426	5,714,948	7,269,158	8,581,967
Hebron	8,547	2,775	0	0	0	0
Hickory Creek	199,836	313,478	481,074	657,483	889,026	1,201,982
Highland Village	585,000	959,395	1,509,340	1,999,035	2,267,290	2,425,120
Justin	90,200	115,264	156,108	211,395	306,956	445,199
Krugerville	53,977	66,040	86,420	107,739	134,240	169,088
Krum	96,250	111,144	128,933	149,477	173,195	207,867
Lake Dallas	350,952	382,593	415,817	435,686	451,491	467,816
Lakewood Village	15,169	17,516	21,851	27,241	32,341	36,967
Lewisville	5,362,500	7,691,516	11,530,442	15,008,463	16,785,758	18,314,862
Lincoln Park	34,650	36,656	46,089	57,768	71,655	89,936
Little Elm	86,250	104,936	126,329	157,493	196,232	259,286
Northlake	13,013	15,619	20,930	27,372	32,496	38,064
Oak Point	65,681	81,909	99,745	112,846	127,594	145,846
Pilot Point	196,350	231,154	309,744	405,123	504,815	605,792
Ponder	26,950	31,729	36,807	42,672	49,443	56,516
Sanger	392,900	525,312	726,779	936,580	1,206,834	1,540,260
Shady Shores	102,396	121,215	142,174	158,797	168,816	177,427
The Colony <sup>1</sup>	1,462,500	1,892,042	2,369,779	2,739,709	3,123,051	3,553,082
Other Cities & Towns	409,871	666,049	762,210	862,287	946,390	1,045,264
Rural Areas	2,019,402	2,990,988	3,404,632	3,818,353	4,141,060	4,463,844
<b>Total for Study Area</b>	<b>29,934,649</b>	<b>36,305,651</b>	<b>49,585,268</b>	<b>62,423,503</b>	<b>73,224,884</b>	<b>83,143,327</b>

<sup>1</sup> When this study began, separate projections were made for Eastvale and The Colony because Eastvale had not yet been incorporated into The Colony. However, Eastvale was incorporated into The Colony on August 11, 1987 and projections for The Colony include projections previously estimated for Eastvale.

TABLE 2-15  
 AVERAGE DAILY WASTEWATER FLOW<sup>1</sup>  
 (GPD)  
 SPECIAL PARTICIPATING AGENCIES

Organization	1986	1990	1995	2000	2005	2010
Bartonville Water Supply	--	--	--	--	--	--
Blackrock Water Supply	--	--	--	--	--	--
Bolivar Water Supply	--	--	--	--	--	--
Lake Cities Municipal Utility Authority	659,904	736,384	817,544	868,480	913,260	959,458
Mustang Water Supply	--	--	--	--	--	--
T.S.W. Water Company	--	--	--	--	--	--
Wren Water Supply	--	--	--	--	--	--

-- Indicates the agency does not operate a wastewater collection system.

<sup>1</sup> The quantities in this table are also contained within the quantities noted in Table 2-14 for cities and rural areas.

TABLE 2-16  
 ALTERNATIVE AVERAGE DAILY WASTEWATER  
 FLOW PROJECTIONS<sup>1</sup>  
 (MGD)

	1986	1990	1995	2000	2005	2010
High	34.89	40.49	56.60	93.31	112.19	128.32
Medium	31.69	36.30	49.58	62.42	73.22	83.14
Low	25.85	26.84	40.48	47.99	53.92	59.86

<sup>1</sup> Average daily flows were computed by multiplying high, medium and low population estimates from Table 2-1 and the weighted average per capita flow from Table 2-12. In addition, per capita flow was increased 10% for the high estimate.

### 3.0 ANALYSIS OF EXISTING SYSTEMS

#### 3.1 INVENTORY OF WATER AND WASTEWATER FACILITIES

An essential element of a regional plan is the inventory of existing and planned facilities. A discussion of such facilities for each participating agency follows. In addition, a summary of the participating agencies is presented in Table 3-1.

##### 3.1.1 Water Facilities

The existing water facilities within the study area include two water treatment plants, raw water pump stations, intake structures, municipal and private water distribution systems, City of Dallas transmission mains, and numerous wells. The two water treatment plants are operated by the cities of Denton and Lewisville.

A summary of existing and planned facilities for the participating agencies is presented below. This information was obtained from questionnaires, interviews and engineering reports.

City of Argyle. The City of Argyle does not operate a water system; Argyle Water Supply Corporation and Argyle Water Company provide the City with water service. This system is inadequate for peak demand periods. Current plans include a contract to purchase water from the City of Denton.

City of Aubrey. The City of Aubrey operates its own water system. Their present system consists of two wells with total capacity of 0.31 MGD and two ground storage tanks. The City of Aubrey is committed to construct an additional well and a 100,000-gallon elevated storage tank.

Town of Bartonville. The Town of Bartonville does not operate a water system; Bartonville Water Supply Corporation and Argyle Water Supply Corporation provide Bartonville with water service.

Bartonville Water Supply Corporation. Bartonville Water Supply Corporation provides retail water service to Bartonville, Copper Canyon, Double Oak, parts of Flower Mound, parts of Highland Village and some unincorporated areas of Denton County. Bartonville Water Supply's present system consists of nine wells with a total capacity of 1.96 MGD and twelve ground storage tanks with a total capacity of 1.16 million gallons. Planned facilities include additional ground storage, elevated storage and new wells.

Black Rock Water Supply Corporation. Black Rock Water Supply Corporation provides retail water service to rural areas in the vicinity of Aubrey. Their present system consists of two wells with a total capacity of 73,000 gallons per day. Black Rock has no plans for expansion at this time.

Bolivar Water Supply Corporation. Bolivar Water Supply Corporation provides water service to rural areas in the northwest portion of Denton County and portions of Cooke and Wise counties. Bolivar's present system consists of ten wells with a total capacity of 1.81 MGD, six ground storage tanks with a total storage capacity of 320,000 gallons, and six standpipes with a total storage capacity of 310,000 gallons. Planned facilities include a new 100 gpm well scheduled to be in service this year.

City of Carrollton. The City of Carrollton operates its own water system. Their present system consists of one well with a capacity of 1.50 million gallons, four ground storage tanks with a total storage capacity of 7.00 million gallons and four elevated storage tanks with a total storage capacity of 4.00 million gallons. The City of Carrollton obtains 26.8 MGD treated water from the City of Dallas,

primarily from the Elm Fork Treatment Plant. Planned facilities include additional ground and elevated storage.

City of Copper Canyon. The City of Copper Canyon does not operate a water system; Bartonville Water Supply Corporation provides the City with water service.

Town of Corinth. The Town of Corinth operates its own water system. Their present system consists of one 500,000-gallon ground storage tank. Corinth has a contract with the City of Denton to obtain treated water. This contract specifies that the rate at which Corinth may take water from Denton's water system is no less than 7,000 gpd and not more than 100,000 gpd. Planned facilities include 1.5 million gallons additional ground storage capacity to be on-line in 1987.

Dallas Water Utilities. Dallas Water Utilities provides wholesale raw and treated water services to various utilities in Denton County. The City of Denton currently purchases 5.90 MGD raw water from the City of Dallas. The City of Lewisville also purchases raw water from Dallas Water Utilities. Both Denton and Lewisville obtain this water from Lake Lewisville. The Town of Flower Mound obtains 3.2 MGD from Dallas--with the right to purchase up to 11.0 MGD. The City of Carrollton purchases 26.8 MGD from Dallas. The City of The Colony purchases 2.5 MGD treated water from the City of Dallas with the right to purchase up to 7.1 MGD. Dallas holds water rights in Lakes Lewisville, Grapevine and Ray Roberts that total 150.7 MGD estimated firm yield.

City of Denton. The City of Denton operates its own water system and provides wholesale treated water to the Town of Corinth and Lake Cities Municipal Utility Authority. Denton's present system consists of a 30 MGD raw water pump station, 44,700 feet of 27-inch and 30-inch raw water pipeline with a capacity of 32.6 MGD, a 24 MGD water treatment plant, four ground storage tanks with a total storage capacity of 7.00 million gallons, three elevated storage tanks with a total

storage capacity of 4.36 million gallons. Plans for expansion include a new 8 to 10 MGD water treatment plant and additional raw water pipeline scheduled to begin construction in 1988 and completed in 1990. Bids have been opened and a contract is pending for expansion of the existing water treatment plant from 24 MGD to 30 MGD. Other planned improvements include expansion of the raw water pump station to 32.6 MGD, and additional ground and elevated storage facilities.

Town of Flower Mound. The Town of Flower Mound operates its own water system. Their present system includes two ground storage tanks with a total storage of 3.0 million gallons and one elevated storage tank with a storage capacity of 1.0 million gallons. Flower Mound purchases 3.2 MGD treated water from Dallas with the right to purchase up to 11.0 MGD. Planned facilities include 5.0 million gallons additional ground storage and 1.0 million gallons additional elevated storage.

City of Highland Village. The City of Highland Village operates its own water system. Their present system includes five wells with a total capacity of 2.66 MGD, ground storage with a total capacity of 1.7 million gallons and one elevated storage tank with the capacity of 300,000 gallons. Highland Village has negotiated a treated water contract with the City of Lewisville for 3.0 MGD treated water for a period of ten years. Service shall be available in 1988.

City of Justin. The City of Justin operates its own water system. Their present system includes four wells with a total capacity of 0.65 MGD, two ground storage tanks with a total storage capacity of 230,000 gallons, and one 60,000-gallon elevated storage tank. Planned facilities include 120,000 gallons elevated storage and a new 190 gpm well.

Mustang Water Supply Corporation. Mustang water supply is a member-owned non-profit corporation that provides water service only to members of the corporation. Some of their members have connections within the city limits of Aubrey, Cross Roads, Krugerville and the ETJ's of Oak Point, Pilot Point and



Denton. Their present system consists of four wells with a total capacity of 1.18 MGD and six ground storage tanks with a total capacity of 270,000 gallons. Mustang Water Supply has no plans for expansion at the present time.

Lake Cities Municipal Utility Authority. Lake Cities Municipal Utility Authority currently purchases 0.5 MGD treated water from the City of Denton and they provide retail water service to Lake Dallas, Shady Shores, that portion of Hickory Creek east of IH 35E, and an unincorporated area between Hickory Creek and Lake Dallas. In addition to purchases from Denton, their present system consists of five wells with a total capacity of 1.2 MGD, five ground storage tanks with a total storage capacity of 81,000 gallons and two elevated storage tanks with a total storage capacity of 300,000 gallons.

City of Lewisville. The City of Lewisville operates its own water system and plans to provide wholesale treated water service to the City of Highland Village in 1988. Lewisville's present system consists of a 18 MGD raw water pumping station, 5,000 feet of 21-inch raw water pipeline, a raw water intake facility, a 12 MGD water treatment plant, three ground storage tanks with a total storage capacity of 5.0 million gallons and three elevated storage tanks with a total storage capacity of 4.5 million gallons. Planned improvements include a 6.0 MGD expansion of the treatment plant, expansion or relocation of the intake structure, new raw water pipelines and additional ground and elevated storage facilities. The City of Lewisville has executed an agreement to purchase 6.0 MGD treated water from the City of Dallas via The Colony - Dallas treated water transmission main.

Town of Little Elm. The Town of Little Elm operates its own water system which currently consists of five wells with a total capacity of 0.28 MGD, six ground water storage tanks and one elevated storage tank with total storage capacities of 240,000 gallons and 70,000 gallons, respectively. Planned facilities include two new 50 gpm wells and additional ground and elevated storage tanks.

City of Pilot Point. The City of Pilot Point operates its own water system. Their present system consists of four wells with a total capacity of 1.08 MGD, three ground storage tanks with a total storage capacity of 575,000 gallons, and two elevated storage tanks with a total storage capacity of 325,000 gallons. Pilot Point has no plans for expansion at the present time.

Town of Ponder. The Town of Ponder operates its own water system. Their present system consists of two wells with a total capacity of 0.27 MGD one 20,000-gallon ground storage tank and one 30,000-gallon elevated storage tanks. Planned facilities include a new 135 gpm well, and 250,000 gallons additional ground storage.

City of Sanger. The City of Sanger operates its own water system. Their present system consists of five wells with a total capacity of 0.83 MGD. Sanger has no plans for expansion at the present time.

City of The Colony. The City of The Colony operates its own water system. Their present system consists of three wells with a total capacity of 5.72 MGD, five ground storage tanks with a total storage capacity of 6.4 million gallons and two elevated storage tanks with a total storage capacity of 1.0 million gallons. The Colony also purchases 2.5 MGD treated water from the City of Dallas, with the right to purchase up to 7.1 MGD. They have no plans for expansion at the present time.

T.S.W. Incorporated Water Company. T.S.W. provides water service for trailer parks east of Ponder and near Little Elm and Hackberry. Their present system consists of four wells with a total capacity of 0.29 MGD. T.S.W. has no plans for expansion at the present time.

Wren Water Supply Corporation. Wren Water Supply provides retail water service to the subdivision of Denton Northwest Estates. Their present system

consists of one 0.12 MGD well and a 57,500-gallon ground storage tank. Wren plans to have an additional 50,000-gallon elevated storage tank in-service by 1990.

### 3.1.2 Wastewater Facilities

The existing wastewater facilities within the study area include thirteen wastewater treatment plants, municipal and private collection systems and numerous lift stations. A summary of the existing and planned facilities for the participating agencies that have wastewater systems is presented below. This information was obtained from questionnaires, interviews and engineering reports.

City of Argyle. The City of Argyle is currently served by septic tanks but is in the process of developing a Wastewater Master Plan. Argyle plans to provide wastewater collection services to 50% of the population by 1990 and 80% of the population by 2010.

City of Aubrey. The City of Aubrey operates its own wastewater collection system and a 0.08 MGD treatment plant. Aubrey has no plans for expansion at the present time.

Town of Bartonville. The Town of Bartonville is currently served by septic tanks but is in the process of developing a Master Land Use Plan that will address the adequacy of their septic tanks. Based on the results of the Land Use Plan, Bartonville will assess their need for a wastewater collection and treatment system.

City of Carrollton. The City of Carrollton operates its own wastewater collection system; the wastewater is transferred to the Central Plant of the Trinity River Authority (TRA) for treatment. The City of Carrollton is having a study done that will assess their future needs, and is considering alternatives for serving the northern portion of their growth area.

City of Copper Canyon. The City of Copper Canyon is currently served by septic tanks and has no plans for providing wastewater collection services at the present time.

Town of Corinth. The Town of Corinth collects its wastewater and has a contract with the City of Denton for treatment. Corinth is presently in the bid stages of a construction project to upgrade its wastewater facilities. Three lift stations and various sewer lines are being upgraded.

City of Denton. The City of Denton operates its own wastewater collection system and a 12.0 MGD treatment plant which treats wastewater from Denton and Corinth. Denton's plans include an 8 MGD expansion of their treatment plant, various new interceptors and lift stations as proposed by their Master Plan.

Town of Flower Mound. The Town of Flower Mound operates its own wastewater collection system and a 0.75 MGD treatment plant. Flower Mound's plans include a 2.0 MGD expansion of their treatment plant and two new lift stations.

City of Highland Village. The City of Highland Village collects its wastewater and has a contract with the City of Lewisville for treatment. Their plans include a new lift station scheduled to be in service in 1987.

City of Justin. The City of Justin operates its own wastewater collection system and 0.125 MGD treatment plant. Justin's plans include a 0.250 expansion of their treatment plant and various new interceptors and lift stations.

Lake Cities Municipal Utility Authority. Lake Cities Municipal Utility Authority provides wastewater collection and treatment services for Lake Dallas, Shady Shores, that portion of Hickory Creek east of IH-35E and an unincorporated

area between Hickory Creek and Lake Dallas. They currently operate a 1.1 MGD treatment plant which is to be expanded to 2.2 MGD by 1990.

City of Lewisville. The City of Lewisville operates its own wastewater collection system and a 6.0 MGD treatment plant which treats wastewater from Lewisville and Highland Village. Lewisville plans include a 6.0 MGD expansion of their treatment plant, various new interceptors and lift stations.

Town of Little Elm. The Town of Little Elm operates its own wastewater collection system and a 0.10 MGD treatment plant, which they plan to expand to a 0.35 MGD plant.

City of Pilot Point. The City of Pilot Point operates its own wastewater collection system and a 0.35 MGD treatment plant. Pilot Point has no plans at the present time to expand their system.

Town of Ponder. The Town of Ponder operates its own wastewater collection system and a 0.07 MGD treatment plant. Ponder has no plans at the present time to expand their system.

City of Sanger. The City of Sanger operates its own wastewater collection system and a 1.0 MGD treatment plant. Sanger has no plan, at the present time to expand their system.

City of The Colony. The City of the Colony operates its own wastewater collection system and a 2.5 MGD treatment plant. The Colony plans to add a new lift station in two to five years.

TABLE 3-1  
SUMMARY OF PARTICIPATING AGENCIES

Agency	Type Utility	Service Provided	No. of Connections		Remarks
			Water	Wastewater	
Denton, County of	N/A	N/A	N/A	N/A	A sponsor of the project, but the County does not directly provide water and wastewater service.
Argyle, City of	None	Water	481	-	Argyle Water Supply Corporation and Argyle Water Company provide water service. The city is served by septic tanks.
Aubrey, City of	Utility Department	Water & Wastewater	500	500	The City of Aubrey owns and operates the water system, wastewater system and wastewater treatment facilities.
Bartonville, Town of	None	Water	100	-	Bartonville Water Supply Corporation and Argyle Water Supply Corporation provide water service. The town is served by septic tanks.
Bartonville Water Supply Corporation	Non-profit Corporation	Retail Water	1,309	-	Bartonville Water Supply Corporation serves Bartonville, Copper Canyon, Double Oak, parts of Flower Mound, parts of Highland Village and some unincorporated areas of Denton County.
Black Rock Water Supply Corporation	Non-profit Corporation	Water	180	-	Black Rock Water Supply Corporation serves rural areas in the vicinity of Aubrey.
Bolivar Water Supply Corporation	Non-profit Corporation	Water	2,054	-	Bolivar Water Supply provides water service for rural areas in Denton, Cooke and Wise County.
Carrollton, City of	Utility Department	Water and Wastewater	23,108	23,108	26.8 MGD treated water is purchased from the City of Dallas. Carrollton's wastewater is treated by the Trinity River Authority.
Copper Canyon, Town of	None	Water	312	-	Bartonville Water Supply provides water service. The town is served by septic tanks.
Corinth, Town of	Utility Department	Water and Wastewater	1,148	1,111	Corinth obtains treated water from the City of Denton. The Town collects its wastewater and sends it to the City of Denton for treatment.

TABLE 3-1 (Cont'd)

Agency	Type Utility	Service Provided	No. of Connections		Remarks
			Water	Wastewater	
Dallas Water Utilities	Utility Department	Water and Wastewater	N/A	N/A	Provides wholesale treated and untreated water services to various utilities in Denton County.
Denton, City of	Utility Board	Water and Wastewater	16,245	15,476	The City of Denton provides wholesale water to the Town of Corinth and Lake Cities Municipal Utility Authority. The City of Denton also treats Corinth's wastewater.
Flower Mound, Town of	Utility Department	Water and Wastewater	3,044	2,693	Flower Mound purchases 3.2 MGD with the right to purchase up to 11 MGD treated water from the City of Dallas. Most of City is served by wastewater collection system and City operated treatment plant.
Highland Village, City of	Utility Department	Water and Wastewater	1,751	1,720	Highland Village owns and operates the water system and wastewater collection system. The City of Lewisville provides wastewater treatment.
Justin, City of	Utility Department	Water and Wastewater	434	396	City of Justin owns and operates the water system, wastewater collection system, and wastewater treatment facilities.
Lake Cities Municipal Utility Authority	Utility Authority	Water and Wastewater	2,550	2,370	Lake Cities purchases 0.5 MGD treated water from the City of Denton. They provide retail water service and wastewater service for Lake Dallas, Shady Shores, a portion of Hickory Creek east of IH35, and an unincorporated area between Hickory Creek and Lake Dallas.
Lewisville, City of	Utility Department	Water and Wastewater	10,876	10,184	The City of Lewisville purchases untreated water from the City of Dallas and supplies wholesale water service and wastewater treatment service to Highland Village.
Little Elm, Town of	Utility Department	Water and Wastewater	490	484	The Town of Little Elm owns and operates the water system, wastewater collection system, and wastewater treatment facilities.

TABLE 3-1 (Concluded)

Agency	Type Utility	Service Provided	No. of Connections		Remarks
			Water	Wastewater	
Mustang Water Supply Corporation	Member Owned Non-profit Corporation	Water	510	-	Mustang Water Supply serves only members of the Corporation. Their members live within the city limits of Aubrey Cross Roads and Krugerville and the ETJ's of Oak Point, Pilot Point and Denton.
Pilot Point, City of	Utility Department	Water and Wastewater	1,030	921	The City of Pilot Point owns and operates the water system, wastewater system and wastewater treatment facilities. A portion of the city is served by septic tanks.
Ponder, Town of	Utility Department	Water and Wastewater	315	105	The Town of Ponder provides water service to inside city customers and to adjacent areas. Provides wastewater service within their own city limits. A portion of city on septic tanks.
Sanger, City of	Utility Department	Water and Wastewater	1,500	1,500	The City of Sanger owns and operates the water system, wastewater collection system and wastewater treatment facilities.
T.S.W. Incorporated Water Company	Investor Owned	Water	270	-	T.S.W. provides water service for trailer parks east of Ponder and near Little Elm and Hackberry.
The Colony	Utility Department	Water and Wastewater	5,955	5,955	2.5 MGD treated water is purchased from the City of Dallas. The Colony owns and operates a wastewater collection system and treatment facilities.
Wren Water Supply Corporation	Investor Owned	Water	135	-	Wren Water Supply Corporation serves the subdivision of Denton Northwest Estates.



#### 4.0 WATER RESOURCES

#### 4.1 EXISTING WATER SUPPLY SOURCES

The primary existing sources of water supply for the communities of Denton County include: Lewisville Lake on the Elm Fork of the Trinity River near Lewisville, Texas; Grapevine Lake on Denton Creek near Grapevine, Texas and Ray Roberts Lake on the Elm Fork, upstream of Lewisville Lake, near Sanger, Texas. The locations of the above reservoirs are shown on Figure 1-1. The total estimated firm yield of three reservoirs is 183.98 MGD of which Denton holds rights to 24.06 MGD, Dallas 150.71 MGD, Grapevine 3.17 MGD, and Park Cities MUD 6.04 MGD. A general discussion of each follows.

Lewisville Lake. The top of the water conservation pool is elevation 515.0 and the allotted conservation storage amounts to 408,241 acre-feet, of which Dallas has rights to 95.2 percent and the City of Denton has the remaining 4.8 percent. The firm yield of the reservoir is approximately 88.5 MGD (Dallas: 84.2 MGD and Denton: 4.3 MGD). The conservation pool is expected to be raised 7 feet in conjunction with the completion of Ray Roberts Lake.

Grapevine Lake. The operating level for the conservation pool is elevation 535.0, below which elevation is a usable conservation storage of 136,250 acre-feet. The firm yield of Grapevine Lake is approximately 19.48 MGD divided between the City of Dallas (10.27 MGD), Park Cities MUD (6.04 MGD) and the City of Grapevine (3.17 MGD).

Ray Roberts Lake. This new lake is nearing completion. When it is completed and filled, the conservation level will be 632.5 feet. Considering the adjustments in the Lake Lewisville conservation level, the incremental firm yield of

Ray Roberts Lake will be 76.0 MGD of which Dallas holds rights to 56.24 MGD and Denton 19.76 MGD.

Table 4-1 summarizes the water rights discussed above.

#### 4.2 DALLAS REQUIREMENTS

The City of Dallas is the principal sponsor of the three reservoirs. Based on the yield of the reservoirs, Dallas has constructed two major water treatment plants: Bachman and Elm Fork. Plans are underway to expand the Elm Fork plant in Carrollton. Consequently, it is reasonable to assume that the City of Dallas will retain sufficient yield to provide for its treatment plants.

#### 4.3 DALLAS COMMITMENT TO DENTON COUNTY COMMUNITIES

Over the years, Dallas has expressed a willingness to provide water supplies to those communities impacted by the development of its water supply reservoirs. In addition Dallas has adopted a planning area that contains all of the area prescribed for this study. Dallas presently has water supply contracts with Denton, Lewisville, Carrollton, The Colony, and Flower Mound. In addition, certain of those contracts contemplate resale to other nearby cities.

Based on the analysis regarding water requirements for the study area, and water availability in the local region, it appears reasonable to assume that a major portion of the water needs should be satisfied from local sources. The rights held by Denton in Lake Lewisville and Ray Roberts will be available, especially to meet the needs of the City of Denton. However, by the year 2010, it is expected that Denton's rights will not be sufficient to meet all of its needs. Therefore, additional supplies will be needed.

#### 4.4 ASSESSMENT OF WATER SUPPLY NEEDS

Projections of future requirements indicate that the study area will need approximately 137 MGD of water supply to meet requirements under drought conditions for year 2010. To determine whether or to what extent there is a shortfall in available resources requires consideration of various scenarios. The following facts should be taken into account:

- o The study area (most of Denton County) falls within the "water service planning area" of the City of Dallas as defined by the Peat, Marwick, Mitchell and Company Study, "Analysis of Water Service Area," dated May 9, 1980.
- o The State of Texas has granted to the City of Dallas rights to store water in and use water from local reservoirs (Grapevine, Lewisville and Ray Roberts) that approximate 151 MGD in annual dependable yield. Denton has similar rights for approximately 24 MGD in Lakes Ray Roberts and Lewisville.
- o City of Dallas has expressed a willingness to sell water to communities impacted by its water supply reservoirs.
- o City of Dallas by Council Resolution dated December 19, 1984, reaffirmed "its willingness to sell treated water to entities within the water service area . . ." under specified conditions of service. Council Resolution No. 844011 is contained in the Appendix.
- o In recent conversations, the Director of Dallas Water Utilities expressed a preference for providing raw water instead of treated water to meet the future needs of Denton County.
- o The City of Dallas depends on the storage capacity and yield of the Denton County reservoirs to provide a raw water supply to its Bachman and Elm Fork Water Treatment Plants.

- o Dallas has not limited its sale of water resources to Denton County solely from Grapevine, Lewisville or Ray Roberts reservoirs. The Dallas System also includes four other reservoirs.
- o Dallas has expressed a willingness to assist the communities of Denton County in providing for future water supply needs. Dallas referenced the needs of Denton County as part of its testimony in the hearings for water rights in Lake Fork Reservoir.
- o The status of rights to treated effluent return flows remains in doubt. Agencies (including Dallas, Denton and Park Cities MUD) with water rights in Lakes Grapevine, Lewisville and Ray Roberts are making beneficial use of effluent return flows because of their right to overdraft the firm yield of the reservoir, but have not been granted a definitive right to the flows.

It is clear from the record that the City of Dallas has on occasion included the needs of Denton County in its projections of water supply requirements. However, it is not reasonable to expect that Dallas will unilaterally spend its money to develop water supplies adequate for all future needs of Denton County--especially in the absence of a binding contract. What one can expect, based on past actions and recent expressions, is that Dallas will sell reasonable quantities of water to Denton County entities and upon request will assist Denton County in planning for and developing additional supplies. The financial participation of Dallas in the development of this master plan is an indication of that willingness.

In addition to unit price, other relevant factors such as proximity, independence of supply, quality and political strategy need to be considered when deciding whether to develop one's own supply or to purchase from others. Most cities addressing water supply needs elsewhere in Texas would have to initiate new projects under today's environmental rules at today's prices to develop a water supply. To be able to purchase water from an established entity may be advantageous--especially if the price is based on the cost of previously built

projects. Denton County will need to develop additional water supplies, but they may be able to defer such an expenditure because of the availability of purchased water from Dallas. Nonetheless, it is expected that Denton County will need to initiate in the near future a program to develop its own independent supplies to supplement other sources.

The total requirements have been estimated to be 137 MGD by the year 2010. How and from what sources that amount of water can be secured requires careful analysis. The first step in that analysis is to determine what quantities may be obtained from the local lakes, especially Ray Roberts and Lewisville. EH&A met with Dallas Water Utilities staff to obtain information about the availability of water. Two approaches were discussed. DWU could analyze that portion of their system that depends on the water rights in the Elm Fork of the Trinity River and advise Denton County of the quantities that could be made available without impairing the efficiency of their system. Or, EH&A could make an independent estimate of the amounts needed and possibly available from Dallas. The DWU staff expressed a preference for the latter approach.

The beginning point for making such an analysis is the determination of the commitment Dallas has already made in contracts with entities in Denton County. Dallas has agreed in essence to meet the full needs of specified entities per the contracts noted in Table 4-2. The total drought needs for year 2010 are estimated to be approximately 93 MGD.

A separate study was performed by CH<sub>2</sub>M Hill for Dallas in 1984 that estimated the 2010 needs of Dallas customer cities in Denton County to be approximately 98 MGD, including the City of Carrollton (see Table 4-3). Adjusting the estimate for Carrollton to include only the 23.64 MGD currently projected for 2010 drought conditions for the Denton County portion, the CH<sub>2</sub>M Hill total estimated would be 75 MGD. The CH<sub>2</sub>M Hill estimate for the year 2050 for the same cities is approximately 260 MGD, including all of Carrollton. Comparing that study with this

study, one can assume that Dallas would be expected to supply between 75 and 93 MGD by the year 2010. If the EH&A projections had been made to the expiration date of each contract or to 2050, the estimated quantities would be higher.

For purposes of this study, based on existing contracts it is assumed that Dallas is committed to supply at least 90 MGD by 2010 to Denton County entities. Whether Dallas could be expected to supply more would be subject to negotiation between the parties.

Using 90 MGD as the base supply locally available from Dallas, plus the 24.06 MGD of firm yield represented by independent water rights owned by the City of Denton (which are projected for full utilization within the City of Denton), the following scenarios address the probable deficiency.

Scenario 1

Make full use of Denton's rights for Denton, estimate requirements under existing contracts with Dallas, and obtain balance needed from new sources:

Total Requirements	137.02	MGD
Less: Denton Rights	24.06	MGD
Purchase from Dallas	<u>90.00</u>	MGD
New Sources Needed by 2010	22.96	MGD

Scenario 2

Make full use of Denton's rights for Denton, negotiate with Dallas for additional supplies (from either local lakes or one or the other water supply reservoirs on the Dallas System).

Total Requirements	137.02	MGD
Less: Denton Rights	<u>24.06</u>	MGD
Purchase From Dallas	112.96	MGD

### Scenario 3

Make full use of Denton's rights for Denton, estimate requirements under existing contracts with Dallas and obtain rights for use of effluent return flows to supply balance.

Total Requirements	137.02	MGD
Less: Denton Rights	24.06	MGD
Purchase from Dallas	<u>90.00</u>	MGD
Rights from Return Flows	22.96	MGD

Because of the current uncertainties about the rights to probable return flows, and because such return flows are not a documented element of the firm yield of the water supply reservoir, we recommend that Scenario 3 not be relied upon at this time. However, efforts in the future to obtain rights to use certain amounts of return flows may be in the best interest of Denton County entities.

Scenario 2 is reasonable and should be explored. However, we recommend that Scenario 1 be considered the preferred alternative. It would be advantageous to have some portion of the supply from an independent source. Furthermore, as one looks beyond the year 2010, it will be a necessity to develop additional supplies to meet the needs of the area. The Denton County system should, in cooperation with other nearby water supply agencies, pursue the development of new resources.

#### 4.5 WATER SUPPLY ALTERNATIVES

Under Scenario 1, various options are available. The following list is in the order of priority we recommend.

1. Develop an exchange agreement for water from Cooper Reservoir. The cities of Irving and Dallas and the North Texas Municipal Water District have indicated interest in such an agreement.
2. Negotiate with agencies who hold water rights that not fully utilized for possible sale or transfer of a portion of their rights. (In this connection, we suggest that all of the sponsors of the Cooper project be contacted.)
3. Jointly develop a new water supply project with other agencies.
4. Purchase from the State of Texas water storage rights they may have obtained by their participation in the funding of new sources.
5. Purchase water from an agency other than Dallas.
6. Develop a new water supply lake solely for Denton County needs.

The exchange agreement mentioned above could probably meet all the shortfall in Denton County until the year 2010, allowing sufficient time for new supply resources to be developed.

#### 4.5.1 Innovative Supply Options

In our evaluation of opportunities for meeting future water supply needs of Denton County, we were expected to consider the standard forms of water supply including:

- o Purchase of a supply from an existing agency.
- o Development of new reservoirs for water purposes.



In addition, we think Denton County should consider innovative approaches to water supply, including:

- o Use of saline waters from the Red River.
- o Use of effluent return flows.
- o Regional exchange of available water supplies.

Obtaining a supply from the Red River or from effluent return flows both offer long term potential; but neither appears to be feasible for the immediate future in Denton County. However, the idea of a regional exchange has considerable merit and should be evaluated from a technical standpoint as well as from a policy and institutional view.

#### 4.5.2 Water Exchange Concept

North Texas Municipal Water District and the City of Irving hold water rights of approximately 40 MGD each in Cooper Reservoir now under construction on the Sulphur River. Tentative plans are for the two entities to build a joint pipeline to the vicinity of Lavon Reservoir; NTMWD would discharge its share into Lavon, making it available to their existing intake and treatment works. Irving would continue westward with a smaller pipeline to the vicinity of Lake Lewisville. Irving is negotiating with Dallas for use of Lake Lewisville as a storage and balancing reservoir and the possibility of a contract to treat the water for Irving. NTMWD also has tentative plans for a major transmission line for treated water from its treatment plant in Wylie to the southern portion of its service area near Mesquite, Sunnyvale, Rockwell and Kaufman.

Another set of conditions concern the needs of Dallas in the northern reaches of its service area. Dallas has water rights in three lakes in the upper Trinity Basin upstream from its Elm Fork and Bachman Plant. But, the rights in Lakes Lewisville, Ray Roberts and Grapevine are not adequate for the demands

projected for the northern portions of its service area, including major entities in Denton County. Therefore, Dallas is having to transport large quantities of water across its system from its more abundant eastern supplies.

An exchange looks like an excellent opportunity for substantial benefit to all parties, requiring a minimum of new construction, but a maximum of coordination and cooperation. One possible scenario follows:

1. Obtain agreement from Denton County, Dallas, NTMWD and Irving to pursue the strategy.
2. NTMWD could agree to transport its water to either Lake Ray Roberts or Lake Lewisville for use within Denton County.
3. Dallas could agree to exchange the same amount of water, making available to NTMWD (probably treated water out of its Eastside Treatment Plant) a supply on the east side of its system for the needs of the south portion of NTMWD service area.
4. Irving could agree to share in the cost of a pipeline from the vicinity of Lavon to Denton County.
5. All parties could benefit:
  - o Dallas would obtain a needed supplemental source in the Dallas north service area, reducing cross system transmission and extending the adequacy of its raw water resources for the Elm Fork and Bachman treatment plants. Dallas could also realize short-term revenues from temporary surplus East Texas water rights.
  - o NTMWD: Would provide a needed supply to a growing portion of the NTMWD system without having to construct a long pipeline.
  - o Irving: Would obtain a cost saving on the construction of its pipeline.

- o Denton County: Would obtain a significant new water supply. It would allow Denton County to defer for a few years the development of a new water supply reservoir and the attendant cost.

The concept of an exchange as described above appears to be feasible. It is recommended for immediate attention by all parties, including the Texas Water Commission. Plans are being made by the parties for conventional use of the water; to be timely considered, the concept will need to be investigated on a priority basis.

#### 4.5.3 Water Supply Steps

The following appears to be a reasonable course of action to secure a long-term reliable water supply for Denton County.

1. Reconfirm with Dallas its willingness to sell sufficient raw and treated water from local lakes and existing treated water supplies to meet at least an average daily demand of 90 MGD over the next 25 years.
2. Explore with Denton the possibility of interim use of temporarily surplus water in Ray Roberts Lake--to minimize purchases from Dallas.
3. Explore with Dallas its willingness to sell additional quantities of water to meet the 2010 estimated demands of 137 MGD within the study area.
4. Cooperate with Denton and Dallas in obtaining a dependable right to effluent return flows.
5. Pursue final definition of, agreement to, and approval for an exchange of all or part of the water rights held by NTMWD in Cooper Reservoir.

6. Confirm that Tarrant County Water Control and Improvement District is willing to plan for the raw water supply needs of the southwest corner of Denton County (not in the study area). Likewise, confirm the willingness of (or contract with) the City of Fort Worth to provide treated water service in that area. This step particularly applies if a County-wide water agency is created for Denton County.
7. In the near future, cooperate with various regional entities in the development of new water supply sources, including the Parkhouse project (Sulphur Bluff) downstream of Cooper Reservoir on the Sulphur River. This step should be initiated in 5 to 10 years to provide for water supply needs beyond the year 2010.
8. Make maximum and best use of available ground water supplies. Given the limitation of ground water supplies, all water utilities (especially the cities) should make plans to convert to surface supplies as soon as feasible. The limited ground water supplies should not be considered toward meeting the projected 25-year requirement of 137 MGD. They can be utilized to the extent they are available in meeting the interim needs of utilities until conversion to surface water supplies is feasible but otherwise should be treated only as a contingent or reserve supply by the cities.

#### 4.6 OTHER SOURCES

Other raw water sources that possibly could be made available include:

- a. Other Dallas Water Supply Sources
- b. Proposed Sulphur Bluff (Parkhouse Reservoir)
- c. Lake Texoma
- d. Cooper Reservoir (under construction on Sulphur River)

#### 4.6.1 Other Dallas Water Supply Sources

While the amounts of water that can be committed by Dallas from local lakes in Denton County is limited, additional supplies may be available from other lakes of the Dallas Water Supply System. The City of Dallas has indicated:

"If additional water supplies are obtained from Dallas, those supplies would have to be from eastern reservoirs and would be expected to be under terms varying from supplies provided from Denton County reservoirs."

The availability and cost of such additional supplies from Dallas would need to be evaluated and compared with other strategies available to Denton County.

#### 4.6.2 Proposed Sulphur Bluff (Parkhouse) Reservoir

This is a proposed reservoir in the Texas Water Plan. As indicated in Figure 4-1, the site is downstream of the Cooper Reservoir now under construction on the Sulphur River. The total drainage area is about 1,026 square miles, of which 645 square miles are in the South Sulphur River basin and 381 square miles are in the North Sulphur River basin. However, because Cooper Reservoir is located within the South River watershed, it will intercept runoff from about 476 square miles, leaving the South River watershed about 169 square miles. This site has a prolific yield with an initial capacity of 846,960 acre-feet, and is considered to be quite feasible. To build the project, several sponsors would need to join together.

#### 4.6.3 Lake Texoma

Considerable yield is available in this existing lake. However, the water is presently too saline for direct use and would require considerable dilution. The North Texas Municipal Water District is pursuing a strategy for use of limited quantities of Lake Texoma water and to introduce it into Lake Lavon. Various

groups including the State of Oklahoma are opposing the plan of North Texas Municipal Water District to use water from Texoma for municipal purposes.

#### 4.6.4 Cooper Reservoir

The North Texas Municipal Water District and the City of Irving each hold rights to 39.5 MGD in this reservoir and are making plans to construct a joint pipeline to bring the water into this area. It is expected that both agencies would cooperate with Denton County if the mutual interest of all parties could be served by joint participation. For example, some or all of NTMWD's rights in Cooper could be transported into Denton County. In return, Dallas could deliver out of the Eastside Water Treatment Plant (or out of Lake Ray Hubbard) an equal amount into the southern end of the NTMWD service area near Mesquite and Kaufmann. Also, the Sulphur River Authority holds water rights in the Cooper project and may have rights that are surplus to its needs.

#### 4.7 RETURN FLOWS

The existence of return flows generated by the discharge of effluent from wastewater treatment plants into surface waters has been recognized for some time. Such flows become part of the water resource available for use. Under various circumstances such flows can become an important element of the total water resources available to meet water supply needs. Interest in the use of return flows is increasing as the quantity of effluent discharge increases and as the quality improves through modern wastewater treatment practices.

The presence of return flows is well documented. Most up-basin return flows in Texas are being combined with raw water supplies. Some systems have been able to extend the adequacy or to lower the unit cost of their water supplies by the use of return flows. For Denton County, the potential for future use of such flows seems to warrant consideration as an alternative source of future water

supply. Any such use would minimize the need for and the cost of constructing new water supply reservoirs. However, in this report, we are not recommending reliance on this potential source at this time because many legal issues remain unresolved. The right to such flows has not been settled.

#### 4.8 GROUND WATER SUPPLIES

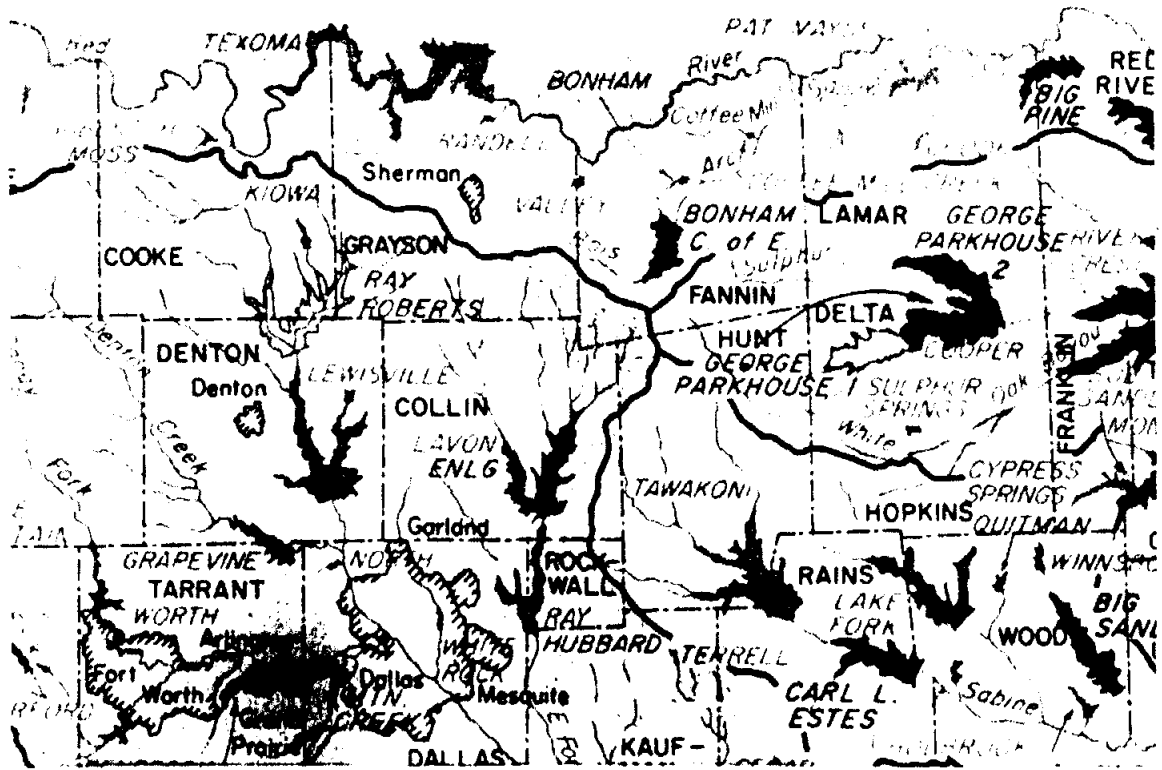
Indications are that existing ground water supplies are not adequate to provide for growth. Per information received from the Texas Water Development Board, the annual effective recharge for Denton County is approximately 6,100 acre-feet (approximately 5.5 MGD) and the present recoverable storage for Denton County is estimated to be approximately 49,000 acre-feet. The present total pumping rate for entities using ground water as a water source is approximately 6 MGD, exceeding the annual effective recharge by approximately 0.5 MGD and therefore resulting in a gradual depletion of recoverable storage. If the ground water pumping rate increased uniformly over the years to a pumping rate of approximately 9 MGD by the year 2010 (as depicted in Figure 4-2), Denton County's recoverable storage would be completely depleted and the only available ground water would consist of the annual effective recharge.

Given the condition of limited ground water supplies, a prudent course of action seems to be for the cities to make plans for conversion to surface water supplies, to use ground water resources to the extent available only as an interim source until surface water supplies are available, and to reserve available ground water supplies for rural use and for peaking or emergency use within the cities. The Steering Committee has adopted a strategy for ground water which embodies this basic course of action. A copy of the adopted strategy is included in the Appendix.

For additional information about ground water supplies, one can refer to Report 269, produced by the Texas Department of Water Resources, dated April

1982. The report is titled, "Occurrence, Availability and Chemical Quality of Ground Water in the Cretaceous Aquifers of North-Central Texas, Volumes 1 and 2."





Map of Reservoirs

FIGURE 4-1

TABLE 4-1  
WATER RIGHTS FOR RESERVOIRS IN DENTON COUNTY  
(Million Gallons Per Day Firm Yield)

Agency	Grapevine	Lewisville	Ray Roberts	Total
City of Dallas	10.27	84.20	56.24	150.71
City of Denton	-	4.30	19.76	24.06
City of Grapevine	3.17	-	-	3.17
Park Cities MUD	<u>6.04</u>	<u>-</u>	<u>-</u>	<u>6.04</u>
Totals	19.48	88.50	76.00	183.98

TABLE 4-2  
 WHOLESALE WATER SUPPLY CONTRACTS BETWEEN  
 DALLAS AND DENTON COUNTY ENTITIES

City	Type of Service	Contract Expiration	Estimated 2010 Daily Demand (MGD)	
			Normal Weather	Drought Weather
Denton	Raw Water	8/7/2015	23.20	26.68
Customer Cities*				
Argyle	Wholesale Treated		0.87	1.00
Corinth	Wholesale Treated		5.09	5.85
Hickory Creek	Wholesale Treated		1.72	1.98
Shady Shores	Wholesale Treated		0.22	0.25
Lewisville**		12/16/2016	26.08	30.00
Customer Cities*				
Highland Village	Wholesale Treated		5.80	6.67
Flower Mound	Treated Water	01/21/2017	12.94	14.88
Carrollton (Denton County portion)	Treated Water	06/28/2013	20.56	23.64
The Colony	Treated Water	11/05/2010	<u>4.90</u>	<u>5.64</u>
Subtotal			101.38	116.59
Less Denton's Rights			<u>24.06</u>	<u>24.06</u>
Total Estimated Requirements			77.32	92.53

\* The customer cities listed are mentioned in the contracts. Additional customer cities may be permitted according to a specified process.

\*\* Lewisville has a second contract for delivery of up to 6 MGD of treated water out of The Colony pipeline.

TABLE 4-3  
 PROJECTED ANNUAL WATER DEMAND<sup>1</sup>  
 (1,000'S OF GALLONS)  
 DROUGHT WEATHER CONDITIONS  
 FOR DALLAS CUSTOMER CITIES IN  
 DENTON COUNTY

Denton County Cities	2010	2050
Carrollton <sup>2</sup>	16,918,200	37,715,000
Denton	9,501,000	30,992,600
Flower Mound	1,546,400	4,359,300
Lewisville	4,961,000	10,920,300
The Colony	<u>2,722,100</u>	<u>10,777,600</u>
Total	35,648,700	94,764,800
Average Daily Demand (MGD)	97.67	259.63
Adjusted Average Daily Demand <sup>3</sup> (MGD)	74.96	-

<sup>1</sup> The annual water demands shown on this table were obtained from a separate study by CH<sub>2</sub>M Hill, Long-Range Water Demand Forecasts (1984) for Dallas Water Utilities.

<sup>2</sup> Includes all of Carrollton.

<sup>3</sup> Adjusted to include only the Denton County portion of Carrollton.

# GROUND WATER PUMPING

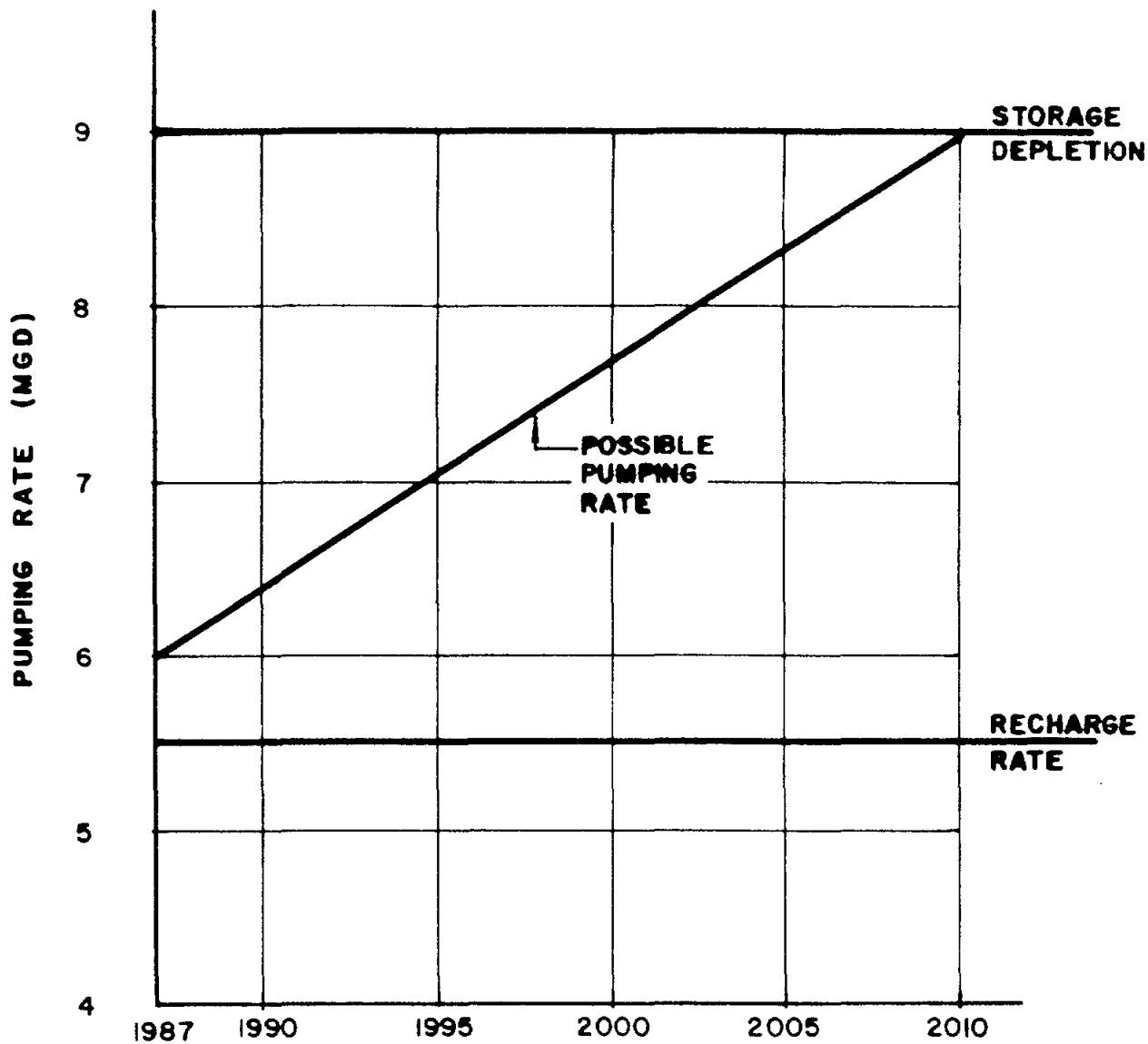


FIGURE 4-2

5.0            IDENTIFICATION AND EVALUATION OF INSTITUTIONAL  
ALTERNATIVES

In the analysis of the water and wastewater needs of the entities in Denton County, several institutional alternatives were identified and are shown on Table 5-1. A copy of this form was distributed to members of the Steering Committee for their review and rating with regard to entity preferences.

Table 5-1 outlines the list of alternatives discussed with the Steering Committee. The ratings for each indicate the consolidated results of a poll taken of the Steering Committee as to their subjective preference for each idea. The consolidated preference ratings of the consulting team are also noted.

The results of the poll were discussed with the attorneys of Hutchison Price Boyle & Brooks. The financial advisor, First Southwest, was also consulted. After considering legal and financial issues, infrastructure requirements and long-term feasibility, the list of institutional strategies was narrowed to six. Table 5-2 outlines the six alternatives considered most feasible. At the Steering Committee meeting on June 24, 1987, the Committee expressed its preference and selected the following three as preferred strategies:

- o    Alternative A - Wholesale contracts between cities, other public agencies and local utilities;
- o    Alternative B - Create a new County-wide regional agency;
- o    Alternative F - Contract with existing regional entities based outside Denton County.

## 5.1 LEGAL PERSPECTIVE

The following is a review, from a legal perspective, of five institutional or governmental approaches that will be considered in the implementation of an overall strategy to accommodate the water supply and wastewater handling needs of Denton County.

The Alternative General Strategies are listed in Table 5-2, and are discussed in the order there listed with the following general exception: alternatives lettered "D" and "E" are simply variations of the "B" alternative. Alternative "D" is simply limited as to legal purpose, and the other, "E," is not limited by boundary restrictions or by material purpose. Thus, Alternatives "D" and "E" will not be analyzed separately. Alternative "F" involves contracting with other regional agencies, and is a viable approach, at least for certain services. However, it is not evaluated in this section.

It is apparent that the most significant elements that cause an institutional approach to be legally sound or legally unsound depend necessarily upon an analysis of the objectives being sought. While the final, specific objectives of the County have not been defined, the following preliminary statement of one of the major objectives for the County might be stated in very general terms as follows:

"To provide on a countywide basis, with the County as a broad discrete region of common interests, and with sub-regions within the County because of localized practical or financial communities of interest, the legal ability to plan, develop and implement water supply programs for the region and to provide for the handling of wastewater within the region over an extended period of time, and to finance necessary costs on a reasonable basis."

Assuming this to be a valid statement of a general objective, an outline of some of the legal pros and cons of Alternatives "A," "B" and "C" follows.

### 5.1.1 Alternative A - Wholesale Contracts Between Cities

This alternative generally relies on existing law and presently available legal technology.

#### Pros:

1. No material changes in laws would be required;
2. All actions depend on contracts entered into by willing parties under general municipal utility powers or the Interlocal Cooperation Act;
3. Not necessary to confront geopolitical problems implicit in addressing necessary governance questions if separate agencies are created;
4. Can conveniently delineate service areas without establishing geographical boundaries;
5. Only those areas that can afford it have to be served.

#### Cons:

1. Inherently not a regional approach to accomplishing the objective;
2. Sponsoring cities must finance and develop supplies and facilities beyond their own current needs, leading, in the event of ultimate sponsoring city growth, to the need to protect "self" first;
3. Would create significant financing difficulties in the light of existing city bond covenants, coverage requirements and similar matters for sponsoring cities;
4. No ability to regulate any water quality or other similar activities in unincorporated, developing areas.



5.1.2 Alternative B - Create County-Wide Regional Agency

This alternative should be supplemented to grant to the county-wide agency the power to create subregional agencies (with the power to levy taxes solely within the subregion) for the purpose of establishing a financing base in less established, but growing, subregions. It is also assumed, however, that the county-wide agency would not have taxing power itself.

Pros:

1. Is in fact a county-wide agency that can be made capable of implementing the objective;
2. Can write the law on a tailor-made basis to suit the precise needs of the County, with such powers, duties and responsibilities as are considered appropriate to achieve the objective;
3. Provides the flexibility to move with the times and to alter strategies as conditions change;
4. Can contract on basis of collective needs of participants without necessity of any city becoming inherently responsible for the debts of another, and without concern for existing prohibitive bond covenants;
5. Financially, each city can "look out" for its own constituency and can protect its interests by contract;
6. Can create subregions with taxing power in not-yet developed areas in order to provide financial base for contract services to developing areas without imposing that burden on others;
7. No need to define boundaries other than as those of the County, except to the extent subregions are created;
8. Since no general taxing power is granted, no elections would be required in any area other than in the subregions having taxing power;

9. Can conveniently contract with others, e.g., TRA and North Texas, for special services with costs allocated by contract among the participants within the County;
10. Would permit discrete subregional financing strategies of both wastewater and water supply facilities but under the umbrella of a larger agency having a regionwide perspective;
11. Does not diminish ability to contract with third-party sources for special needs, e.g., TRA and North Texas.

Cons:

1. Would be required to address important geopolitical-legal questions such as method of selecting governing board and the types of service and regulatory powers that would be vested in the agency;
2. Would require the passage of legislation and therefore would require substantial unanimity of support within the County;
3. Any regulatory power, e.g., of septic tanks or the distribution of limited ground water supplies, will be difficult to obtain unless a significant case is made and support obtained throughout the County.

5.1.3 Alternative C - Create Special District to Provide Wholesale and Retail Sources on a Regional Basis

Like Alternative B, this alternative would require new legislation for each special district.

Pros:

1. Would permit identification of "subregional" communities of interest, both financial and political, without confronting necessarily complex political governance issues;

2. Would permit separate contracting among the subregional district and with a third-party source for a common water supply, and individually for individual needs such as subregional wastewater treatment;
3. Can write the law for each subregion to meet its own precise needs, including, in appropriate cases, taxing power.

Cons:

1. Is basically only an enlarged version of Alternative A, and does not completely address the objective;
2. Must confront governance issues directly on a localized basis;
3. Boundaries should be formed principally on the basis of underlying financial capacity and credit, rather than a political or geographical consideration;
4. Boundaries would have to be fixed at an early stage based on "projected" or "best guess" growth trends that might prove to be incorrect in future years, thus jeopardizing any long-term planning and financing ability;
5. Unless taxing power is granted, there would be little ability to create a financing base in undeveloped, but developing, areas.

It is the ultimate intent of this outline simply to highlight important considerations that must be given in making the final choice as to the best governmental or institutional mechanism that should be used in accomplishing the objectives. The outline did not at this point address in detail such obvious issues as (1) the inherent differences between a wastewater agency and a water supply agency, (2) legal questions that pertain to the ownership of water rights, (3) the scope of any regulatory authority that may be needed, or (4) the permitting process inherent in any implementing plan. It was our preliminary view that such details, while extremely important, will be more properly addressed in the refinement stages of the study. This is particularly so should Alternative "B" be selected. Under that

alternative, the single agency can be authorized to move into and out of particular geographical areas based upon types of service to be provided, need and financial capacity of the areas and entities involved.

Finally, a ranking of the alternatives in light of the objective sought:

- o First Choice: Conceding that very complex political and policy decisions are inherent in Alternative B, nevertheless, that alternative is our first choice by a wide margin. In our view, the ability to "write the law," the ability to finance various needs on a sub-regional basis under the same umbrella agency (even in less developed areas through subregional taxing power), and the inherent ability to adjust activities to meet changing needs over a long period of time make this the desirable alternative.
  
- o Second and Third Choice: Under either Alternative A or Alternative C, some portions of the County's objective, as we have defined it, can be achieved. However, the choice between these two cannot be made in our view without further definition of the objective itself. Therefore, we do not rank these alternatives at this time.

## 5.2 SELECTION OF INSTITUTIONAL STRATEGY

Selection of the most appropriate and acceptable institutional forum is critical to successful implementation of this plan. The agency(s) needs financial and political stability. It also needs the trust, support and participation of the customer wholesale utilities. It is assumed that the regional system will provide wholesale service to other entities who will deliver the retail service to individual customers within their respective service boundaries.

It is expected that some combination of all three preferred strategies will be employed in the final plan. However, creation of a county-wide agency with broad planning, financing and operating powers is considered the primary strategy. Steps need to be initiated immediately to define the powers and organization of such an agency, to draft legislation for its creation and to start the process for building support to assure passage of such legislation. The scope of powers and duties for such a regional agency should be broad. Specific consideration should be given to including the regulation of ground-water supplies, certain aspects of watershed protection, septic tank controls around the lakes, acquisition of raw water supplies and contracts with other agencies for operation of regional facilities.

TABLE 5-1  
SUMMARY OF PRELIMINARY PREFERENCE RATINGS  
OPTIONAL INSTITUTION STRATEGIES  
DENTON COUNTY PLANNING STUDY

Institutional Option	Average Rating				
	Study Participants		Engineering Project Team		
	Low	High	1	2	5
1. Strategically located cities in Denton County provide wholesale treated water or wastewater service to their neighbors.	3.63	4.20			
2. Three or four major cities form a partnership to provide wholesale treated water or wastewater service on a regional basis.	3.10	3.00			
3. Cities (large or small) jointly fund a treatment plant to meet their needs. Contract with one city to operate.	3.26	4.20			
4. Contract with a private entity such as a water corporation to build and operate a regional treatment plant.	2.53	1.40			
5. Dallas build a regional water treatment plant in Denton County supported solely by Denton County revenues.	2.16	2.00			
6. Dallas expand its treated water transmission system further into Denton County.	2.68	2.60			
7. Include nearby cities of adjoining counties in the regional system.	3.06	3.40			
8. Provide for interconnection between Denton County system and other water systems in Dallas, Collin and Tarrant Counties.	3.00	4.20			

TABLE 5-1 (Concluded)

Institutional Option	Average Rating				
	Study Participants		Engineering Project Team		
	Low	High	1	2	3
9. A nearby agency such as Trinity River Authority or North Texas Municipal Water District provide service in Denton County.	2.47	2.80			
10. Contract with an agency such as TRA or NTMWD to serve an isolated area near the county line.	3.33	4.60			

TABLE 5-2  
DENTON COUNTY WATER STUDY  
ALTERNATIVE GENERAL STRATEGIES

- 
- 
- A.\* Wholesale contracts between cities, other public agencies and local utilities. Strategically located cities in Denton County would provide wholesale treated water or wastewater service to neighboring cities, other public agencies and local utilities. When appropriate, provide for joint funding and ownership of major facilities. Where feasible, provide for emergency interconnections with other water systems.
- B.\* Create county-wide regional agency. By legislation, establish a regional agency without taxing power, but with broad powers to provide services supported by contract revenue bond financing. Except by mutual agreement, the agency would not take over facilities or responsibilities of existing utilities. Would provide wholesale services that are complementary and supplementary to retail services provided by municipal and other local water and wastewater utilities. As an umbrella agency with county-wide responsibilities, take the initiative to plan for and to finance those services best provided on a regional basis, including raw water supplies, transmission lines, water treatment plants, regional storage and wastewater treatment plants. Operate or contract for operation of regional facilities and provide wholesale services at cost to participating utilities. Facilitate joint funding of major facilities. With concurrence of affected cities, facilitate the creation of subregional systems with powers to finance local infrastructure--where utility revenues are not sufficient. Regulate septic tanks in a water quality zone around the water supply reservoirs and plan for the best use and distribution of limited ground water supplies. Implement the regional plan as an interconnected regional network and provide for emergency interconnection with water systems in adjoining



TABLE 5-2 (Cont'd)

- 
- 
- counties. When mutually agreeable, contract with cities and other utilities to operate local treatment works.
- C. Create special districts to provide wholesale and retail services on a sub-regional basis. To respond to the different needs of various parts of the county, establish two or more special districts with broad powers to plan, build and operate regional water and wastewater facilities. Provide wholesale services to local utilities and retail service in or out of cities as agreed upon. When mutually agreeable, contract with cities and other utilities to operate local treatment works.
- D. Create county-wide agency for raw water supply and for regional wastewater services. Similar responsibilities as Alternative B but limited to raw water supplies and regional wastewater services. The cities would provide wholesale treated water services per Alternative A.
- E. Create a regional agency representing specific member cities. Similar powers and scope of services as Alternative B. However, it would not have specific boundaries. Rather, it would provide wholesale water and wastewater services to those specific cities who join the system; also, provide wholesale services by contract to other retail utilities.
- F.\* Contract with existing regional entities based outside Denton County. Provide for similar services and powers as described in other alternatives by contracting with agencies such as Trinity River Authority or North Texas Municipal Water District. Such contracts could be with one or more cities but should be coordinated with the regional plan. Such contracts could provide only for financing of infrastructure or could also provide for the construction and

TABLE 5-2 (Concluded)

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operation of facilities. This concept would most likely be considered for a subregional system where there is both a need and a community of interest. However, it could, possibly work as a way of providing certain services outlined in Alternative B.

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- \* Selected by the Steering Committee as a preferred strategy. The three preferred strategies are considered most appropriate for the circumstances in Denton County and form the basis for the remainder of this report.

## 6.0 INVESTIGATIONS AND EVALUATION OF WATER SERVICE PLANS

### 6.1 INTRODUCTION

The objective of this section of the Denton County Planning Study is to make investigations to develop alternative infrastructure plans for providing water service to the Denton County communities and water supply corporations within the planning area. Alternative studies consider the potential water demand for the years 1986 through 2010. The demands which were developed in the Phase II Report consider population projections, per capita consumption, average and peak day demands for normal and drought weather conditions. Investigations indicate that the total average daily demand for the study area in the year 2010 will be approximately 119.1 MGD for normal weather conditions and 137.0 MGD during drought conditions. The criteria developed hereinafter are used to evaluate the general infrastructure requirements to achieve a functional, operative and cost-effective engineering design that can be incorporated into a functioning regional institutional management plan and that can effectively provide service to the Denton County communities.

The alternate water infrastructure plans presented are preliminary in nature for study and general planning purposes only, and are not considered to be final. Final construction plans are beyond the scope of this report.

An inventory of the existing water facilities within the study area was made and is presented in Section 3.0 of this report. Major factors that impact the development of infrastructure plans are:

1. The Cities of Denton and Lewisville operate water treatment facilities and purchase raw water from Dallas. Denton does, however, have water rights as set forth in Section 4.0.

2. The Cities of The Colony, Carrollton and Lewisville and the Town of Flower Mound purchase treated water from the City of Dallas.
3. All other entities in the planning area depend on declining ground-water supplies, which are inadequate to meet their future demands.

## 6.2 GENERAL DESIGN CRITERIA

General design criteria and other parameters considered necessary to develop alternate infrastructure plans are as set forth herein:

1. The Cities of Denton and Lewisville now have capital improvement programs underway for expansion of their respective water treatment plants. Therefore, to maximize the use of the plants and distribution systems, it is reasonable to assume that the two cities will plan to develop the projected plant expansions to their planned capacities for the purpose of serving their own citizens plus other entities under contract until the other entities become part of the proposed regional system.
2. To assist in the orderly development and planning for facilities necessary to serve treated water to all of the cities within the study area, the County will need to be subdivided into service areas that will:
  - a. utilize the existing facilities and expand such facilities as necessary to serve other cities within the designated service area; and
  - b. construct new water treatment plants and service mains where it would be more economical to do so because of Lake Lewisville topographic constraints.
3. Recognize the fact that Lake Lewisville topographic features, with three major arms, make it necessary to develop around the lake

rather than crossing the lake with underwater pipelines at prohibitive costs and operational hazards.

4. The plans consider only the treatment and distribution of potable water to the vicinity of cities. Other entities would need to make arrangements for connections thereto. The plans will utilize the raw water supply sources from Lake Lewisville and Lake Ray Roberts.
5. Additional sources of raw water supplies are required in the future.
6. Treated water service demands, required by those water supply corporations serving cities, are included in the demand quantities for the various cities shown in Table 2-5.
7. The alternate plans should consider interconnections with other water supply systems adjacent to the County. Namely, the North Texas Municipal Water District (NTMWD) on the east, Dallas on the south and Fort Worth on the southwest.
8. Consideration should be given to the potential for positive benefits of providing water service in the future to rapidly growing areas bordering Denton County, where mutually beneficial and where consistent with the Plan.
9. Water demand factors evaluated elsewhere in other sections of this report are summarized as follows:
  - a. Maximum Daily Demand = Average Day x 2.1 factor;
  - b. Drought Demand = Average Day x 1.15 factor; and
10. The approved ground-water strategy goal assumes that all cities dependent on ground-water supplies will convert to a surface water supply before year 2010.

### 6.3 SPECIFIC DESIGN PARAMETERS

In addition to the above general design criteria, other requirements and considerations that will influence the proposed infrastructure alternate plans are as follows:

1. Water Rights: Water rights in Lakes Lewisville and Ray Roberts, expressed as firm yield, are as follows:

	Lewisville	Ray Roberts
Dallas Rights	84.20	56.24
Denton Rights	<u>4.30</u>	<u>19.76</u>
Total Water Rights	88.50 MGD	76.00 MGD

Based on the firm yield in Lake Ray Roberts, Denton's rights would normally serve a water treatment plant having a maximum capacity equal to  $19.76 \times 2.1 = 41.5$  MGD. Thus, water supply to a proposed water treatment plant below Lake Ray Roberts would ordinarily be limited to 41.5 MGD capacity unless more supply from Dallas is negotiated.

2. City of Denton Water Treatment Plant: The City of Denton's existing water treatment plant has a capacity of 24.0 MGD. Present plans are to expand the plant to 30.0 MGD in year 1988. In addition, the City is making plans to construct an 8.0 to 10.0 MGD plant at Lake Ray Roberts with provision to expand the plant in stages to an ultimate capacity up to 100 MGD.

Thus, the City of Denton's plans for a plant at Lake Ray Roberts will have an impact on the size of any proposed regional infrastructure system to serve other cities.

3. City of Lewisville Water Treatment Plant: The City of Lewisville owns and operates a 12.0 MGD water treatment plant and plans to

expand the plant to its ultimate 18.0 MGD capacity by 1995. Also, the 6.0 MGD to be purchased from the Dallas/Colony system will give Lewisville a total of 24.0 MGD treated water capacity available to meet its demands.

4. Existing Colony Pipeline: Data and service allocations from the pipeline supply from Dallas' Elm Fork Water Treatment Plant are as follows:

- a. Size of line - 36" diameter
- b. Capacity - 22.5 MGD; V = 4.92 fps
- c. City of The Colony now has a contract with Dallas for 7.1 MGD with an option for an additional 3.0 MGD. Based on current projections, a 10.1 MGD treated water supply is expected to be adequate until the year 2010, including Eastvale, which is expected to consolidate with The Colony.
- d. Lewisville has a contract to purchase 6.0 MGD from the Dallas/Colony system.
- e. Potential usage of water from the Colony pipeline is:

(1) The Colony	10.1 MGD
(2) Lewisville	6.0
(3) Other entities in South and East regional service areas	<u>6.4</u>
Total	22.5 MGD

5. Existing Flower Mound Pipeline: The City of Flower Mound has a contract with Dallas to purchase 11.0 MGD from the existing 30" diameter pipeline. The line capacity is 11.0 MGD and V = 3.47 fps.

6. Water Transmission Line Parameters: In general, the regional water transmission lines and distribution system network will be

TABLE 6-9  
TREATED WATER REQUIREMENTS FOR  
CITY WHOLESALE CONCEPT  
CITIES WITHIN THE DENTON WHOLESALE SERVICE AREA

	Average Daily Demand (MGD)		
	1990	2000	2010
Argyle	0.26	0.56	0.87
Aubrey	0.16	0.25	0.35
Corinth	0.92	2.89	5.09
Corral City	0.01	0.02	0.02
Cross Roads	0.05	0.08	0.12
Denton	12.36	18.16	23.20
Hickory Creek	0.40	0.91	1.72
Justin	0.15	0.29	0.64
Krugerville	0.09	0.15	0.24
Krum	0.16	0.21	0.30
Lake Dallas	0.43	0.50	0.54
Lincoln Park	0.05	0.08	0.13
Northlake	0.02	0.04	0.05
Pilot Point	0.33	0.58	0.86
Ponder	0.04	0.06	0.08
Sanger	0.65	1.28	2.20
Shady Shores	<u>0.14</u>	<u>0.20</u>	<u>0.22</u>
<b>TOTAL AVERAGE DAILY DEMAND</b>	<b>16.22</b>	<b>26.26</b>	<b>36.63</b>
Drought Demand <sup>1</sup>	18.65	30.20	42.12
Required Treatment Plant Capacity <sup>2</sup>	39.17	63.42	88.45
Less Existing Plant Capacity	30.00	30.00	30.00
New Plant Capacity Required	9.17	33.42	58.45

<sup>1</sup> Drought demand is estimated to be 15% greater than average day demand.

<sup>2</sup> Treatment capacity is estimated to be 2.1 times drought demand.



TABLE 6-10  
TREATED WATER REQUIREMENTS FOR  
CITY WHOLESALE CONCEPT  
CITIES WITHIN THE LEWISVILLE WHOLESALE SERVICE AREA

	Average Daily Demand (MGD)		
	1990	2000	2010
Bartonville	0.22	0.69	1.27
Copper Canyon	0.27	0.81	1.41
Double Oak	0.42	0.72	0.92
Flower Mound (Excess over Dallas Supply)	0.00	3.76	8.39
Highland Village	2.02	5.00	5.80
Lewisville	<u>10.39</u>	<u>21.05</u>	<u>26.08</u>
<b>TOTAL AVERAGE DAILY DEMAND</b>	<b>13.32</b>	<b>32.03</b>	<b>43.87</b>
Drought Demand <sup>1</sup>	15.32	36.83	50.45
Required Treatment Plant Capacity <sup>2</sup>	32.17	77.34	105.94
Less Treated Water Available <sup>3</sup>	24.00	24.00	24.00
New Plant Capacity Required	8.17	53.34	81.94

<sup>1</sup> Drought demand is estimated to be 15% greater than average day demand.

<sup>2</sup> Treatment capacity is estimated to be 2.1 times drought demand.

<sup>3</sup> The treated water available includes the planned treatment plant capacity of 18.0 MGD, plus 6.0 MGD contracted from Dallas out of The Colony pipeline.

TABLE 6-11  
TREATED WATER REQUIREMENTS FOR  
CITY WHOLESALE CONCEPT  
CITIES WITHIN THE COLONY WHOLESALE SERVICE AREA

	Average Daily Demand (MGD)		
	1990	2000	2010
Carrollton <sup>1</sup> (1/2 of Denton Co. Portion)	0.00	7.29	10.28
Lakewood Village	0.02	0.04	0.05
Little Elm	0.15	0.22	0.37
Oak Point	0.12	0.16	0.21
The Colony <sup>2</sup>	<u>2.90</u>	<u>3.91</u>	<u>5.06</u>
<b>TOTAL AVERAGE DAILY DEMAND</b>	<b>3.19</b>	<b>11.62</b>	<b>15.97</b>
Drought Demand <sup>3</sup>	3.67	13.36	18.37
Treated Water Capacity Required <sup>4</sup>	7.70	28.06	38.58
Less Pipeline Capacity Available <sup>5</sup>	16.50	16.50	16.50
New Plant Capacity Required	-	11.56	22.08

- <sup>1</sup> It is anticipated that Carrollton would not tie into The Colony system until after 1990. In the meantime, Carrollton's needs can be met directly from the Dallas system.
- <sup>2</sup> Average daily demand for The Colony includes water demands previously estimated for Eastvale.
- <sup>3</sup> Drought demand is estimated to be 15% greater than average day demand.
- <sup>4</sup> Treatment capacity is estimated to be 2.1 times drought demand.
- <sup>5</sup> The Colony pipeline capacity, 22.5 MGD, minus the 6.0 MGD contract between Lewisville and Dallas.

TABLE 6-13

SERVICE SCHEDULE FOR TRI-REGIONAL STRATEGY  
CITIES WITHIN THE NORTH REGIONAL SERVICE AREA

	Average Daily Demand (MGD)		
	1990	2000	2010
Aubrey	--	0.25	0.35
Cross Roads	--	--	0.12
Denton <sup>1</sup>	2.03	10.51	18.72
Krugerville	--	0.15	0.24
Lincoln Park	--	--	0.13
Pilot Point	--	0.58	0.86
Sanger	<u>0.65</u>	<u>1.28</u>	<u>2.20</u>
<b>TOTAL AVERAGE DAILY DEMAND</b>	<b>2.68</b>	<b>12.77</b>	<b>22.62</b>
Drought Demand <sup>2</sup>	3.08	14.69	26.01
North Regional Plant Capacity Required <sup>3</sup>	6.47	30.85	54.63

<sup>1</sup> Additional average daily demand required by the City of Denton to serve their wholesale customers, as determined in Table 6-12.

<sup>2</sup> Drought demand is estimated to be 15% greater than average day demand.

<sup>3</sup> Treatment capacity is estimated to be 2.1 times drought demand.

-- No service scheduled.

TABLE 6-14  
 SERVICE SCHEDULE FOR TRI-REGIONAL STRATEGY  
 CITIES WITHIN THE LEWISVILLE WHOLESALE SERVICE AREA

	Average Daily Demand (MGD)		
	1990	2000	2010
Highland Village <sup>1</sup>	2.02	5.00	5.80
Lewisville	<u>10.39</u>	<u>21.05</u>	<u>26.08</u>
TOTAL AVERAGE DAILY DEMAND	12.41	26.05	31.88
Drought Demand <sup>2</sup>	14.27	29.96	36.66
Required Treatment Plant Capacity <sup>3</sup>	29.97	62.92	76.99
Less Lewisville Plant Capacity <sup>4</sup>	24.00	24.00	24.00
Additional Water Required <sup>5</sup>	5.97	38.92	52.99

- 1 Highland Village could obtain directly from the Regional System any excess over what Lewisville can supply under contract.
- 2 Drought demand is estimated to be 15% greater than average day demand.
- 3 Treatment capacity is estimated to be 2.1 times drought demand.
- 4 The treated water available from Lewisville includes the treatment plant capacity, 18.0 MGD, plus 6.0 MGD contracted from Dallas out of The Colony pipeline.
- 5 Additional treated water required would be supplied by the proposed South Regional Plant.

TABLE 6-15  
 SERVICE SCHEDULE FOR TRI-REGIONAL STRATEGY  
 CITIES WITHIN THE SOUTH REGIONAL SERVICE AREA

	Average Daily Demand (MGD)		
	1990	2000	2010
Argyle	0.26	0.56	0.87
Bartonville	0.22	0.69	1.27
Copper Canyon	0.27	0.81	1.41
Corral City	0.01	0.02	0.02
Double Oak	0.42	0.72	0.92
Flower Mound (Excess over Dallas Supply)	--	3.76	8.39
Justin	--	--	0.64
Highland Village <sup>1</sup>	--	--	--
Lewisville <sup>2</sup>	2.47	16.12	21.94
Northlake	--	--	<u>0.05</u>
<b>TOTAL AVERAGE DAILY DEMAND</b>	<b>3.65</b>	<b>22.68</b>	<b>35.51</b>
Drought Demand <sup>3</sup>	4.20	26.08	40.84
South Regional Plant Capacity Required <sup>4</sup>	8.81	54.77	85.76

<sup>1</sup> Service to Highland Village is scheduled from the Lewisville System. However, they could obtain from the South Regional System any excess requirements over what Lewisville can supply under contract.

<sup>2</sup> Additional average daily demand required by the City of Lewisville to serve their wholesale customers as determined in Table 6-14.

<sup>3</sup> Drought demand is estimated to be 15% greater than average day demand.

<sup>4</sup> Treated water required is estimated to be 2.1 times drought demand.

-- No service scheduled.

TABLE 6-16  
 SERVICE SCHEDULE FOR TRI-REGIONAL STRATEGY  
 CITIES SERVED WITHIN EAST REGIONAL SERVICE AREA

	Average Daily Demand (MGD)		
	1990	2000	2010
Carrollton <sup>1</sup> (1/2 of Denton Co. Portion)	--	7.29	10.28
Lakewood Village	--	--	0.05
Little Elm	--	0.22	0.37
Oak Point	--	--	0.21
The Colony <sup>2</sup>	<u>2.90</u>	<u>3.91</u>	<u>5.06</u>
<b>TOTAL AVERAGE DAILY DEMAND</b>	<b>2.90</b>	<b>11.42</b>	<b>15.97</b>
Drought Demand <sup>3</sup>	3.34	13.13	18.37
Treated Water Capacity Required <sup>4</sup>	7.01	27.57	38.58
Pipeline Capacity Available <sup>5</sup>	16.50	16.50	16.50
New Plant Capacity Required	-	11.07	22.08

- <sup>1</sup> It is anticipated that Carrollton would not tie into The East Regional system until after 1990. In the meantime, Carrollton's needs can be met directly from the Dallas system.
- <sup>2</sup> Average daily demands for The Colony include water demands previously estimated for Eastvale.
- <sup>3</sup> Drought demand is estimated to be 15% greater than average day demand.
- <sup>4</sup> Treatment capacity is estimated to be 2.1 times drought demand.
- <sup>5</sup> The Colony pipeline capacity, 22.5 MGD, minus the 6.0 MGD contract between Lewisville and Dallas.
- No service scheduled.

TABLE 6-17  
 SERVICE SCHEDULE FOR COMPREHENSIVE REGIONAL STRATEGY  
 CITIES WITHIN THE NORTH REGIONAL SERVICE AREA

	Average Daily Demand (MGD)		
	1990	2000	2010
Aubrey	--	0.25	0.35
Corinth	0.92	2.89	5.09
Cross Roads	--	--	0.12
Denton	12.36	18.16	23.20
Hickory Creek	0.40	0.91	1.72
Krugerville	--	0.15	0.24
Krum	--	--	0.30
Lake Dallas	0.43	0.50	0.54
Lincoln Park	--	--	0.13
Pilot Point	--	0.58	0.86
Ponder	--	--	0.08
Sanger	0.65	1.28	2.20
Shady Shores	<u>0.14</u>	<u>0.20</u>	<u>0.22</u>
<b>TOTAL AVERAGE DAILY DEMAND</b>	<b>14.90</b>	<b>24.92</b>	<b>35.05</b>
Drought Demand <sup>1</sup>	17.14	28.66	40.31
Required Treatment Plant Capacity <sup>2</sup>	35.99	60.19	84.65
Less Denton Plant Capacity	30.00	30.00	30.00
North Regional Plant Capacity Required	5.99	30.19	54.65

- <sup>1</sup> Drought demand is estimated to be 15% greater than average day demand.  
<sup>2</sup> Treatment capacity is estimated to be 2.1 times drought demand.  
 -- No service scheduled.

TABLE 6-18

SERVICE SCHEDULE FOR COMPREHENSIVE REGIONAL STRATEGY  
CITIES WITHIN THE SOUTH-EAST REGIONAL SERVICE AREA

	Average Daily Demand (MGD)		
	1990	2000	2010
Argyle	0.26	0.56	0.87
Bartonville	0.22	0.69	1.27
Carrollton <sup>1</sup>	7.86	14.58	20.56
Copper Canyon	0.27	0.81	1.41
Corral City	--	--	0.02
Double Oak	0.42	0.72	0.92
Eastvale	0.07	0.11	0.15
Flower Mound (Excess over Dallas Supply)	--	3.76	8.39
Highland Village	2.02	5.00	5.80
Justin	--	--	0.64
Lakewood Village	--	--	0.05
Lewisville	10.39	21.05	26.08
Little Elm	--	0.22	0.37
Northlake	--	--	0.05
Oak Point	--	--	0.21
<b>TOTAL AVERAGE DAILY DEMAND</b>	<b>21.51</b>	<b>47.50</b>	<b>66.79</b>
Drought Demand <sup>2</sup>	24.74	54.63	76.81
Required Treatment Plant Capacity <sup>3</sup>	51.95	114.72	161.30



TABLE 6-18 (Concluded)

	Average Daily Demand (MGD)		
	1990	2000	2010
Less Existing Lewisville Capacity (18 + 6.0 from Dallas)	24.00	24.00	24.00
East Regional Plant Capacity Required	27.95	90.72	137.30

- 1 Assumes that the entire demand of the Denton County portion of Carrollton would be met by the regional system.
- 2 Drought demand is estimated to be 15% greater than average day demand.
- 3 Treatment capacity is estimated to be 2.1 times drought demand.
- No service scheduled.

TABLE 6-19  
 SERVICE SCHEDULE FOR CITY WHOLESALE CONCEPT  
 CITIES WITHIN THE DENTON WHOLESALE SERVICE AREA

	Average Daily Demand (MGD)		
	1990	2000	2010
Argyle	0.26	0.56	0.87
Aubrey	--	0.25	0.35
Corinth	0.92	2.89	5.09
Corral City	--	--	0.02
Cross Roads	--	--	0.12
Denton	12.36	18.16	23.20
Hickory Creek	0.40	0.91	1.72
Justin	--	--	0.64
Krugerville	--	0.15	0.24
Krum	--	--	0.30
Lake Dallas	0.43	0.50	0.54
Lincoln Park	--	--	0.13
Northlake	--	--	0.05
Pilot Point	--	0.58	0.86
Ponder	--	--	0.08
Sanger	0.65	1.28	2.20
Shady Shores	<u>0.14</u>	<u>0.20</u>	<u>0.22</u>
<b>TOTAL AVERAGE DAILY DEMAND</b>	<b>15.16</b>	<b>25.48</b>	<b>36.63</b>
Drought Demand <sup>1</sup>	17.43	29.30	42.12
Required Treatment Plant Capacity <sup>2</sup>	36.60	61.53	88.45
Less Existing Plant Capacity	30.00	30.00	30.00
New Plant Capacity Required	6.60	31.53	58.45

<sup>1</sup> Drought demand is estimated to be 15% greater than average day demand.

<sup>2</sup> Treatment capacity is estimated to be 2.1 times drought demand.

-- No service scheduled.

TABLE 6-20  
 SERVICE SCHEDULE FOR CITY WHOLESALE CONCEPT  
 CITIES WITHIN THE LEWISVILLE WHOLESALE SERVICE AREA

	Average Daily Demand (MGD)		
	1990	2000	2010
Bartonville	0.22	0.69	1.27
Copper Canyon	0.27	0.81	1.41
Double Oak	0.42	0.72	0.92
Flower Mound (Excess over Dallas Supply)	--	3.76	8.39
Highland Village	2.02	5.00	5.80
Lewisville	<u>10.39</u>	<u>21.05</u>	<u>26.08</u>
<b>TOTAL AVERAGE DAILY DEMAND</b>	<b>13.32</b>	<b>32.03</b>	<b>43.87</b>
Drought Demand <sup>1</sup>	15.32	36.83	50.45
Required Treatment Plant Capacity <sup>2</sup>	32.17	77.34	105.94
Less Treated Water Available <sup>3</sup>	24.00	24.00	24.00
New Plant Capacity Required	8.17	53.34	81.94

<sup>1</sup> Drought demand is estimated to be 15% greater than average day demand.

<sup>2</sup> Treatment capacity is estimated to be 2.1 times drought demand.

<sup>3</sup> The treated water available includes the planned treatment plant capacity of 18.0 MGD, plus 6.0 MGD contracted from Dallas out of The Colony pipeline.

-- No service scheduled.

TABLE 6-21  
 SERVICE SCHEDULE FOR CITY WHOLESAL CONCEPT  
 CITIES WITHIN THE COLONY WHOLESAL SERVICE AREA

	Average Daily Demand (MGD)		
	1990	2000	2010
Carrollton <sup>1</sup> (1/2 of Denton Co. Portion)	--	7.29	10.28
Lakewood Village	--	--	0.05
Little Elm	--	0.22	0.37
Oak Point	--	--	0.21
The Colony <sup>2</sup>	<u>2.90</u>	<u>3.91</u>	<u>5.06</u>
<b>TOTAL AVERAGE DAILY DEMAND</b>	<b>2.90</b>	<b>11.42</b>	<b>15.97</b>
Drought Demand <sup>3</sup>	3.34	13.13	18.37
Treated Water Capacity Required <sup>4</sup>	7.01	27.57	38.58
Less Pipeline Capacity Available <sup>5</sup>	16.50	16.50	16.50
New Plant Capacity Required	-	11.07	22.08

- <sup>1</sup> It is anticipated that Carrollton would not tie into The Colony system until after 1990. In the meantime, Carrollton's needs can be met directly from the Dallas system.
- <sup>2</sup> Average daily demands for The Colony include water demands previously estimated for Eastvale.
- <sup>3</sup> Drought demand is estimated to be 15% greater than average day demand.
- <sup>4</sup> Treatment capacity is estimated to be 2.1 times drought demand.
- <sup>5</sup> The Colony pipeline capacity, 22.5 MGD, minus the 6.0 MGD contract between Lewisville and Dallas.
- No service scheduled.

TABLE 6-22  
SCHEDULE FOR WATER SERVICE  
TO THE CITIES

Cities	Year*
Argyle	1990
Aubrey	2000
Bartonville	1990
Carrollton	2000
Copper Canyon	1990
Corral City	2010
Cross Roads	2010
Denton	1990
Double Oak	1990
Flower Mound	2000
Highland Village	1990
Justin	2010
Krugerville	2000
Krum	2010
Lakewood Village	2010
Lewisville	1990
Lincoln Park	2010
Little Elm	2000
Northlake	2010
Oak Point	2010
Pilot Point	2000
Ponder	2010
Sanger	1990
The Colony	2010

\* Year is the estimated year of need for connecting to the proposed regional water system based on current estimates of growth and demand and estimates of existing and currently planned capacities.

Note: Cities not listed would continue to be served by or through the system of other entities.

TABLE 6-23  
WATER FACILITIES - PRELIMINARY IMPLEMENTATION SCHEDULE  
FOR TRI-REGIONAL STRATEGY

Item	Year of Need		
	1990	2000	2010
<u>NORTH REGIONAL SERVICE AREA</u>			
1. Raw Water Intake, 55 MGD	X		
2. Plant Land Cost, 30 Ac	X		
3. First Stage Treatment Plant, 7.0 MGD	X		
4. Second Stage Addition to Plant, 24.0 MGD		X	
5. Third Stage Addition to Plant, 24.0 MGD			X
6. Plant Discharge Piping, 72 x 60	X		
7. 18" $\phi$ to Sanger	X		
8. 60" $\phi$ Main	X		
9. 54" $\phi$ Main	X		
10. 4.0 M Gallon Ground Storage	X		
11. 16" $\phi$ Main, Conn. to Argyle			X
12. 16" $\phi$ Conn. to Aubrey		X	
13. 12" $\phi$ Conn. to Krugerville		X	
14. 12" $\phi$ Conn. to Pilot Point			X
15. 12" $\phi$ Conn. to Denton, Cross Roads and Lincoln Park		X	
16. 12" $\phi$ Conn. K-ville/Cross Roads			X
17. 12" $\phi$ Conn. to Krum			X
18. 12" $\phi$ Conn. to Ponder			X
<u>SOUTH REGIONAL SERVICE AREA</u>			
19. Raw Water Intake	X		
20. 72" $\phi$ Raw Water	X		
21. Plant Land Cost	X		
22. First Stage Treatment Plant	X		
23. Second Stage Plant Addition		X	
24. Third Stage Plant Addition			X
25. 72" $\phi$ Plant/Dist.	X		
26. 54" $\phi$ to Highland Village	X		
27. 30" $\phi$ to Copper Canyon	X		
28. 24" $\phi$ to Double Oak	X		
29. 20" $\phi$ to Bartonville	X		
30. 16" $\phi$ to Argyle	X		
31. 12" $\phi$ Justin, H. Lake, Corral City			X
32. 36" $\phi$ to Flower Mound		X	
33. 4.0 M Gallon Ground Storage		X	
<u>EAST REGIONAL SERVICE AREA</u>			
34. Raw Water Intake, 23 MGD		X	
35. 42" $\phi$ Raw Water		X	
36. Plant Land Cost, 20 Ac		X	
37. First Stage Plant, 11.5 MGD		X	
38. Second Stage Plant, 11.5 MGD			X
39. 42" $\phi$ to Carrollton		X	
40. 4.0 M Gallon Ground Storage		X	
41. 12" $\phi$ to Little Elm		X	
42. 12" $\phi$ to Lakewood Village and Oak Point			X
43. 12" $\phi$ Interconnection to Lincoln Park			X

TABLE 6-24  
SUMMARY: PRELIMINARY ESTIMATED CONSTRUCTION COST OF  
ALTERNATIVE WATER SERVICE PLANS

Item	Estimated Cost-Year			Grand Total
	1990	2000	2010	
<b>TRI-REGIONAL CONCEPT</b>				
1. North Regional Service Area	\$21,172,400	\$22,148,020	\$23,529,760	\$ 66,850,180
2. South Regional Service Area	23,912,700	41,102,240	32,222,560	97,237,500
3. East Regional Service Area	<u>0.00</u>	<u>25,445,700</u>	<u>11,045,800</u>	<u>36,491,500</u>
TOTAL	\$45,085,100	\$88,695,960	\$66,798,120	\$200,579,180
<b>COMPREHENSIVE REGIONAL CONCEPT</b>				
1. North Regional Service Area	\$21,172,400	\$22,148,020	\$24,816,960	\$ 68,137,380
2. South-East Regional Service Area	<u>77,334,900</u>	<u>48,709,940</u>	<u>35,545,800</u>	<u>161,590,640</u>
TOTAL	\$98,507,300	\$70,857,960	\$60,362,760	\$229,728,020
<b>CITY WHOLESALE CONCEPT</b>				
1. Denton Service Area	\$22,084,400	\$22,148,020	\$26,301,520	\$ 70,533,940
2. Lewisville Service Area	25,086,000	40,352,400	29,600,000	95,038,400
3. Colony Service Area	<u>0.00</u>	<u>25,445,700</u>	<u>11,045,800</u>	<u>36,491,500</u>
TOTAL	\$47,170,400	\$87,946,120	\$66,947,320	\$202,063,840

Note: These estimates do not include allowances for engineering, construction administration and inspection, legal fees, cost of financing nor right-of-way acquisition. Not including right-of-way, a reasonable estimate of such costs would be 15 to 20%.

DENTON COUNTY WATER AUTHORITY-PROPOSED WATER SYSTEM REVENUE BONDS (Includes 36 Mos. Capitalized Interest)

FISCAL YEAR (9-30)	PROPOSED \$77,795,000 DCWA WATER SYSTEM REVENUE BONDS, DATED SEPT. 1, 1990	LESS: CAPITALIZED INTEREST	LESS: RESERVE FUND EARNINGS	PROPOSED \$113,410,000 DCWA WATER SYSTEM REVENUE BONDS, DATED MARCH 1, 2000	LESS: RESERVE FUND EARNINGS	PROPOSED \$85,615,000 DCWA WATER SYSTEM REVENUE BONDS, DATED MARCH 1, 2010	LESS: RESERVE FUND EARNINGS	LESS: INTEREST EARNINGS ON CONSTRUCTION FUND	NET DEBT SERVICE REQUIREMENTS	FISCAL YEAR (9-30)
1989/1990										1989/1990
1990/1991			\$618,000					\$2,917,312	\$0	1990/1991
1991/1992	\$5,835,000	\$5,835,000	\$618,000						\$0	1991/1992
1992/1993	\$5,835,000	\$5,835,000	\$618,000						\$0	1992/1993
1993/1994	\$8,048,750		\$618,000						\$7,430,750	1993/1994
1994/1995	\$8,068,750		\$618,000						\$7,450,750	1994/1995
1995/1996	\$8,073,750		\$618,000						\$7,455,750	1995/1996
1996/1997	\$8,063,750		\$618,000						\$7,445,750	1996/1997
1997/1998	\$8,135,000		\$618,000						\$7,517,000	1997/1998
1998/1999	\$8,087,500		\$618,000						\$7,469,500	1998/1999
1999/2000	\$8,121,250		\$618,000	\$4,252,500	\$415,000			\$4,252,500	\$7,088,250	1999/2000
2000/2001	\$8,132,500		\$618,000	\$10,911,250	\$830,000				\$17,595,750	2000/2001
2001/2002	\$8,121,250		\$618,000	\$10,916,250	\$830,000				\$17,589,500	2001/2002
2002/2003	\$8,087,500		\$618,000	\$10,906,250	\$830,000				\$17,545,750	2002/2003
2003/2004	\$8,127,500		\$618,000	\$10,977,500	\$830,000				\$17,657,000	2003/2004
2004/2005	\$8,137,500		\$618,000	\$10,930,000	\$830,000				\$17,619,500	2004/2005
2005/2006	\$8,117,500		\$618,000	\$10,963,750	\$830,000				\$17,633,250	2005/2006
2006/2007	\$8,067,500		\$618,000	\$10,975,000	\$830,000				\$17,594,500	2006/2007
2007/2008	\$8,083,750		\$618,000	\$10,963,750	\$830,000				\$17,599,500	2007/2008
2008/2009	\$8,062,500		\$618,000	\$10,930,000	\$830,000				\$17,544,500	2008/2009
2009/2010	\$8,196,250		\$618,000	\$10,970,000	\$830,000	\$3,210,000	\$312,500	\$3,210,000	\$17,405,750	2009/2010
2010/2011				\$10,980,000	\$830,000	\$8,248,750	\$625,000		\$17,773,750	2010/2011
2011/2012				\$10,960,000	\$830,000	\$8,298,750	\$625,000		\$17,803,750	2011/2012
2012/2013				\$10,910,000	\$830,000	\$8,237,500	\$625,000		\$17,692,500	2012/2013
2013/2014				\$10,926,250	\$830,000	\$8,265,000	\$625,000		\$17,736,250	2013/2014
2014/2015				\$11,001,250	\$830,000	\$8,277,500	\$625,000		\$17,823,750	2014/2015
2015/2016				\$10,935,000	\$830,000	\$8,275,000	\$625,000		\$17,755,000	2015/2016
2016/2017				\$10,927,500	\$830,000	\$8,257,500	\$625,000		\$17,730,000	2016/2017
2017/2018				\$10,971,250	\$830,000	\$8,225,000	\$625,000		\$17,741,250	2017/2018
2018/2019				\$10,962,500	\$830,000	\$8,273,750	\$625,000		\$17,781,250	2018/2019
2019/2020				\$10,997,500	\$830,000	\$8,300,000	\$625,000		\$17,842,500	2019/2020
2020/2021						\$8,303,750	\$625,000		\$7,678,750	2020/2021
2021/2022						\$8,285,000	\$625,000		\$7,660,000	2021/2022
2022/2023						\$8,243,750	\$625,000		\$7,618,750	2022/2023
2023/2024						\$8,276,250	\$625,000		\$7,651,250	2023/2024
2024/2025						\$8,278,750	\$625,000		\$7,653,750	2024/2025
2025/2026						\$8,251,250	\$625,000		\$7,626,250	2025/2026
2026/2027						\$8,290,000	\$625,000		\$7,665,000	2026/2027
2027/2028						\$8,195,000	\$625,000		\$7,570,000	2027/2028
2028/2029						\$8,166,250	\$625,000		\$7,541,250	2028/2029
2029/2030						\$8,196,250	\$625,000		\$7,571,250	2029/2030
	\$155,237,500		\$12,360,000	\$223,267,500	\$17,015,000	\$168,355,000	\$12,812,500	\$10,379,812	\$481,559,000	

ASSUMPTIONS:

- (1) INTEREST ON THE BONDS CALCULATED AT A RATE OF 7.5%
- (2) EARNINGS ON RESERVE FUND CALCULATED AT 7.5%
- (3) 36 MONTHS CAPITALIZED INTEREST ON INITIAL ISSUE

Note: 15.25% was added to estimates of construction cost as an allowance for engineering, financing and legal costs.



TABLE 6-26

FIRST *Southwest* COMPANY

DENVER COUNTY WATER AUTHORITY-PROPOSED WATER SYSTEM REVENUE BONDS (Does not include Capitalized Interest)

FISCAL YEAR (9-30)	PROPOSED \$57,650,000 DCWA WATER SYSTEM REVENUE BONDS, DATED SEPT. 1, 1990	LESS: RESERVE FUND EARNINGS	PROPOSED \$113,410,000 DCWA WATER SYSTEM REVENUE BONDS, DATED MARCH 1, 2000	LESS: RESERVE FUND EARNINGS	PROPOSED \$85,615,000 DCWA WATER SYSTEM REVENUE BONDS, DATED MARCH 1, 2010	LESS: RESERVE FUND EARNINGS	LESS: INTEREST EARNINGS ON CONSTRUCTION FUND	NET DEBT SERVICE REQUIREMENTS	FISCAL YEAR (9-30)
1989/1990								\$0	1989/1990
1990/1991	\$5,578,750	\$420,000					\$2,917,312	\$2,241,438	1990/1991
1991/1992	\$5,577,500	\$420,000						\$5,157,500	1991/1992
1992/1993	\$5,568,750	\$420,000						\$5,148,750	1992/1993
1993/1994	\$5,552,500	\$420,000						\$5,132,500	1993/1994
1994/1995	\$5,528,750	\$420,000						\$5,108,750	1994/1995
1995/1996	\$5,593,750	\$420,000						\$5,173,750	1995/1996
1996/1997	\$5,547,500	\$420,000						\$5,127,500	1996/1997
1997/1998	\$5,590,000	\$420,000						\$5,170,000	1997/1998
1998/1999	\$5,521,250	\$420,000						\$5,101,250	1998/1999
1999/2000	\$5,541,250	\$420,000	\$4,252,500	\$415,000			\$4,252,500	\$4,706,250	1999/2000
2000/2001	\$5,546,250	\$420,000	\$10,911,250	\$830,000				\$15,207,500	2000/2001
2001/2002	\$5,536,250	\$420,000	\$10,916,250	\$830,000				\$15,202,500	2001/2002
2002/2003	\$5,607,500	\$420,000	\$10,906,250	\$830,000				\$15,263,750	2002/2003
2003/2004	\$5,560,000	\$420,000	\$10,977,500	\$830,000				\$15,287,500	2003/2004
2004/2005	\$5,593,750	\$420,000	\$10,930,000	\$830,000				\$15,273,750	2004/2005
2005/2006	\$5,605,000	\$420,000	\$10,963,750	\$830,000				\$15,318,750	2005/2006
2006/2007	\$5,593,750	\$420,000	\$10,975,000	\$830,000				\$15,318,750	2006/2007
2007/2008	\$5,560,000	\$420,000	\$10,963,750	\$830,000				\$15,273,750	2007/2008
2008/2009	\$5,600,000	\$420,000	\$10,930,000	\$830,000				\$15,280,000	2008/2009
2009/2010	\$5,706,250	\$420,000	\$10,970,000	\$830,000	\$3,210,000	\$312,500	\$3,210,000	\$15,113,750	2009/2010
2010/2011			\$10,980,000	\$830,000	\$8,248,750	\$625,000		\$17,773,750	2010/2011
2011/2012			\$10,960,000	\$830,000	\$8,298,750	\$625,000		\$17,803,750	2011/2012
2012/2013			\$10,910,000	\$830,000	\$8,237,500	\$625,000		\$17,692,500	2012/2013
2013/2014			\$10,926,250	\$830,000	\$8,265,000	\$625,000		\$17,736,250	2013/2014
2014/2015			\$11,001,250	\$830,000	\$8,277,500	\$625,000		\$17,823,750	2014/2015
2015/2016			\$10,935,000	\$830,000	\$8,275,000	\$625,000		\$17,755,000	2015/2016
2016/2017			\$10,927,500	\$830,000	\$8,257,500	\$625,000		\$17,730,000	2016/2017
2017/2018			\$10,971,250	\$830,000	\$8,225,000	\$625,000		\$17,741,250	2017/2018
2018/2019			\$10,962,500	\$830,000	\$8,273,750	\$625,000		\$17,781,250	2018/2019
2019/2020			\$10,997,500	\$830,000	\$8,300,000	\$625,000		\$17,842,500	2019/2020
2020/2021					\$8,303,750	\$625,000		\$7,678,750	2020/2021
2021/2022					\$8,285,000	\$625,000		\$7,660,000	2021/2022
2022/2023					\$8,243,750	\$625,000		\$7,618,750	2022/2023
2023/2024					\$8,276,250	\$625,000		\$7,651,250	2023/2024
2024/2025					\$8,278,750	\$625,000		\$7,653,750	2024/2025
2025/2026					\$8,251,250	\$625,000		\$7,626,250	2025/2026
2026/2027					\$8,290,000	\$625,000		\$7,665,000	2026/2027
2027/2028					\$8,195,000	\$625,000		\$7,570,000	2027/2028
2028/2029					\$8,166,250	\$625,000		\$7,541,250	2028/2029
2029/2030					\$8,196,250	\$625,000		\$7,571,250	2029/2030
	\$111,508,750	\$8,400,000	\$223,267,500	\$17,015,000	\$168,355,000	\$12,812,500	\$10,379,812	\$454,523,938	

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ASSUMPTIONS:  
 (1) INTEREST ON THE BONDS CALCULATED AT A RATE OF 7.5%  
 (2) EARNINGS ON RESERVE FUND CALCULATED AT 7.5%

Note: 15.25% was added to estimates of construction cost as an allowance for engineering, financing and legal costs.

## 7.0 INVESTIGATIONS AND EVALUATION OF WASTEWATER SERVICE PLAN

### 7.1 INTRODUCTION

The objective of this section of the Denton County Planning Study is to make necessary investigations to develop alternative infrastructure plans for providing wastewater service to the Denton County communities. Alternative studies consider the potential wastewater service requirements for the years 1986 through 2010. The criteria developed hereinafter are used to evaluate the general infrastructure requirements to achieve a functional, operative and cost-effective engineering design that can be incorporated into a regional institutional management plan and can effectively provide wastewater service to the Denton County communities

A basic service plan has been developed to provide wastewater collection and treatment facilities for the communities within the study area. This service plan is discussed in the following sections. As indicated in Figure 7-1, the plan basically divides the County into service areas according to the major drainage basins. It is anticipated that the rural areas and a few small communities within the service area will continue to use septic tanks beyond the year 2010. However, it is recommended that all communities in areas around the lakes establish collection and treatment systems to alleviate potential water quality problems.

### 7.2 GENERAL DESIGN CRITERIA

General design criteria and other parameters considered necessary to develop the basic infrastructure plan are as set forth herein.

1. The Cities of Denton, Lewisville and Lake Cities now have improvement programs under way for expansion of their respective wastewater treatment plants. Therefore, to maximize the use of the existing plants and collection systems, it is reasonable to assume that the existing systems will plan to develop the projected plant expansions to their planned capacities for the purpose of serving their own citizens plus other nearby entities under contract until the other entities can become part of the regional system.
2. To assist in the orderly development and planning for facilities necessary to serve wastewater to all of the cities within the study area, the County will need to be subdivided into service areas that will:
  - a. utilize the existing facilities and expand such facilities as necessary to serve other cities within the designated service area; and
  - b. construct new wastewater treatment plants and collection mains where it would be more economical to do so because of drainage constraints.
3. For planning purposes, it is reasonable to assume that those plants with capacities greater than 1.0 MGD will remain in operation throughout the planning horizon. Those cities served by these plants that require additional capacity should construct collection mains to transport excess flows to the nearest regional plant. It is also anticipated that small treatment plants will eventually be phased out. It is beyond the scope of this study to determine when and if these plants will be abandoned. Therefore, as growth reaches the plant capacity, flows have been diverted to a nearby regional plant.
4. These plans consider only regional treatment and collection systems. Lateral lines, house connections and internal lines will continue to be the responsibility of the cities.

5. The average daily flows used to develop infrastructure plans were obtained from Section 2.0 of this report. The total average daily flow for the study area is projected to be more than 83 MGD by 2010. However, the treatment capacity required is only 73 MGD due to rural communities remaining on septic tanks and a portion of Carrollton's flow being treated by TRA.
6. The peak flows for wastewater were estimated to be four times the projected average daily flow. Peak flows were used to size sewer mains.
7. Horizontal ground distances were obtained from USGS maps of the area. The contours of the areas were used in determining whether force mains or gravity lines should be used.
8. Preliminary planning is for pipelines to be located parallel to highways or creek beds.
9. Decisions on when a particular community would require a sanitary sewer system were based on flow and location. Communities with low flows in remote areas would continue using their existing system until their flows are high enough to require a sanitary sewer system and/or connection to the regional system.

### 7.3 SPECIFIC DESIGN CRITERIA

The service plan calls for regional wastewater collection, transfer and treatment service. The plan would use certain existing plants plus proposed new plants as indicated in Figure 7-1. Existing treatment capacity within the study area is approximately 27 MGD. In addition, Carrollton is transporting its wastewater to TRA Central Plant. A summary of the treatment requirements is shown in Table 7-1. As indicated, approximately 73 MGD total treatment capacity will be required by 2010 in the study area. Approximately 15 MGD in new capacity is planned by various entities to be constructed in the next few years. The regional

system would need to build approximately 32 MGD capacity (the exact amount will depend on the number of small existing plants to be abandoned) to meet 2010 needs.

The description of the requirements for each service area is shown below. The projected year of need is tabulated in Table 7-2.

1. Southeast Service Area Treatment Plant: The treatment requirements for cities within the Southeast Service Area are shown in Table 7-3.
  - a. Bartonville. The community of Bartonville is currently served by septic tanks. It is estimated that the average daily flow would be 0.12 MGD in 1990, 0.29 MGD in 2000 and 0.48 MGD in 2010. It is expected that the community will need to connect to the regional system by the year 2000.
  - b. Carrollton. The City of Carrollton's wastewater is currently treated by the Trinity River Authority. Most of Carrollton would continue to be served by TRA; however, for the area north of Indian Creek, Carrollton (approximately one-half of Carrollton's needs in Denton County) should connect to the regional system by 1990. One-half of the projected average daily flows in Denton County are 3.03 MGD in 1990, 5.47 MGD in 2000 and 7.71 MGD in 2010.
  - c. Copper Canyon. Copper Canyon is another city currently served by septic tanks. The projected average daily flows are 0.15 MGD in 1990, 0.39 MGD in 2000 and 0.65 MGD in 2010. It is expected that Copper Canyon will need to connect to the regional system by the year 2000.
  - d. Double Oak. The community of Double Oak is now served by septic tanks. The projected average daily flows are 0.23 MGD in 1990, 0.35 MGD in 2000 and 0.42 MGD in 2010.

It is expected that Double Oak will need to connect to the regional system by 1990.

- e. Flower Mound. Flower Mound has a 2.75 MGD treatment plant and all of its wastewater is currently treated there. The projected average daily flows for 1990, 2000 and 2010 are 2.20 MGD, 5.71 MGD and 8.58 MGD, respectively. Flower Mound will need to divert excess flows to the regional system by the year 2000.
- f. Highland Village. Highland Village's wastewater is currently treated by the City of Lewisville. Their projected average daily flows are 0.95 MGD in 1990, 2.00 MGD in 2000 and 2.42 MGD in 2010. Highland Village could continue to be served by Lewisville until 1990, but will need to connect to the regional system by 2000.
- g. Lewisville. Lewisville owns and operates its own wastewater collection system and a 6.0 MGD treatment plant. The projected average daily flows are 7.69 MGD in 1990, 15.00 MGD in 2000 and 18.31 MGD in 2010. Lewisville plans to expand its treatment plant to 12.0 MGD. The expanded plant is scheduled to be in service by 1989; therefore, Lewisville will need to divert excess flows to a regional plant by the year 2000.
- h. Little Elm. Little Elm is currently served by its own 0.10 MGD treatment plant. The average daily flows projected for 1990, 2000 and 2010 are 0.10 MGD, 0.16 MGD and 0.26 MGD, respectively. Little Elm will need to connect to the regional system by the year 1990.
- i. The Colony. The Colony operates its own wastewater collection system and a 2.5 MGD treatment plant. The average daily flows for 1990, 2000 and 2010, including those previously estimated for Eastvale, are 1.89 MGD, 2.74 MGD

and 3.55 MGD, respectively. The Colony will need to divert excess flow to the regional system by the year 2000.

2. Denton Service Area Treatment Plant: Treatment requirements for cities within the Denton Service Area are shown in Table 7-4.
  - a. Argyle. Current treatment is by septic tanks. The projected average daily flows for 1990, 2000 and 2010 are 0.18 MGD, 0.39 MGD and 0.61 MGD, respectively. Argyle will need to connect to Denton's system by the year 1990.
  - b. Corral City. Current treatment is by septic tanks. A projected average daily flow of 0.01 MGD has been projected for all three time periods (1990, 2000 and 2010). The projected average daily flow is so low that it is recommended that treatment should remain on the existing septic tank system until growth warrants a collection system, which may occur before 2010.
  - c. Corinth. Wastewater is currently treated by the Denton Wastewater Treatment Plant. The projected average daily flows are 0.63 MGD by 1990, 1.94 MGD by 2000 and 3.31 MGD by 2010. Corinth will continue to be served by Denton's treatment plant.
  - d. Denton. The wastewater from Denton is currently being treated by their own 12.0 MGD treatment plant. The projected average daily flows are 10.19 MGD by 1990, 14.24 MGD by 2000 and 18.04 MGD by 2010. Denton plans to expand its existing plant to 20.0 MGD. The expanded plant is scheduled to be in service by 1995. Denton will need to connect to the regional system because the expanded treatment plant will not be able to accommodate all the projected flows up to the year 2010.

0.40 MGD and 0.60 MGD, respectively. Pilot Point will need to connect to the regional system by the year 2000.

- d. Sanger. Sanger currently treats wastewater at its own 1.0 MGD treatment plant. The average daily flows projected are 0.52 MGD by 1990, 0.94 MGD by 2000 and 1.54 MGD by 2010. It is recommended that Sanger connect to the regional system before 2010.
4. Lakewood Village Service Area Treatment Plant: Treatment requirements for cities within the Lakewood Village Service Area are shown in Table 7-6.
- a. Cross Roads. Cross Roads is currently served by septic tank systems. The projected average daily flows are 0.04 MGD by 1990, 0.05 MGD by 2000 and 0.08 MGD by 2010. Cross Roads will need to connect to the regional system by 1990.
  - b. Lakewood Village. Lakewood Village is currently served by an existing package plant. The average daily flows projected are 0.02 MGD by 1990, 0.03 MGD by 2000 and 0.04 MGD by 2010. Lakewood Village will need to connect to the regional system by 1990.
  - c. Lincoln Park. Lincoln Park is currently served by an existing package plant. The projected average daily flows for 1990, 2000 and 2010 are 0.04 MGD, 0.06 MGD and 0.09 MGD, respectively. Lincoln Park will need to connect to the regional system by 1990.
  - d. Oak Point. Oak Point is currently served by septic tanks. The average daily flows projected are 0.08 MGD by 1990, 0.11 MGD by 2000 and 0.14 MGD by 2010. Oak Point will need to connect to the regional system by 1990.



5. Southwest Service Area Treatment Plant: Treatment requirements for cities within the Southwest Service Area are shown in Table 7-7.
  - a. Justin. Justin currently treats wastewater at its own treatment plant. The plant has a capacity of 0.12 MGD. The projected average daily flows are 0.12 MGD by 1990, 0.21 MGD by 2000 and 0.44 MGD by 2010. While Justin could expand their existing plant, it would appear advisable for Justin to connect to the regional system by 1990.
  - b. Northlake. Northlake's current treatment is by septic tanks. The projected average daily flows for 1990, 2000 and 2010 are 0.01 MGD, 0.03 MGD and 0.04 MGD, respectively. It is recommended that Northlake remain on the septic tank system until 2010 because the flows generated are so low that it would not be economically justifiable for Northlake. However, potential growth could change the outlook very quickly.
  - c. Ponder. Ponder currently treats wastewater at its own treatment plant. This plant has a capacity of 0.07 MGD. The projected average daily flows are 0.03 MGD by 1990, 0.04 MGD by 2000 and 0.06 MGD by 2010. Based on the projected flows, the treatment plant at Ponder appears to have sufficient capacity to treat wastewater until at least 2010; therefore, the City may wish to remain with their present plant and not connect to the regional system until after the year 2010.
  
6. Lake Cities MUA Service Area Treatment Plant: Treatment requirements for cities within the Lake Cities MUA Service Area are shown in Table 7-8.

- a. Hickory Creek (East). Currently, the wastewater from that portion of Hickory Creek east of IH-35E is treated at the Lake Cities Wastewater Treatment Plant. The average daily flows projected are 0.21 MGD for 1990, 0.26 MGD for 2000 and 0.30 MGD for 2010. Hickory Creek does not need to connect to the regional system as its needs can be served better by the Lake Cities Wastewater Treatment Plant. The west portion is projected to be served by Denton.
- b. Lake Dallas. The average daily flows projected for Lake Dallas for 1990, 2000 and 2010 are 0.38 MGD, 0.44 MGD and 0.47 MGD, respectively. Lake Dallas does not need to connect to the regional system as its needs can be better served by the Lake Cities Wastewater Treatment Plant.
- c. Shady Shores. The average daily flows projected for Shady Shores for 1990, 2000 and 2010 are 0.12 MGD, 0.16 MGD and 0.18 MGD, respectively. Shady Shore does not need to connect to the regional system, as its needs can be better served by the Lake Cities Wastewater Treatment Plant.

Based on the above studies, the proposed wastewater treatment and collection facilities will be developed for construction in three stages to meet the service demands for periods ending in the years as follows:

Stage 1 - Year 1990

Stage 2 - Year 2000

Stage 3 - Year 2010

To facilitate planning and stage construction, the treatment requirements for each service area for the years 1990, 2000 and 2010 are shown in Tables 7-9 through 7-14.

#### 7.4 ALTERNATIVE WASTEWATER SERVICE PLANS

Four wastewater service plans were considered for the Denton County Service Area. The treatment and collection system is basically the same for these alternatives. The difference is in the treatment plant and discharge locations of a proposed regional plant to serve the southeast portion of the County.

- o Basic Plan. Build a raw wastewater pump station at a southeast location and pump to a new treatment plant on the east shore of Lake Lewisville, as indicated on Figure 7-1.
- o Option No. 1. Construct a new southeast plant and pump effluent for discharge into Lake Lewisville on the east side above Little Elm.
- o Option No. 2. Construct a new southeast plant and discharge effluent directly into Trinity River.
- o Option No. 3. Discharge into TRA's system. This would require Denton County to pay the share of main sewer lines to TRA's Central Plant and treatment plant expansion.

The basic plan and options were developed to treat wastewater effluent discharge limits of BOD/TSS/Ammonia Nitrogen equal to 10/15/5 mg/l. More stringent effluent requirements will cost substantially more. Limits in the 10/15 class have been the normal levels for this region in recent years. However, it is expected that considerably more stringent levels will be justified or required in the future. More stringent standards may be particularly appropriate as the quantity of effluent being discharged into water supplies increases in the future, and when the assimilative capacity of the lakes is fully understood.

## 7.7 PROPOSED WASTEWATER SYSTEM REVENUE BONDS

After preparing preliminary construction costs, First Southwest Company, the financial advisors, tabulated proposed wastewater system revenue bonds for the Base Plan. These tabulations are shown in Tables 7-20 and 7-21. These tables reflect an allowance of 15% for engineering and financing cost over and above the construction costs tabulated in Table 7-21.

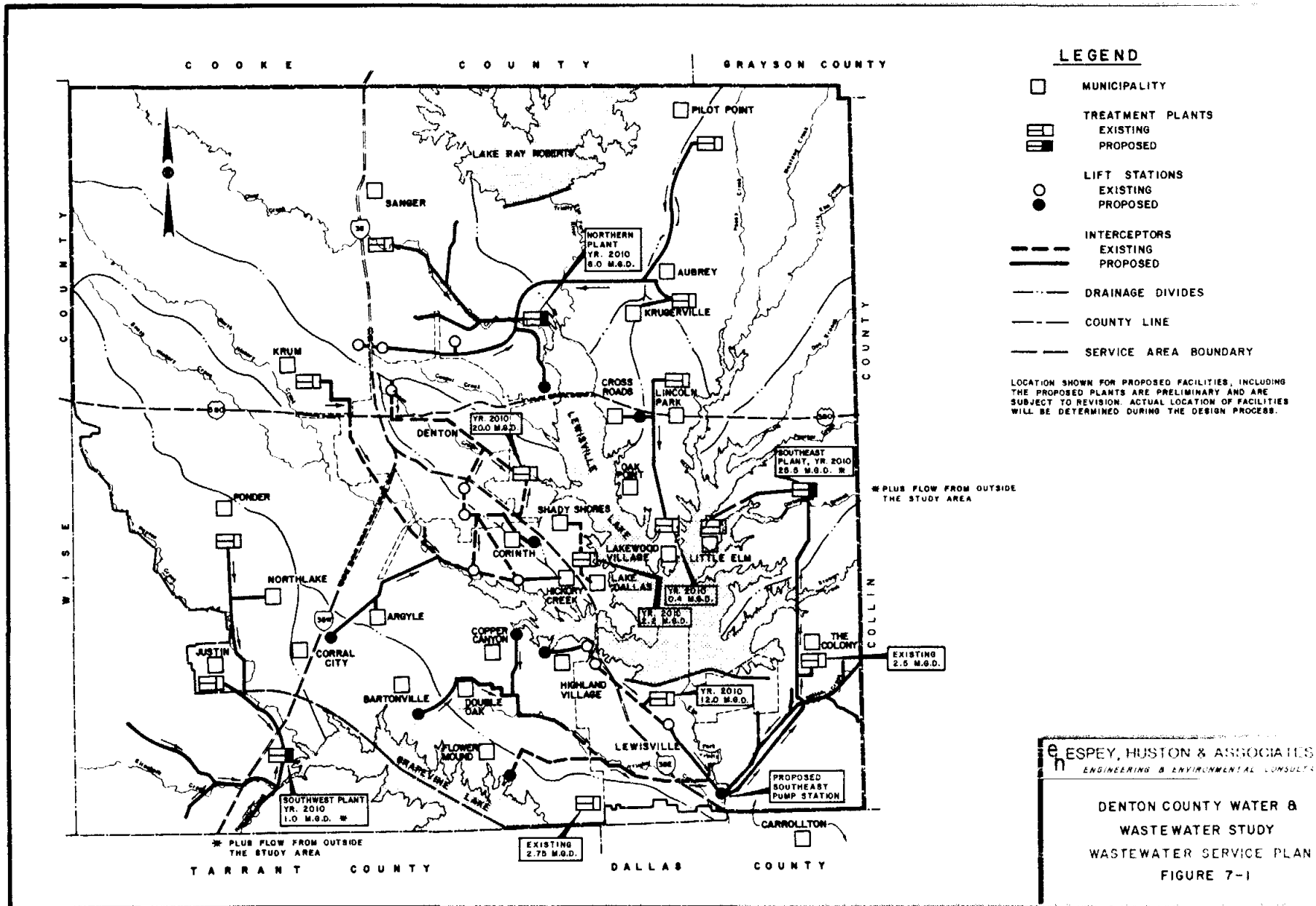


TABLE 7-1  
WASTEWATER SERVICE PLAN  
SUMMARY OF  
TOTAL TREATMENT REQUIREMENTS

Service Area	Average Daily Flow (MGD)			Existing Plant Capacity	Proposed Plant Capacity 2010
	1990	2000	2010		
Southeast	16.36	32.11	42.38	11.35	42.75 <sup>1,2</sup>
Denton	11.21	17.12	20.00	12.08	20.00
North County	0.94	1.64	5.66	1.43	6.00
Lakewood Village	0.18	0.25	0.35	-	0.40
Southwest	0.16	0.28	0.54	0.19	1.00 <sup>2</sup>
Lake Cities MUA	<u>0.71</u>	<u>0.86</u>	<u>0.95</u>	<u>1.10</u>	<u>2.20</u>
<b>TOTAL</b>	<b>29.56</b>	<b>52.26</b>	<b>69.88</b>	<b>26.15</b>	<b>72.35</b>

<sup>1</sup> Total treatment plant capacity of Lewisville (12.0 MGD), Flower Mound (2.75 MGD), The Colony (2.5 MGD) and a new Southeast Regional Plant (25.5 MGD).

<sup>2</sup> Plus flow from from outside the Study Area.

TABLE 7-2  
 SCHEDULE FOR WASTEWATER SERVICE  
 TO THE CITIES

Cities	Year*
Argyle	1990
Aubrey	1990
Bartonville	2000
Carrollton	1990
Copper Canyon	2000
Corinth	1990
Cross Roads	1990
Denton	2010
Double Oak	1990
Flower Mound	2000
Highland Village	2000
Justin	1990
Krugerville	1990
Krum	1990
Lakewood Village	1990
Lewisville	2000
Lincoln Park	1990
Little Elm	1990
Oak Point	1990
Pilot Point	2000
Sanger	2010
The Colony	2000

\* Year is the estimated year of need for connecting to the proposed regional wastewater system based on current estimates of growth and flow and estimates of existing and planned capacities.

Note: Cities not listed would remain on septic tanks, expand their existing facilities or continue to be served by or through other systems.

TABLE 7-3  
TREATMENT REQUIREMENTS FOR THE  
WASTEWATER SERVICE PLAN  
CITIES WITHIN THE SOUTHEAST SERVICE AREA

City	Average Daily Flow (MGD)		
	1990	2000	2010
Bartonville	0.12	0.29	0.48
Carrollton <sup>1</sup> (½ Denton Co. portion)	3.03	5.47	7.71
Copper Canyon	0.15	0.39	0.65
Double Oak	0.23	0.35	0.42
Flower Mound	2.20	5.71	8.58
Highland Village	0.95	2.00	2.42
Lewisville	7.69	15.00	18.31
Little Elm	0.10	0.16	0.26
The Colony <sup>2</sup>	<u>1.89</u>	<u>2.74</u>	<u>3.55</u>
Required Treatment Plant Capacity	16.36	32.11	42.38
Less Existing Plant Capacity <sup>3</sup>	<u>17.25</u>	<u>17.25</u>	<u>17.25</u>
Additional Plant Capacity Required	-	14.86	25.13

<sup>1</sup> The City of Carrollton's wastewater is currently treated by the Trinity River Authority. It is anticipated that one-half of Carrollton's needs in Denton County will also be treated by TRA.

<sup>2</sup> Average daily flow for The Colony includes wastewater flow previously estimated for Eastvale.

<sup>3</sup> The existing plant capacity by 1990 includes Flower Mound's 2.75 MGD plant, Lewisville's 12.0 MGD plant and The Colony's 2.50 MGD plant. Therefore, the existing plant capacity is 17.25 MGD.



TABLE 7-4  
TREATMENT REQUIREMENTS FOR THE  
WASTEWATER SERVICE PLAN  
CITIES WITHIN THE DENTON SERVICE AREA

City	Average Daily Flow (MGD)		
	1990	2000	2010
Argyle	0.18	0.39	0.61
Corinth	0.63	1.94	3.31
Denton	10.19	14.24	18.04
Hickory Creek <sup>1</sup>	0.10	0.40	0.90
Krum	<u>0.11</u>	<u>0.15</u>	<u>0.21</u>
Required Treatment Plant Capacity	11.21	17.12	23.07
Less Denton Plant Capacity	<u>12.00</u>	<u>20.00</u>	<u>20.00</u>
Flow to be Diverted to the North County Plant	-	-	3.07

<sup>1</sup> The wastewater flow from that portion of Hickory Creek west of IH-35.

TABLE 7-5  
TREATMENT REQUIREMENTS FOR THE  
WASTEWATER SERVICE PLAN  
CITIES WITHIN THE NORTH COUNTY SERVICE AREA

City	Average Daily Flow (MGD)		
	1990	2000	2010
Aubrey	0.12	0.19	0.28
Denton <sup>1</sup>	-	-	3.07
Krugerville	0.07	0.11	0.17
Pilot Point	0.23	0.40	0.60
Sanger	<u>0.52</u>	<u>0.94</u>	<u>1.54</u>
Required Treatment Plant Capacity	0.94	1.64	5.66

<sup>1</sup> Additional plant capacity required by Denton over and above planned expansion of the existing plant.

TABLE 7-6  
TREATMENT REQUIREMENTS FOR THE  
WASTEWATER SERVICE PLAN  
CITIES WITHIN THE LAKEWOOD VILLAGE SERVICE AREA

City	Average Daily Flow (MGD)		
	1990	2000	2010
Cross Roads	0.04	0.05	0.08
Lakewood Village	0.02	0.03	0.04
Lincoln Park	0.04	0.06	0.09
Oak Point	<u>0.08</u>	<u>0.11</u>	<u>0.14</u>
Required Treatment Plant Capacity	0.18	0.25	0.35

TABLE 7-7  
TREATMENT REQUIREMENTS FOR THE  
WASTEWATER SERVICE PLAN  
CITIES WITHIN THE SOUTHWEST SERVICE AREA

City	Average Daily Flow (MGD)		
	1990	2000	2010
Justin	0.12	0.21	0.44
Northlake	0.01	0.03	0.04
Ponder	<u>0.03</u>	<u>0.04</u>	<u>0.06</u>
Required Treatment Plant Capacity	0.16	0.28	0.54

TABLE 7-8  
TREATMENT REQUIREMENTS FOR THE  
WASTEWATER SERVICE PLAN  
CITIES WITHIN THE LAKE CITIES MUA SERVICE AREA

City	Average Daily Flow (MGD)		
	1990	2000	2010
Hickory Creek <sup>1</sup>	0.21	0.26	0.30
Lake Dallas	0.38	0.44	0.47
Shady Shore	<u>0.12</u>	<u>0.16</u>	<u>0.18</u>
Required Treatment Plant Capacity	0.71	0.86	0.95

<sup>1</sup> The wastewater flow from that portion of Hickory Creek east of IH-35.

TABLE 7-9  
 SERVICE SCHEDULE FOR THE  
 WASTEWATER SERVICE PLAN  
 CITIES WITHIN THE SOUTHEAST SERVICE AREA

City	Average Daily Flow (MGD)		
	1990	2000	2010
Bartonville	-	0.29	0.48
Carrollton <sup>1</sup>	3.03	5.47	7.71
Copper Canyon	-	0.39	0.65
Double Oak	0.23	0.35	0.42
Flower Mound	0.01	0.16	0.26
Highland Village	-	2.00	2.42
Lewisville	-	3.00	6.31
The Colony	-	<u>0.24</u>	<u>1.05</u>
Required Treatment Plant Capacity	3.27	14.86	25.13

<sup>1</sup> The City of Carrollton's wastewater is currently treated by the Trinity River Authority. It is anticipated that one-half of Carrollton's needs in Denton County will also be treated by TRA.

- No service scheduled.

TABLE 7-10  
 SERVICE SCHEDULE FOR THE  
 WASTEWATER SERVICE PLAN  
 CITIES WITHIN THE DENTON SERVICE AREA

City	Average Daily Flow (MGD)		
	1990	2000	2010
Argyle	0.18	0.39	0.61
Corinth	0.63	1.94	3.31
Denton <sup>1</sup>	10.19	14.24	14.97
Hickory Creek <sup>2</sup>	0.10	0.40	0.90
Krum	<u>0.11</u>	<u>0.15</u>	<u>0.21</u>
Required Treatment Plant Capacity	11.21	17.12	20.00

<sup>1</sup> Approximately 3.07 MGD wastewater flow from Denton will be diverted to the North County Regional Plant in the year 2010.

<sup>2</sup> The wastewater flow from that portion of Hickory Creek west of IH-35.

TABLE 7-11  
 SERVICE SCHEDULE FOR THE  
 WASTEWATER SERVICE PLAN  
 CITIES WITHIN THE NORTH COUNTY SERVICE AREA

City	Average Daily Flow (MGD)		
	1990	2000	2010
Aubrey	0.12	0.19	0.28
Denton <sup>1</sup>	-	-	3.07
Krugerville	0.07	0.11	0.17
Pilot Point	-	0.40	0.60
Sanger	-	-	<u>1.54</u>
Required Treatment Plant Capacity	0.19	0.70	5.66

<sup>1</sup> Additional plant capacity required by Denton.

- No service scheduled.



TABLE 7-12  
 SERVICE SCHEDULE FOR THE  
 WASTEWATER SERVICE PLAN  
 CITIES WITHIN THE LAKEWOOD VILLAGE SERVICE AREA

City	Average Daily Flow (MGD)		
	1990	2000	2010
Cross Roads	0.04	0.05	0.08
Lakewood Village	0.02	0.03	0.04
Lincoln Park	0.04	0.06	0.09
Oak Point	<u>0.08</u>	<u>0.11</u>	<u>0.14</u>
Required Treatment Plant Capacity	0.18	0.25	0.35

TABLE 7-13  
 SERVICE SCHEDULE FOR THE  
 WASTEWATER SERVICE PLAN  
 CITIES WITHIN THE SOUTHWEST SERVICE AREA

City	Average Daily Flow (MGD)		
	1990	2000	2010
Justin	0.12	0.21	0.44
Northlake	-	0.03	0.04
Ponder	-	-	-
Required Treatment Plant Capacity	0.12	0.24	0.48

- No service scheduled.

TABLE 6-12  
 SERVICE SCHEDULE FOR TRI-REGIONAL STRATEGY  
 CITIES WITHIN THE DENTON WHOLESALE SERVICE AREA

	Average Daily Demand (MGD)		
	1990	2000	2010
Corinth	0.92	2.89	5.09
Denton	12.36	18.16	23.20
Hickory Creek	0.40	0.91	1.72
Krum	--	--	0.30
Lake Dallas	0.43	0.50	0.54
Ponder	--	--	0.08
Shady Shores	<u>0.14</u>	<u>0.20</u>	<u>0.22</u>
<b>TOTAL AVERAGE DAILY DEMAND</b>	<b>14.25</b>	<b>22.66</b>	<b>31.15</b>
Drought Demand <sup>1</sup>	16.39	26.06	35.82
Required Treatment Plant Capacity <sup>2</sup>	34.42	54.73	75.22
Less Anticipated Plant Capacity	30.00	30.00	30.00
Additional Water Required <sup>3</sup>	4.42	24.73	45.22

<sup>1</sup> Drought demand is estimated to be 15% greater than average day demand.

<sup>2</sup> Treatment capacity is estimated to be 2.1 times drought demand.

<sup>3</sup> Additional treated water required would be supplied by the proposed North Regional Plant.

-- No service scheduled.

TABLE 7-15  
COMPARISON OF WASTEWATER TREATMENT OPTIONS

Option	Concerns	Rating			
		(Low) 1	2	3	(High) 4
Basic	Environmental Impact				X
	Land Available				X
	Costs			X	
	Implementation			X	
	Potential Reuse of Treated Effluent				X
No. 1	Environmental Impact	X			
	Land Available	X			
	Costs		X		
	Implementation		X		
	Potential Reuse of Treated Effluent				X
No. 2	Environmental Impact	X			
	Land Available	X			
	Costs		X		
	Implementation		X		
	Potential Reuse of Treated Effluent	X			
No. 3	Environmental Impact				X
	Land Available				X
	Costs	X			
	Implementation		X		
	Potential Reuse of Treated Effluent	X			

TABLE 7-16

SUMMARY: PRELIMINARY ESTIMATED CONSTRUCTION COST OF WASTEWATER SERVICE PLAN  
BASE PLAN\*

Systems	Costs of Implementation			Total
	1990	2000	2010	
Southeast System	\$23,352,753	\$29,625,381	\$22,000,000	\$ 74,978,134
Denton System	1,959,306	520,000	1,317,504	3,796,810
North Denton System	946,985	1,000,000	17,154,197	19,101,182
Lakewood Village System	1,715,331	298,210	315,000	2,328,541
Southwest System	618,784	240,000	480,000	1,338,784
Lake Cities System	--	--	--	--
<b>TOTAL</b>	<b>\$28,593,159</b>	<b>\$31,683,591</b>	<b>\$41,266,701</b>	<b>\$101,543,451</b>

\*Base Plan- Build a raw pump station at a southeast location and pump to a new Treatment Plant site on the east shore of Lake Lewisville.

- Notes:
1. For cost estimating purposes, effluent quality for all plants was assumed to be 10/15/5 (BOD/TSS/NH<sub>3</sub>). More stringent effluent standards may be required which could raise the cost considerably.
  2. These estimates do not include allowances for engineering, construction administration and inspection, legal fees, right-of-way acquisition, nor cost of financing the improvements. Not including right-of-way, a reasonable estimate of such costs would be 15-20%.

TABLE 7-17

SUMMARY: PRELIMINARY ESTIMATED CONSTRUCTION COST OF WASTEWATER SERVICE PLAN  
OPTION NO. 1\*

Systems	Costs of Implementation			Total
	1990	2000	2010	
Southeast System	\$23,352,753	\$29,625,381	\$22,000,000	\$ 74,978,134
Denton System	1,959,306	520,000	1,317,504	3,796,810
North Denton System	946,985	1,000,000	17,154,197	19,101,182
Lakewood Village System	1,715,331	298,210	315,000	2,328,541
Southwest System	618,784	240,000	480,000	1,338,784
Lake Cities System	--	--	--	--
Added Land Cost	<u>3,556,000</u>	<u>--</u>	<u>--</u>	<u>3,556,000</u>
<b>TOTAL</b>	<b>\$32,149,159</b>	<b>\$31,683,591</b>	<b>\$41,266,701</b>	<b>\$105,099,451</b>

\*Option 1- Construct a new Southeast Treatment Plant and pump treated effluent for discharge into Lake Lewisville on the east side above Little Elm.

- Notes:
1. For cost estimating purposes, effluent quality for all plants was assumed to be 10/15/5 (BOD/TSS/NH<sub>3</sub>). More stringent effluent standards may be required which could raise the cost considerably.
  2. These estimates do not include allowances for engineering, construction administration and inspection, legal fees, right-of-way acquisition, nor cost of financing the improvements. Not including right-of-way, a reasonable estimate of such costs would be 15-20%.

TABLE 7-18

SUMMARY: PRELIMINARY ESTIMATED CONSTRUCTION COST OF WASTEWATER SERVICE PLAN  
OPTION NO. 2\*

Systems	Costs of Implementation			Total
	1990	2000	2010	
Southeast System	\$17,272,753	\$23,461,381	\$21,000,000	\$61,734,134
Denton System	1,959,306	520,000	1,317,504	3,796,810
North Denton System	946,985	1,000,000	17,154,197	19,101,182
Lakewood Village System	1,715,331	298,210	315,000	2,328,541
Southwest System	618,784	240,000	480,000	1,338,784
Lake Cities System	--	--	--	--
Additional Land Cost	<u>3,556,000</u>	<u>--</u>	<u>--</u>	<u>3,556,000</u>
<b>TOTAL</b>	<b>\$26,069,159</b>	<b>\$25,519,591</b>	<b>\$40,266,701</b>	<b>\$91,855,451</b>

\*Option 2- Construct a new South Plant and discharge effluent directly into Trinity River.

- Notes:
1. For cost estimating purposes, effluent quality for all plants was assumed to be 10/15/5 (BOD/TSS/NH<sub>3</sub>). More stringent effluent standards may be required which could raise the cost considerably.
  2. These estimates do not include allowances for engineering, construction administration and inspection, legal fees, right-of-way acquisition, nor cost of financing the improvements. Not including right-of-way, a reasonable estimate of such costs would be 15-20%.

TABLE 7-19

SUMMARY: PRELIMINARY ESTIMATED CONSTRUCTION COST OF WASTEWATER SERVICE PLAN  
OPTION NO. 3\*

Systems	Costs of Implementation			Total
	1990	2000	2010	
Southeast System	\$ 5,272,753	\$ 3,461,381	--	\$ 8,734,134
Denton System	1,959,306	520,000	1,317,504	3,796,810
North Denton System	946,985	1,000,000	17,154,197	19,101,182
Lakewood Village System	1,715,331	298,210	315,000	2,328,541
Southwest System	618,784	240,000	480,000	1,338,784
Lake Cities System	--	--	--	--
Equalization & Pumping	2,500,000	1,500,000	1,500,000	5,500,000
Sewer Line (17.5 mile, 48" diameter)	--	10,903,200	--	10,903,200
TRA Plant Expansion	<u>10,000,000</u>	<u>20,000,000</u>	<u>20,000,000</u>	<u>50,000,000</u>
<b>TOTAL</b>	<b>\$23,013,159</b>	<b>\$37,922,791</b>	<b>\$40,766,701</b>	<b>\$101,702,651</b>

\*Option 3- Instead of constructing a treatment at the southeast side, construct an equalization system to discharge into TRA's system.

- Notes:
1. For cost estimating purposes, effluent quality for all plants was assumed to be 10/15/5 (BOD/TSS/NH<sub>3</sub>). More stringent effluent standards may be required which could raise the cost considerably.
  2. These estimates do not include allowances for engineering, construction administration and inspection, legal fees, right-of-way acquisition, nor cost of financing the improvements. Not including right-of-way, a reasonable estimate of such costs would be 15-20%.



TABLE 7-20

DENVER COUNTY WATER AUTHORITY-PROPOSED WASTEWATER SYSTEM REVENUE BONDS

(INCLUDES 36 MOS. CAPITALIZED INTEREST)

FISCAL YEAR (9-30)	PROPOSED \$48,765,000 DCWA WASTEWATER SYSTEM REVENUE BONDS, DATED SEPT. 1, 1990	LESS: CAPITALIZED INTEREST	LESS: RESERVE FUND EARNINGS	PROPOSED \$40,515,000 DCWA WASTEWATER SYSTEM REVENUE BONDS, DATED MARCH 1, 2000	LESS: RESERVE FUND EARNINGS	PROPOSED \$52,765,000 DCWA WASTEWATER SYSTEM REVENUE BONDS, DATED MARCH 1, 2010	LESS: RESERVE FUND EARNINGS	LESS: INTEREST EARNINGS ON CONSTRUCTION FUND	NET DEBT SERVICE REQUIREMENTS	FISCAL YEAR (9-30)
1989/1990									\$0	1989/1990
1990/1991	\$3,660,000	\$3,660,000	\$358,760					\$1,813,875	\$0	1990/1991
1991/1992	\$3,660,000	\$3,660,000	\$358,760						\$0	1991/1992
1992/1993	\$3,660,000	\$3,660,000	\$358,760						\$0	1992/1993
1993/1994	\$5,103,750		\$358,760						\$4,744,990	1993/1994
1994/1995	\$5,087,500		\$358,760						\$4,728,740	1994/1995
1995/1996	\$5,063,750		\$358,760						\$4,704,990	1995/1996
1996/1997	\$5,032,500		\$358,760						\$4,673,740	1996/1997
1997/1998	\$5,090,000		\$358,760						\$4,731,240	1997/1998
1998/1999	\$5,036,250		\$358,760						\$4,677,490	1998/1999
1999/2000	\$5,071,250		\$358,760	\$1,518,750	\$149,000			\$1,518,750	\$4,563,490	1999/2000
2000/2001	\$5,091,250		\$358,760	\$3,903,750	\$298,000				\$8,338,240	2000/2001
2001/2002	\$5,096,250		\$358,760	\$3,932,500	\$298,000				\$8,371,990	2001/2002
2002/2003	\$5,086,250		\$358,760	\$3,953,750	\$298,000				\$8,383,240	2002/2003
2003/2004	\$5,061,250		\$358,760	\$3,871,250	\$298,000				\$8,275,740	2003/2004
2004/2005	\$5,117,500		\$358,760	\$3,885,000	\$298,000				\$8,345,740	2004/2005
2005/2006	\$5,055,000		\$358,760	\$3,891,250	\$298,000				\$8,289,490	2005/2006
2006/2007	\$5,073,750		\$358,760	\$3,890,000	\$298,000				\$8,306,990	2006/2007
2007/2008	\$5,070,000		\$358,760	\$3,881,250	\$298,000				\$8,294,490	2007/2008
2008/2009	\$5,043,750		\$358,760	\$3,961,250	\$298,000				\$8,348,240	2008/2009
2009/2010	\$5,187,500		\$358,760	\$3,930,000	\$298,000	\$1,980,000	\$194,000	\$1,980,000	\$8,266,740	2009/2010
2010/2011				\$3,891,250	\$298,000	\$5,115,000	\$388,125		\$8,320,125	2010/2011
2011/2012				\$3,941,250	\$298,000	\$5,121,250	\$388,125		\$8,376,375	2011/2012
2012/2013				\$3,880,000	\$298,000	\$5,120,000	\$388,125		\$8,313,875	2012/2013
2013/2014				\$3,907,500	\$298,000	\$5,111,250	\$388,125		\$8,332,625	2013/2014
2014/2015				\$3,920,000	\$298,000	\$5,095,000	\$388,125		\$8,328,875	2014/2015
2015/2016				\$3,917,500	\$298,000	\$5,071,250	\$388,125		\$8,302,625	2015/2016
2016/2017				\$3,900,000	\$298,000	\$5,136,250	\$388,125		\$8,350,125	2016/2017
2017/2018				\$3,867,500	\$298,000	\$5,090,000	\$388,125		\$8,271,375	2017/2018
2018/2019				\$3,916,250	\$298,000	\$5,132,500	\$388,125		\$8,362,625	2018/2019
2019/2020				\$3,942,500	\$298,000	\$5,063,750	\$388,125		\$8,320,125	2019/2020
2020/2021						\$5,083,750	\$388,125		\$4,695,625	2020/2021
2021/2022						\$5,088,750	\$388,125		\$4,700,625	2021/2022
2022/2023						\$5,078,750	\$388,125		\$4,690,625	2022/2023
2023/2024						\$5,053,750	\$388,125		\$4,665,625	2023/2024
2024/2025						\$5,110,000	\$388,125		\$4,721,875	2024/2025
2025/2026						\$5,047,500	\$388,125		\$4,659,375	2025/2026
2026/2027						\$5,066,250	\$388,125		\$4,678,125	2026/2027
2027/2028						\$5,062,500	\$388,125		\$4,674,375	2027/2028
2028/2029						\$5,132,500	\$388,125		\$4,744,375	2028/2029
2029/2030						\$4,980,000	\$388,125		\$4,591,875	2029/2030
	\$97,347,500		\$7,175,200	\$79,702,500	\$6,109,000	\$103,740,000	\$7,956,500	\$5,312,625	\$246,146,830	

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- ASSUMPTIONS:  
 (1) INTEREST ON THE BONDS CALCULATED AT A RATE OF 7.5%  
 (2) EARNINGS ON RESERVE FUND CALCULATED AT 7.5%  
 (3) 36 MONTHS CAPITALIZED INTEREST ON INITIAL ISSUE

Note: 15.25% was added to estimates of construction cost as an allowance for engineering, financing and legal costs.

DENTON (COUNTY WATER AUTHORITY-PROPOSED WASTEWATER SYSTEM REVENUE BONDS

(DOES NOT INCLUDE CAPITALIZED INTEREST)

FISCAL YEAR (9-30)	PROPOSED \$36,565,000 DCWA WASTEWATER SYSTEM REVENUE BONDS, DATED SEPT. 1, 1990	LESS: RESERVE FUND EARNINGS	PROPOSED \$40,515,000 DCWA WASTEWATER SYSTEM REVENUE BONDS, DATED MARCH 1, 2000	LESS: RESERVE FUND EARNINGS	PROPOSED \$52,765,000 DCWA WASTEWATER SYSTEM REVENUE BONDS, DATED MARCH 1, 2010	LESS: RESERVE FUND EARNINGS	LESS: INTEREST EARNINGS ON CONSTRUCTION FUND	NET DEBT SERVICE REQUIREMENTS	FISCAL YEAR (9-30)
1989/1990								\$0	1989/1990
1990/1991	\$3,515,000	\$270,000					\$1,233,187	\$2,011,813	1990/1991
1991/1992	\$3,551,250	\$270,000						\$3,281,250	1991/1992
1992/1993	\$3,580,000	\$270,000						\$3,310,000	1992/1993
1993/1994	\$3,505,000	\$270,000						\$3,235,000	1993/1994
1994/1995	\$3,526,250	\$270,000						\$3,256,250	1994/1995
1995/1996	\$3,540,000	\$270,000						\$3,270,000	1995/1996
1996/1997	\$3,546,250	\$270,000						\$3,276,250	1996/1997
1997/1998	\$3,545,000	\$270,000						\$3,275,000	1997/1998
1998/1999	\$3,536,250	\$270,000						\$3,266,250	1998/1999
1999/2000	\$3,520,000	\$270,000	\$1,518,750	\$149,000			\$1,518,750	\$3,101,000	1999/2000
2000/2001	\$3,496,250	\$270,000	\$3,903,750	\$298,000				\$6,832,000	2000/2001
2001/2002	\$3,561,250	\$270,000	\$3,932,500	\$298,000				\$6,925,750	2001/2002
2002/2003	\$3,515,000	\$270,000	\$3,953,750	\$298,000				\$6,900,750	2002/2003
2003/2004	\$3,557,500	\$270,000	\$3,871,250	\$298,000				\$6,860,750	2003/2004
2004/2005	\$3,488,750	\$270,000	\$3,885,000	\$298,000				\$6,805,750	2004/2005
2005/2006	\$3,508,750	\$270,000	\$3,891,250	\$298,000				\$6,832,000	2005/2006
2006/2007	\$3,513,750	\$270,000	\$3,890,000	\$298,000				\$6,835,750	2006/2007
2007/2008	\$3,503,750	\$270,000	\$3,881,250	\$298,000				\$6,817,000	2007/2008
2008/2009	\$3,575,000	\$270,000	\$3,961,250	\$298,000				\$6,968,250	2008/2009
2009/2010	\$3,527,500	\$270,000	\$3,930,000	\$298,000	\$1,980,000	\$194,000	\$1,980,000	\$6,695,500	2009/2010
2010/2011			\$3,891,250	\$298,000	\$5,115,000	\$388,125		\$8,320,125	2010/2011
2011/2012			\$3,941,250	\$298,000	\$5,121,250	\$388,125		\$8,376,375	2011/2012
2012/2013			\$3,880,000	\$298,000	\$5,120,000	\$388,125		\$8,313,875	2012/2013
2013/2014			\$3,907,500	\$298,000	\$5,111,250	\$388,125		\$8,332,625	2013/2014
2014/2015			\$3,920,000	\$298,000	\$5,095,000	\$388,125		\$8,328,875	2014/2015
2015/2016			\$3,917,500	\$298,000	\$5,071,250	\$388,125		\$8,302,625	2015/2016
2016/2017			\$3,900,000	\$298,000	\$5,136,250	\$388,125		\$8,350,125	2016/2017
2017/2018			\$3,867,500	\$298,000	\$5,090,000	\$388,125		\$8,271,375	2017/2018
2018/2019			\$3,916,250	\$298,000	\$5,132,500	\$388,125		\$8,362,625	2018/2019
2019/2020			\$3,942,500	\$298,000	\$5,063,750	\$388,125		\$8,320,125	2019/2020
2020/2021					\$5,083,750	\$388,125		\$4,695,625	2020/2021
2021/2022					\$5,088,750	\$388,125		\$4,700,625	2021/2022
2022/2023					\$5,078,750	\$388,125		\$4,690,625	2022/2023
2023/2024					\$5,053,750	\$388,125		\$4,665,625	2023/2024
2024/2025					\$5,110,000	\$388,125		\$4,721,875	2024/2025
2025/2026					\$5,047,500	\$388,125		\$4,659,375	2025/2026
2026/2027					\$5,066,250	\$388,125		\$4,678,125	2026/2027
2027/2028					\$5,062,500	\$388,125		\$4,674,375	2027/2028
2028/2029					\$5,132,500	\$388,125		\$4,744,375	2028/2029
2029/2030					\$4,980,000	\$388,125		\$4,591,875	2029/2030
	\$70,612,500	\$5,400,000	\$79,702,500	\$6,109,000	\$103,740,000	\$7,956,500	\$4,731,937	\$229,857,563	

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ASSUMPTIONS:  
 (1) INTEREST ON THE BONDS CALCULATED AT A RATE OF 7.5%  
 (2) EARNINGS ON RESERVE FUND CALCULATED AT 7.5%

Note: 15.25% was added to estimates of construction cost as an allowance for engineering, financing and legal costs.

## 8.0 RECOMMENDATIONS

### 8.1 GENERAL RECOMMENDATIONS

The principal recommendation concerning the Water and Wastewater Master Plan is that implementation of the Plan be pursued with a sense of urgency. The need for water and wastewater services is continuing to increase. One should expect that efforts will be made to respond to that need--either by individual agencies or within a coordinated regional strategy. It appears that the county is at a critical stage in regard to the development of its water and wastewater systems. The needs of the future can be addressed most efficiently and most effectively by a regional approach. Therefore, any delays could force individual agencies to make plans and commitments which, in the long run, could increase the cost and complexity of implementing the regional plan.

To facilitate implementation, it is recommended that the Steering Committee move immediately into certain detailed planning activities, then into an implementation posture. The Committee has developed a good understanding of the issues, the needs and the alternative strategies. Any significant interruption in schedule or participants could result in delays and added cost. It would seem appropriate that funds already committed to the project by the participants should be used for planning and implementation tasks that remain. Dallas has indicated that its committed funds were for planning tasks within the scope of the study.

Implementation of the Plan is the next major phase. However, some planning tasks remain. A general plan for Denton County has been developed. But certain specific and detailed planning tasks to assure feasibility need to be accomplished to facilitate timely implementation with a minimum of controversy or confusion. Remaining planning tasks include:

1. Explore the feasibility of the water supply exchange concept, in coordination with NTMWD, Dallas, Irving and Texas Water Commission.
2. Develop a detailed water conservation plan as a guideline for the regional agency and participating entities.
3. Develop an institutional plan that will be used as the basis for legislation to create the regional agency. The institutional plan would include an outline of the major responsibilities and powers of the agency, how it would be governed, and the relationship with participating entities and sub-regional operating units of the agency.
4. Develop a plan for financing the facilities and operations of the regional system. Specific issues that need to be addressed include:
  - o the magnitude and source of up-front cost participation by wholesale customer entities;
  - o the degree to which the regional agency will provide financing through bonds and user charges;
  - o the need for and advisability of impact (capital recovery) fees.
5. Develop a prototype contract with conditions of service.
6. Develop a definitive plan of coordination and mutual service responsibilities with other nearby regional agencies including:
  - o North Texas Municipal Water District;
  - o City of Dallas;
  - o Trinity River Authority;
  - o Tarrant County Water Control and Improvement District; and
  - o City of Fort Worth.

Coordinate the plan with the North Central Texas Council of Governments.

7. Coordinate with the County of Denton, NCTCOG, TWC and others as appropriate to identify the need for regulatory powers

concerning septic tanks, especially in a water quality zone around the local lakes, watershed protection program, and underground water supplies.

The above planning tasks should be accomplished under the guidance of the Steering Committee and coordinated with the designated interim agency(s).

It appears that new legislation will be necessary in order to create the type of agency required to finance, design, construct and operate the regional system. The next session of the Legislature is scheduled for Spring 1989. In the meantime, implementation needs to proceed. Therefore, it is recommended that the Steering Committee obtain commitment of a suitable agency(s) for that purpose. Within Denton County, it appears that the cities of Denton and Lewisville are best equipped to handle such duties. Based on preliminary discussions with the two cities and the Steering Committee, it appears that the two cities should address the duties of an interim agency on a partnership basis. Within the partnership, Denton could be primarily responsible for water and Lewisville for wastewater. Responsibilities of the interim agency include:

1. Coordination with NCTCOG and the Texas Water Commission to assure inclusion in and fulfillment of the annual Texas Water Quality Plan.
2. As required, make selections from among the alternative strategies presented within this report.
3. Arrange for the necessary funds to finance interim activities, including the creation of the permanent agency:
  - o completion of detailed plans;
  - o development of legislation; and
  - o site acquisition of key properties required by the plan.
4. Investigate the availability of loans and grants from the State or Federal government.

5. Develop a system of cost participation by Denton County entities during the interim period.
6. Proceed with appropriate engineering reports and designs to assure timely implementation. If the permanent agency is created by the Legislature in 1989, it is assumed that construction contracts can be awarded by the new agency. However, the interim agency should have the power to award construction contracts if warranted.

It is the recommendation that the interim agency employ a manager, other personnel and consultants as required to carry out its responsibilities.

One of the recommended planning activities during the detailed planning phase is the consideration of impact fees. Impact (Capital Recovery) Fees were authorized by the last session of the Legislature (S.B. 336). This method of financing appears to be appropriate for the circumstances in Denton County, where the entire regional system is intended to respond to and provide for growth. Existing systems are already providing for current customers. Consequently, this alternative financing tool should be explored during the interim period--not as a substitute for conventional financing, but as a supplemental source.

## 8.2 SUGGESTED ACTION PLAN FOR IMPLEMENTING THE RECOMMENDED REGIONAL SYSTEM

The following is a preliminary list of action items necessary to implement the regional master plan. This list identifies several key decisions to be made during the implementation process. Additional items will become more readily apparent as the implementation process continues.

1. Adopt the Tri-Regional Service Plan as the preferred strategy.

2. Designate an interim agency for implementing the plan and for pursuit of available loans or grants.
3. Start the process for inclusion of the recommendations in the NCTCOG regional plan and the State of Texas plan.
4. Begin planning for creation of and appointments to a strong, blue ribbon civic committee to carry forward the implementation process.
5. Complete the report and obtain approval of TWDB.
6. Authorize engineering and strategic studies for implementation of the recommended water supply exchange between NTMWD, Denton County and City of Dallas--with participation of City of Irving in the pipeline.
7. Present the plan to participating agencies and obtain resolutions of support from as many participating agencies as possible--especially from the larger entities.
8. Conduct public hearing on the plan in conjunction with NCTCOG and Texas Water Commission.
9. Select and appoint the blue ribbon Implementation Committee. Develop a strategy for interim funding. Maintain the present Steering Committee in an advisory role to the Implementation Committee.
10. Coordinate with TRA and NTMWD and explore the possibility of their participation.
11. Begin the drafting process for proposed legislation.
12. Apply for appropriate grants to help fund the cost of implementing the plan.
13. Authorize the preparation of engineering reports as required to obtain financing, including construction grants and loans.
14. Determine required plant sites and critical rights-of-way. Obtain when feasible.

15. Apply for permits as necessary for discharge or withdrawal of water.
16. Obtain contracts with all entities who want to participate in the regional system.
17. Authorize the preparation of plans and specifications for the initial construction phase, including applicable environmental and regulatory permits.
18. Finalize financial plan.
19. In January 1989, introduce and obtain enabling legislation.
20. Proceed forthwith to organize the regional agency and to implement the plan.

The items listed above involve actions necessary to implement a regional system prior to the creation of a Regional Agency. A discussion of the legal and regulatory steps necessary to create a Regional Agency is included below. Once the legislative process is complete and authority to develop a regional system has been granted, the Regional Agency will assume its role in directing the development of the service plan.

Much of the work can be accomplished under authority of an interim designated agency. It is recommended that Denton and Lewisville be designated as interim regional agencies for purposes of implementing this plan until the permanent agency is created or designated. Denton and Lewisville have the capacity to provide such leadership during the interim period and can either act together as one agency or separately in full coordination with each other. It is recommended that the City Council of both cities adopt resolutions accepting the interim designation to facilitate the acquisition of loans and grants for continued planning and for implementation. The cooperation of key participating agencies can provide for interim use of their facilities or for appropriate oversizing of facilities until the regional agency achieves operational status.



### 8.2.1 Legal and Regulatory Steps

The Steering Committee of the Denton County Water and Wastewater Planning Study has selected the Tri-Regional Water Service Plan and the Basic Wastewater Plan as its preferred strategies for meeting the long-range water and wastewater needs of Denton County. Consistent with the preferred strategies and the responsibilities, power and operational needs of any entity that would be implemented to effect those strategies, the legal advisors were requested to outline certain legal considerations which must be discussed and agreed upon to meet the objective of implementing the preferred strategies. It is assumed that legislation containing the relevant authorizations and powers will be introduced for consideration in the 1989 legislative session. It is further assumed that an interim agency will be used to implement certain activities which must begin prior to the effective date of any legislation creating a new entity.

It is recommended that the Steering Committee members agree on the content of the proposed legislation before it is introduced in the Legislature. At least four to six months will be required for this process to take place, and that six to nine months be allowed for the drafting and agreement process to conclude. With a target completion date of December 1, 1988, this would mean that the process of drafting legislation and working toward a consensus of the Steering Committee should begin no later than March 1, 1988. December 1, 1988 has been targeted as the completion date so that the constitutionally required publication of the intention to introduce the bill may be done approximately 30 days before the start of the 1989 Legislature.

The items to be agreed upon in forming a new entity or entities to meet the water and wastewater needs of Denton County include, but are not limited to, the following:

1. Administration
  - a. How is the entity to be governed?
  - b. Should there be one entity or multiple entities, and what relationship will exist between multiple entities?
  - c. Who appoints or elects the governing body or bodies?
2. Powers
  - a. Contracting authority with public entities and/or private entities
  - b. Condemnation
  - c. Rate regulation to customers
  - d. Service regulation of customers
  - e. Financing authority for long-term and short-term needs
  - f. Funding mechanisms to meet operation, maintenance and debt obligations, including taxes and other revenue sources
  - g. Ownership and operation of system facilities such as reservoirs, distribution systems and treatment systems
  - h. Establishment of service area and jurisdiction
3. Accountability
  - a. Relationship between entities themselves (if more than one entity required)
  - b. Relationship between entity and other governmental bodies
  - c. Relationship between entity and customers other than governmental entities
  - d. Relationship to State agencies
  - e. Relationship to Federal agencies

All of the foregoing items, and those that are contained within the general categories set forth above, must be consistent with all applicable constitutional and statutory requirements. Specific concepts must be agreed upon which will in turn lead to specific language in draft legislation. Until these types of basic issues are agreed upon by the Steering Committee, it is premature to assume the

scope of the legislative authority needed and the best vehicle or vehicles needed to exercise that authority.

### 8.3 RECOMMENDED GUIDELINES FOR CONDITIONS OF SERVICE

In order to create a regional system that operates efficiently and economically and provides quality service, it is necessary to establish guidelines and minimum requirements for obtaining service. These minimum conditions will help to ensure that service is equitable. The following is a list of recommended requirements relating to type of service provided, rules for obtaining service, how customer rates should be set, water quality and conservation programs. These conditions should be evaluated, revised and finalized by the regional agency.

#### 8.3.1 General Principles

1. Except in specific local circumstances requiring tax support for infrastructure, the regional system will be financed from utility revenues.
2. It is expected that the service to be supplied by the regional system will be wholesale service to local utilities. Retail service by the regional entity would be discouraged.
3. Service would be rendered according to formally executed contracts between the wholesale supplier and the local retail utility.
4. The regional supplier would establish reasonable rules and standard contract forms under which service can be obtained.
5. Rates and charges would be based on cost of service. The supplier should be responsible for the rate-setting process, but provide for adequate participation, review and comment by all customer entities.
6. Resale of water outside a customer's corporate boundaries or approved service area will be prohibited except by prior approval.

7. Under the city wholesale concept, extreme care will be exercised to avoid subsidies; each extension of service to another agency would be on a cost-reimbursable basis. Under regional agency concepts, it will be more acceptable to share and to average the cost of facilities among the participating entities.
8. To assure fairness in the distribution of responsibility and cost, the regional system would establish a connection and rate policy to encourage maximum participation during the start-up and that would compensate charter participants for costs borne initially for the benefit of later participants.
9. Water conservation programs will be required of all customer entities.
10. Entities desiring wholesale service will be expected to support their request with appropriate engineering and economic studies concerning the need, proposed facilities, and the capability of the entity to finance and operate the system.

### 8.3.2 Specific Requirements

1. Entities desiring water service must have an adequate water storage and distribution system and an adequate wastewater collection and treatment system or definitive plans therefor. Facilities installed within the ETJ of cities should meet city standards. In rural areas, exceptions to the requirement for wastewater collection systems may be granted if adequate controls in accordance with state or local requirements are and will continue to be exerted over private treatment systems.
2. To reduce the potential for degradation of water quality in the water supply reservoir, entities and individuals developing property on the perimeter of the lakes may be required to meet a higher

standard for connection to an approved wastewater collection system.

3. Water and wastewater master plans for each entity must be developed, reviewed periodically and updated. Plans should include projected demands and capital improvements for a minimum 20-year planning horizon.
4. Service will be provided only to legally constituted entities that have the authority to render utility service to the public. The entity must have the authority to exert control or contract for control over land use and development--with appropriate ordinance powers. Any exceptions will require the concurrence of member cities.
5. Normal practice will be to deliver treated water to customer's ground storage facilities. Exceptions may be granted for small quantities or for extraordinary circumstances.

## APPENDIX

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6. Water Conservation Methods (excerpt from <u>Guidelines for Municipal Water Conservation and Drought Contingency Planning and Program Development</u> , Texas Water Development Board, April 1986)	A-15
7. City of Dallas Council Resolution No. 844011	A-27
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## LIST OF PARTICIPATING ENTITIES

1. Town of Argyle
2. City of Aubrey
3. Town of Bartonville
4. Bartonville Water Supply Corporation
5. Black Rock Water Supply Corporation
6. Bolivar Water Supply Corporation
7. City of Carrollton
8. Town of Copper Canyon
9. City of Corinth
10. City of Dallas
11. City of Denton
12. Denton County
13. Town of Flower Mound
14. City of Highland Village
15. Town of Justin
16. Lake Cities Municipal Utility Authority
17. City of Lewisville
18. Town of Little Elm
19. Mustang Water Supply Corporation
20. City of Pilot Point
21. Town of Ponder
22. City of Sanger
23. T.S.W. Water Supply Corporation
24. City of The Colony
25. Wren Water Supply Corporation

## SCOPE OF SERVICES

Purpose of Study: The purpose of this STUDY is to evaluate and to make recommendations for providing water and wastewater service to Denton County communities and water and wastewater supply entities needing wholesale service, now or in the future, in the service area of the regional water supply system operated by the City of Dallas (generally defined as all of Denton County with exception of the area south and southwest of Denton Creek but subject to other minor exclusions or inclusions). (map attached) See also City of Denton potential water service area (map attached).

Grant Assistance: The City of Denton, on behalf of Denton County communities and water/wastewater supply entities have applied to the Texas Water Development Board for grant assistance for this STUDY. COMMITTEE will prepare monitoring and status reports as required, and ENGINEER will review such reports for technical accuracy and completeness.

Communications: In order to keep participating entities advised of progress, a Newsletter will be prepared by the ENGINEER and mailed on a monthly basis to a mailing list not to exceed 200 addresses.

### 1.0 Preliminary Assessment

- 1.1 ENGINEER & PROJECT MANAGER will identify data to be collected and furnished by participating agencies.
- 1.2 Review published reports furnished by the participating agencies.
- 1.3 Conduct one on one interviews with each of the following participating agencies.

Bartonville Water Supply Corp.  
Town of Bartonville, Texas  
City of Carrollton, Texas  
City of the Colony, Texas  
Town of Copper Canyon, Texas  
City of Corinth, Texas  
City of Dallas, Texas  
City of Denton, Texas  
County of Denton, Texas  
Town of Flower Mound, Texas  
City of Highland Village, Texas  
Lake Cities Municipal Utility Authority  
City of Lewisville, Texas  
Town of Little Elm, Texas  
Town of Ponder, Texas  
City of Sanger, Texas  
TSW Incorporated Water Company

Other entities may agree to participate in costs of this STUDY at a later date. In that event, additional interviews (not to exceed five unless authorized by the County of Denton and the COMMITTEE) will be required.



1.4 Review additional reports furnished by the participating agencies for background information and for data concerning population and demand projection. Such reports include, but may not be limited to the following:

\*Long Range Water Demand Forecasts, Dallas Water Utilities Service Area- CH2M Hill, August 1984

\*Analysis of Water Service Area- Peat Marwich and Mitchell, May 1980

\*Report on Feasibility Study for Aubrey (Ray Roberts) Lake- URS Company, 1977

\*Report on Long Range Water Supply Study to Meet Requirements to the Year 2050 for the City of Dallas, Texas, URS Company, March 1975

\*Water Supply Study for City of Denton- Freese & Nichols, June 1982

\*Water Supply Study for City of Lewisville- Shimek, Jacobs and Finklea, 1982 (~~revised~~ 1985)

\*Water Service Area Questionnaire, Dallas Water Utilities, April 1985

\*Conditions of Service for Treated Water Wholesale Customers, City of Dallas, January 1985

NOTE: The above information is on file in the Planning Division of Dallas Water Utilities in Room 4AS of Dallas City Hall.

1.5 Identify other entities in Denton County that have responsibility for providing water or wastewater services.

1.6 Develop base map for project area.

1.7 As directed by the Project Manager, meet with other identified entities (not to exceed two group meetings).

1.8 Determine, from information and data provided by each entity, the water and wastewater services area of each participating agency and/or the other identified entities in Denton County.

1.9 Develop a draft work plan which shall include a proposed schedule for each phase of work.

1.10 Conduct work session with Steering Committee.

1.11 Finalize the work plan.

1.12 Prepare and submit twenty-five (25) copies of Phase 1.0 report to the Project Manager.

1.13 Conduct review session of Phase 1.0 report with Steering Committee.

2.0 Analysis. Defining the Dimensions of the Project:

2.1 Make an inventory of existing, committed, and planned water and wastewater facilities and their capacities from information furnished by participating and non-participating agencies.

2.2 Meet with various agencies that may have information or who may be affected by the STUDY, including, but not limited to the following agencies:

Texas State Highway Department  
Railroads  
Major Pipeline Companies  
Major Gas and Electric Utilities  
U. S. Corps of Engineers  
Texas Water Commission  
Water Development Board  
North Central Texas Council of Governments  
Trinity River Authority  
North Texas Municipal Water District  
City of Ft. Worth, Texas  
North Texas Industrial Commission

2.3 Develop low, most probable, and high annual population projections for the study area requirements for increments of five (5) years through 2010. Use North Central Texas Council of Government's data as the base population projection and supplement with input from the respective Steering Committee entities and other appropriate data.

2.4 Estimate future per capita consumption of water and of wastewater discharges.

2.5 Develop low, most probable, and high projections for future water demands for average and peak, drought and normal conditions. Projections should be in increments of five years.

2.6 Project low, most probable and high projections for future wastewater treatment requirements for increments of five (5) years through 2010.

2.7 Identify existing untreated water resources available to serve the study area; determine yield expected to be available to study area; consult with Dallas Water Utilities.

2.8 Determine need for supplemental untreated water resources and identify potential sources which may be needed to meet anticipated long-term requirements.

- 2.9 Establish capability and willingness of existing major entities within project area to meet projected water and wastewater demands of the project area.
- 2.10 Meet one on one with each participating entity and review STUDY results.
- 2.11 Conduct workshop with Steering Committee.
- 2.12 Identify alternative strategies, considering near term and long term requirements, with emphasis on institutional agencies for providing water and wastewater services over the next twenty-five (25) years. Specific alternatives to be evaluated include, but shall not be limited to the following:
  - 2.12.1 Untreated water service from Dallas to other entities (either existing or proposed) which could provide treated water service to customers in the service area.
  - 2.12.2 Partnership arrangement between cities to construct water or wastewater treatment plants for benefit of the contracting parties.
  - 2.12.3 Creation of an entity or entities such as utility districts to be sponsored and established by the customers having a need for water or wastewater service.
  - 2.12.4 Enlargement of service area of existing cities (Denton, Lewisville and others) which already have water or wastewater treatment plants in Denton County.
  - 2.12.5 Service to be provided by an established water or wastewater service entity which may or may not presently provide service in the Denton County service area (Dallas, Trinity River Authority, etc).
- 2.13 Prepare and submit twenty-five (25) copies of Phase 2.0 report to the Project Manager.
- 2.14 Conduct review session of Phase 2.0 Report with Steering Committee.

### 3.0 Evaluation of Alternatives:

- 3.1 Evaluate feasibility of existing entities to expand their service areas to meet all or a portion of the project area.

- 3.2 To discuss Item 3.1 above, meet with the major agencies including:
- City of Denton
  - City of Lewisville
  - City of Dallas
  - North Texas Municipal Water District
  - Trinity River Authority
- 3.3 Evaluate previously identified alternatives and determine "most feasible" alternatives (5 to 15). Match water and wastewater in workable combinations.
- 3.4 With aid of a computer model, evaluate in depth the "most feasible" alternatives--documenting costs, advantages and disadvantages.
- 3.5 Consult with legal and financial advisors concerning the alternative institutional strategies.
- 3.6 Develop legal organizational structures with recommendations for service contract concepts and conditions of service required.
- 3.7 Make field reconnaissance of the area as needed to determine probable location of proposed facilities for water and sewer.
- 3.8 Assess infrastructure requirements for "most feasible" alternatives and evaluate technical feasibility.
- 3.9 Conduct Workshop with Steering Committee to evaluate alternatives.
- 3.10 Taking into account the results of the workshop and the advice and comments of the Steering Committee, narrow the alternatives to three general strategies (or service plans) considering technical, legal, policy and financial constraints.
- 3.11 Conduct interviews with major entities that would be affected by the alternative strategies to ensure conceptual agreement with their proposed roles in such plans.
- 3.12 Prepare and submit twenty-five (25) copies of Phase 3.0 report to the Project Manager.
- 3.13 Conduct review session of Phase 3.0 report with Steering Committee.

#### 4.0 Development of Infrastructure Plans:

- 4.1 For each of the top three recommended institutional alternatives, develop an infrastructure plan.
- 4.2 Prepare implementation schedules and preliminary cost estimates for recommended service alternatives.
- 4.3 Identify key political/policy/regulatory/legal steps for implementation.
- 4.4 Provide recommendations for financial and legal strategies for funding initial costs and annual operation and maintenance costs. Provide estimates of potential customer rates under recommended alternatives.
- 4.5 Identify probable initial capital cost participation and continuing contractual relationships between suppliers and customers under recommended alternatives.
- 4.6 Workshop with Steering Committee to review and fine-tune the recommended alternative strategies.
- 4.7 Prepared and submit twenty-five (25) copies of phase 4.0 report to Project Manager.

#### 5.0 Reporting

- 5.1 Submit a draft of Final Report and Executive Summary to Project Manager.
- 5.2 Steering Committee work session to review final report and Executive Summary.
- 5.3 Prepare Final Report and separately bound Executive Summary and submit two hundred (200) copies to Steering Committee.
- 5.4 Participate in presentation(s) of final recommendations (not to exceed five (5) presentations).
- 5.5 Submit documentation report of working papers to Project Manager.
- 5.6 Meet with Steering Committee for closing remarks.

DENTON COUNTY PLANNING STUDY DOCUMENT LIST

TITLE	DOCUMENT DATE	OBTAINED FROM
Map - Carrollton Water System	September 1985	Carrollton
Map - Carrollton Sanitary Sewer System	-	Carrollton
Map - City Limits Of Carrollton	-	Carrollton
Map - Official Zoning For Carrollton	November 1986	Carrollton
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5 Yr Capital Improvement Plan (87-91) For Denton	July 1986	City Of Denton
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Land Use Map	November 1986	City Of Denton
Map Of Service Area	-	City Of Denton
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Corinth - Wastewater System Study Update	March 1986	Corinth
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Map - Highland Village Ss Collection System	-	Highland Village
Lake Cities M.U.A. Water Distribution Analysis	June 1985	Lake Cites M.U.A.
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DENTON COUNTY PLANNING STUDY DOCUMENT LIST

TITLE	DOCUMENT DATE	OBTAINED FROM
Annual Budget (1986-1987) For Lewisville	-	Lewisville
Map - Lewisville Official Zoning Plan (10 Sheets)	-	Lewisville
Map - Lewisville S. Sewer Line - East Section	-	Lewisville
Map - Lewisville S. Sewer Line - West Section	July 1986	Lewisville
Map - Lewisville Thoroughfare Plan	September 1985	Lewisville
Map - Lewisville Wastewater Collection System	March 1985	Lewisville
Map - Lewisville Water Distribution System	1982 Rev 1985	Lewisville
Map - Lewisville Water Line - East Section	-	Lewisville
Map - Lewisville Water Line - West Section	January 1986	Lewisville
Projected Capital Improvements For Lewisville	April 1986	Lewisville
Report On Lewisville Wastewater Collection System	March 1985	Lewisville
Map - Service Area For Little Elm	-	Little Elm
1984 Land Use & 1980-1984 Land Use Trends -Excerpt	February 1985	N.C.T.C.O.G.
1987 Transportation Improvement Program	July 1986	N.C.T.C.O.G.
Current Population Estimates 1986	May 1986	N.C.T.C.O.G.
Data Resources Handbook	-	N.C.T.C.O.G.
Denton County Rural Water And Wastewater Plan	January 1975	N.C.T.C.O.G.
Initiatives For Clean Water	December 1986	N.C.T.C.O.G.
Intro To North Central Texas Thoroughfare System	January 1979	N.C.T.C.O.G.
List - 1980 & 1986 Population For Cities < 1000	-	N.C.T.C.O.G.
Map - Denton County 1980 Census Tracts	-	N.C.T.C.O.G.
Map - Denton County Rural Wastewater Plan	November 1974	N.C.T.C.O.G.
Map - State Planning Region IV-A	-	N.C.T.C.O.G.
Map - Survey Zones & R.A.A.'S (Sh. A A-2 & A-3)	-	N.C.T.C.O.G.
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Map - Limit Of Service Area For Sanger	-	Sanger
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Ground Water Of North-Central Texas, Volume I	April 1982	T.D.W.R.

DENTON COUNTY WATER AND WASTEWATER STUDY  
SUMMARY OF ONE-ON-ONE INTERVIEWS

The following is a brief synopsis of the responses from the individual interviews conducted with each participant in the Denton County Study.

Present System/Adequacy

Responses to this question were specific to each individual entity. Most entities felt their present water and wastewater systems were adequate or marginally adequate for their existing needs.

Goals for the Study

Most entities were concerned with estimating their future needs, identifying alternatives to meet those needs, evaluating long-term and short-term costs, determining size of facilities and phasing of those facilities. In addition, many were concerned about their role in such a system. Many smaller cities and water supply corporations were concerned with converting from ground water to surface water.

Pitfalls to Avoid

Entities suggested the regional system should not create conflicts and competition between the participants, but allow each participant to be treated equally. In addition, avoid creating an entity that will exert control over the individual systems.



### Priority Water and Wastewater Needs

Entities seemed equally concerned with assuring a long-term water supply as well as implementing a wastewater treatment program.

### Service Area Policies

Entities generally provide retail service within the city limits or certified service area. Several entities also provide wholesale service to others.

### Institutional Preferences

Institutional preferences included a regional entity, sub-regional systems or contractual relationships. Some entities expressed the need to maintain control of their own facilities.

### Insights: Policy Issues/Bias/Strategies

Several entities expressed their desire to play a regional role for a portion of the service area. Others expressed an interest in working with other entities but remaining independent. One entity suggested promoting conservation through a steep water rate. In addition, one entity indicated a bias exists between the northern and southern portions of the county.

### Specific Growth Trends/Development Patterns/Pending Projects

The following projects are expected to have an impact on the growth within the study area: the IBM plant, the Boeing plant, Perot's purchase of

3,500 acres adjacent to Argyle, a new north-south airport road west of I-35 going from Denton to Dallas/Fort Worth, extension of the Dallas Tollway and Lake Ray Roberts. The I-35 corridor is expected to be a strong growth area. Growth is expected to continue at a steady rate.

#### Role for Your Agency in Regional System

Most entities felt their role in the regional system was as a participant with a direct role in policy-making and decisions. However, several entities were interested in becoming a "hub" for that system. Others expressed a willingness to participate in managing the regional system.

#### Your Feel for the Answer

Most entities had no response regarding this question. One entity felt the answer was a regional wholesaler with enough independence to ensure that no one was being subsidized. They further suggested that this regional entity should be a water and wastewater utility, rather than creating two separate entities. Another entity suggested a combination of strategies that address the different needs in the South and North with regional roles for the cities of Denton and Lewisville. This strategy would also include a new entity to serve east of Lake Lewisville.

#### How Much of a Rate Increase is a Secure, Adequate Regional System Worth?

On the average, the entities seemed willing to increase water and wastewater rates by approximately 15%. Some entities were willing to pay

whatever it cost when the need becomes apparent; others were not willing to pay more and were concerned with existing high water rates.

Population Projections (Confidence Level)

Entities expressed confidence in the EH&A projections. They felt the growth rate for the next 10 to 15 years would probably be between 7 and 10 percent per year. Comments regarding NCTCOG's projections were that they were generally low.

ADOPTED STRATEGY  
FOR  
DROUGHT WATER DEMANDS

During times of extended hot or dry weather, demands for water tend to increase. Based on experiences in the region, it appears that the impact of drought conditions would be between 15% and 20% over normal demands. For Denton County utilities, a 15% impact for drought demands should be assumed.

The determination of water supply requirements should be based on projections of "drought" demand equal to 115% of normal demand.

Adopted by Project Steering Committee

April 29, 1987

## Water Conservation Methods

Excerpt from

Guidelines for Municipal Water  
Conservation and Drought Contingency  
Planning and Program Development

(Texas Water Development Board, April 1986)

**Education and Information:** The most readily available and lowest cost method of promoting water conservation is to inform water users about ways to save water inside homes and other buildings, in landscaping and lawn uses, and in recreational uses. In-home water use accounts for an average of 65 percent of total residential use, while the remaining 35 percent is used for exterior residential purposes such as lawn watering and car washing. Average residential in-home water use data indicate that about 40 percent is used for toilet flushing, 35 percent for bathing, 11 percent for kitchen uses, and 14 percent for clothes washing. Water saving methods that can be practiced by the individual water user are listed below.

**In the Bathroom, Customers Should be Encouraged to:**

- Take a shower instead of filling the tub and taking a bath. Showers usually use less water than tub baths.
- Install a low-flow shower head which restricts the quantity of flow at 60 psi to no more than 3.0 gallons per minute.
- Take short showers and install a cutoff valve or turn the water off while soaping and back on again only to rinse.

- Not use hot water when cold will do. Water and energy can be saved by washing hands with soap and cold water; hot water should only be added when hands are especially dirty.
- Reduce the level of the water being used in a bath tub by one or two inches if a shower is not available.
- Turn water off when brushing teeth until it is time to rinse.
- Not let the water run when washing hands. Instead, hands should be wet, and water should be turned off while soaping and scrubbing and turned on again to rinse. A cutoff valve may also be installed on the faucet.
- Shampoo hair in the shower. Shampooing in the shower takes only a little more water than is used to shampoo hair during a bath and much less than shampooing and bathing separately.
- Hold hot water in the basin when shaving instead of letting the faucet continue to run.
- Test toilets for leaks. To test for a leak, a few drops of food coloring can be added to the water in the tank. The toilet should not be flushed. The customer can then watch to see if the coloring appears in the bowl within a few minutes. If it does, the fixture needs adjustment or repair.
- Use a toilet tank displacement device. A one-gallon plastic milk bottle can be filled with stones or with water, recapped, and placed in the toilet tank. This will reduce the amount of water in the tank but still provide enough for flushing. (Bricks which some people use for this purpose are not recommended since they crumble eventually and could damage the working mechanism, necessitating a call to the

plumber). Displacement devices should never be used with new low-volume flush toilets.

- Install faucet aerators to reduce water consumption.
- Never use the toilet to dispose of cleansing tissues, cigarette butts, or other trash. This can waste a great deal of water and also places an unnecessary load on the sewage treatment plant or septic tank.
- Install a new low-volume flush toilet that uses 3.5 gallons or less per flush when building a new home or remodeling a bathroom.

**In the Kitchen, Customers Should be Encouraged to:**

- Use a pan of water (or place a stopper in the sink) for rinsing pots and pans and cooking implements when cooking rather than turning on the water faucet each time a rinse is needed.
- Never run the dishwasher without a full load. In addition to saving water, expensive detergent will last longer and a significant energy saving will appear on the utility bill.
- Use the sink disposal sparingly, and never use it for just a few scraps.
- Keep a container of drinking water in the refrigerator. Running water from the tap until it is cool is wasteful. Better still, both water and energy can be saved by keeping cold water in a picnic jug on a kitchen counter to avoid opening the refrigerator door frequently.
- Use a small pan of cold water when cleaning vegetables rather than letting the faucet run.
- Use only a little water in the pot and put a lid on it for cooking most food. Not only does this method save water, but food is more nutritious since vitamins and minerals are not poured down the drain with the extra cooking water.

- Use a pan of water for rinsing when hand washing dishes rather than a running faucet.
- Always keep water conservation in mind, and think of other ways to save in the kitchen. Small kitchen savings from not making too much coffee or letting ice cubes melt in a sink can add up in a year's time.

**In the Laundry, Customers Should be Encouraged to:**

- Wash only a full load when using an automatic washing machine (32 to 59 gallons are required per load).
- Use the lowest water level setting on the washing machine for light loads whenever possible.
- Use cold water as often as possible to save energy and to conserve the hot water for uses which cold water cannot serve. (This is also better for clothing made of today's synthetic fabrics.)

**For Appliances and Plumbing, the Customer Should be Encouraged to:**

- Check water requirements of various models and brands when considering purchasing any new appliance that uses water. Some use less water than others.
- Check all water line connections and faucets for leaks. If the cost of water is \$1.00 per 1,000 gallons, one could be paying a large bill for water that simply goes down the drain because of leakage. A slow drip can waste as much as 170 gallons of water EACH DAY, or 5,000 gallons per month, and can add as much as \$5.00 per month to the water bill.
- Learn to replace faucet washers so that drips can be corrected promptly. It is easy to do, costs very little, and can represent a substantial amount saved in plumbing and water bills.



- Check for water leakage that the customer may be entirely unaware of, such as a leak between the water meter and the house. To check, all indoor and outdoor faucets should be turned off, and the water meter should be checked. If it continues to run or turn, a leak probably exists and needs to be located.
- Insulate all hot water pipes to avoid the delays (and wasted water) experienced while waiting for the water to "run hot."
- Be sure the hot water heater thermostat is not set too high. Extremely hot settings waste water and energy because the water often has to be cooled with cold water before it can be used.
- Use a moisture meter to determine when house plants need water. More plants die from over-watering than from being on the dry side.

**For Out-of-Door Use, Customers Should be Encouraged to:**

- Water lawns early in the morning during the hotter summer months. Much of the water used on the lawn can simply evaporate between the sprinkler and the grass.
- Use a sprinkler that produces large drops of water, rather than a fine mist, to avoid evaporation.
- Turn soaker hoses so the holes are on the bottom to avoid evaporation.
- Water slowly for better absorption, and never water on windy days.
- Forget about watering the streets or walks or driveways. They will never grow a thing.
- Condition the soil with compost before planting grass or flower beds so that water will soak in rather than run off.
- Fertilize lawns at least twice a year for root stimulation. Grass with a good root system makes better use of less water.
- Learn to know when grass needs watering. If it has turned a dull grey-green or if footprints remain visible, it is time to water.

- Not water too frequently. Too much water can overload the soil so that air cannot get to the roots and can encourage plant diseases.
- Not over-water. Soil can absorb only so much moisture and the rest simply runs off. A timer will help, and either a kitchen timer or an alarm clock will do. An inch and one-half of water applied once a week will keep most Texas grasses alive and healthy.
- Operate automatic sprinkler systems only when the demand on the town's water supply is lowest. Set the system to operate between four and six a.m.
- Not scalp lawns when mowing during hot weather. Taller grass holds moisture better. Rather, grass should be cut fairly often, so that only 1/2 to 3/4 inch is trimmed off. A better looking lawn will result.
- Use a watering can or hand water with the hose in small areas of the lawn that need more frequent watering (those near walks or driveways or in especially hot, sunny spots).
- Learn what types of grass, shrubbery, and plants do best in the area and in which parts of the lawn, and then plant accordingly. If one has a heavily shaded yard, no amount of water will make roses bloom. In especially dry sections of the state, attractive arrangements of plants that are adapted to arid or semi-arid climates should be chosen.
- Consider decorating areas of the lawn with rocks, gravel, wood chips, or other materials now available that require no water at all.
- Not "sweep" walks and driveways with the hose. Use a broom or rake instead.
- Use a bucket of soapy water and use the hose only for rinsing when washing the car.

The water conservation plan will need to contain ways to communicate water saving practices, such as those listed above, to the public. Among the methods for public education about water conservation are television, radio, and newspaper announcements and advertisements; posters and public displays; fairs, contests, and school programs; bill stuffers, flyers and newsletters; and sales events. The appropriate combination of educational materials and the methods used to communicate with residential users will depend on the location of the applicant, the type of media available, and other factors unique to the applicant's conditions.

**Plumbing Codes:** Cities of 5,000 population or more and utilities and cities with general plumbing codes will need to adopt water saving plumbing codes for new construction and for replacement of plumbing in existing structures. The standards for residential and commercial fixtures should be:

Tank-type toilets	- No more than 3.5 gallons per flush
Flush valve toilets	- No more than 3.0 gallons per flush
Tank-type urinals	- No more than 3.0 gallons per flush
Flush valve urinals	- No more than 1.0 gallons per flush
Shower heads	- No more than 3.0 gallons per minute
Lavatory and kitchen faucets	- No more than 2.75 gallons per minute
All hot water lines	- Insulated
Swimming pools	- New pools must have recirculating filtration equipment

These standards are recommended because they represent readily available products and technology and do not involve additional costs when compared to "standard" fixtures. For example, conventional toilets using 1.0, 1.5, 2.5, and 3.5 gallons per flush are available at list prices that range from about \$50 to \$150 each. Insulated hot water lines decrease water wasted by reducing the amount of time it takes to receive hot water at the tap. Water lines can be insulated for about \$0.50 per linear foot. In addition, new swimming pools

should contain recirculating filtration and disinfection equipment to eliminate the need to fill and drain the pool daily.

Utilities and cities that do not have a plumbing code will need to adopt a water saving plumbing code or distribute information to their customers and builders to guide them in purchasing and installing water saving plumbing devices.

**Retrofit Programs:** A city or utility should make information available through its education program for plumbers and customers to use when purchasing and installing plumbing fixtures, lawn watering equipment, or water using appliances. Information regarding retrofit devices such as low-flow shower heads or toilet dams that reduce water use by replacing or modifying existing fixtures or appliances should also be provided. A city or utility may wish to provide certain devices (toilet dams, low-flow shower heads, faucet aerators, etc.) free or at a reduced cost to the customer.

**Water Rate Structures:** A city or utility should adopt a conservation-oriented water rate structure. Such a rate structure usually takes the form of an increasing block rate, although continuously increasing rate structures, peak or seasonal load rates, excess use fees, and other rate forms can be used. The increasing block rate structure is the most commonly used water conservation rate structure. Under this structure, the price per unit of water increases in steps or blocks as certain customer use levels are reached. For example, the first 5,000 gallons a month may have a base rate of \$5.00, the next 3,000 gallons a month may cost \$1.50 per thousand gallons, and all use above 8,000 gallons a month may cost \$2.00 per thousand gallons. Generally, when using a block rate structure, the first block accounts for

minimal residential water requirements and normally is 5,000 gallons per month or less. The next block accommodates all but the larger residential customers, and blocks beyond the second tier are set high enough to discourage the use of large quantities of water. Under no circumstance, however, should the price for the first block or base level be established below the actual cost of providing the service. In the event that increased prices for the base level place an excessive burden on the poor, life-line rates may need to be established. In addition, separate rate structures will probably be needed for commercial, institutional, and industrial customers.

**Universal Metering:** All water users, including the utility, city, and other public facilities, should be metered. In addition, the utility should have a master meter. For new multi-family dwellings that are easily metered individually (such as duplexes and fourplexes) or apartments with more than five living units or apartments, each living unit should be metered separately. A regularly scheduled maintenance program of meter repair and replacement will need to be established in accordance with the following time intervals:

1. Production (master) meters - test once a year;
2. Meters larger than 1" - test once a year; and
3. Meters 1" or smaller - test every 10 years.

Most important, metering can provide an accurate accounting of water uses throughout the system when both the utility and customers are metered. In addition, utilities may be able to identify and bill previously unbilled users and, thereby, generate additional revenues. Metering and meter repair and replacement, coupled with an annual water accounting or auditing, can be used in conjunction with other programs such as leak detection and repair and, thereby, save significant quantities of water.

**Water Conserving Landscaping:** As stated previously, annual in-home water use accounts for an average of 65 percent of total residential use, while the remaining 35 percent is used for exterior residential purposes, such as lawn watering and car washing. However, during the summer months, as much as 50 percent of the water used in urban areas is applied to lawns and gardens and adds greatly to the peak demands experienced by most water utilities. In order to reduce the demands placed on a water system by landscape watering, the city or utility should consider methods that either encourage, by education and information, or require, by code or ordinance, water conserving landscaping by residential customers and commercial establishments engaged in the sale or installation of landscape plants or watering equipment. Some methods that should be considered include the following:

1. Establishing platting regulations for new subdivisions that require developers, contractors, or homeowners to use only adapted, low water using plants and grasses for landscaping new homes;
2. Initiating a Xeriscape or Texscape program that demonstrates the use of adapted, low water using plants and grasses;
3. Encouraging or requiring landscape architects to use adapted, low water using plants and grasses and efficient irrigation systems in preparing all site and facility plans;
4. Encouraging or requiring licensed irrigation contractors to always use drip irrigation systems when possible and to design all irrigation systems with water conservation features, such as sprinklers that emit large drops rather than a fine mist and a sprinkler layout that accommodates prevailing wind direction;
5. Encouraging or requiring commercial establishments to use drip irrigation for landscape watering when possible and to install only ornamental fountains that recycle and use the minimum amount of water; and

6. Encouraging or requiring nurseries and local businesses to offer adapted, low water using plants and grasses and efficient landscape watering devices, such as drip irrigation systems.

**Leak Detection and Repair:** A continuous leak detection, location, and repair program can be an important part of a water conservation plan. An annual water accounting or audit should be part of the program. Sources of unaccounted for water include defective hydrants, abandoned services, unmetered water used for fire fighting or other municipal uses, inaccurate or leaking meters, illegal hook-ups, unauthorized use of fire hydrants, and leaks in mains and services. Once located, corrective repairs or actions need to be undertaken. An effective leak detection, location, and repair program will generally pay for itself, especially in many older systems. For example, a utility that produces an average of one million gallons per day at an average water rate of \$0.95 per one thousand gallons will lose approximately \$35,000 in revenue each year when system losses amount to 10 percent.

**Recycling and Reuse:** A city or utility should evaluate the potential of recycling and reuse because these methods may be used to increase water supplies in the applicant's service area. Reuse can be especially important where the use of treated effluent from an industry or a municipal system or agricultural return flows replace an existing use that currently requires fresh water from a city's or utility's supply. Recycling of in-plant process or cooling water can reduce the amount of fresh water required by many industrial operations.

As an example, several cities in Texas now provide treated municipal effluent to industries and irrigation projects in their areas. In industry, the use of

treated wastewater for cooling purposes has a long and very successful history. The same is true for irrigation. One farm near Lubbock has been irrigated with treated wastewater from Lubbock since the 1930s. The City of El Paso has in operation a major aquifer recharge project through which up to 10 million gallons per day of highly treated municipal wastewater will be injected into the aquifer from which the City obtains its water supply.

**Implementation and Enforcement:** Each city or utility that adopts a water conservation program must have the authority and means to implement and enforce the provisions of the program if the goal of conserving water is to be achieved. Enforcement may be provided by utility personnel, local police, or special employees hired to administer and enforce the program. The applicant's water conservation plan will need to include a description of the means to implement and enforce a program, and to annually report on program effectiveness.



December 19, 1984

WHEREAS, the City of Dallas presently provides wholesale treated water service to 16 cities and water districts and to the Dallas/Fort Worth Airport; and

WHEREAS, the City of Dallas maintains a willingness to sell treated water to other entities within the water service area defined by the Peat, Marwick, Mitchell and Company study, "Analysis of Water Service Area", dated May 9, 1980; and

WHEREAS, it is advisable to revise the "Conditions of Service for Treated Water Customers", as adopted by Council Resolution 80126, dated April 30, 1980, for prospective new customers; and

WHEREAS, a subcommittee of the Water Management Advisory Committee has developed and proposed for Dallas' adoption detailed service conditions for new wholesale customers; and

WHEREAS, it is desired that the attached "Conditions of Service for Treated Water Customers" be adopted by Dallas; Now, Therefore,

BE IT RESOLVED BY THE CITY COUNCIL OF THE CITY OF DALLAS:

Section 1. That the City of Dallas reaffirms its willingness to sell treated water to entities within the water service area defined by the Peat, Marwick, Mitchell and Company study, of May 9, 1980, "Analysis of Water Service Area" and adopts the attached "Conditions of Service for Treated Water Customers."

Section 2. That the Director of Dallas Water Utilities is authorized to develop rules and technical standards for implementing the "Conditions of Service for New Treated Water Wholesale Customers."

Section 3. That this resolution shall take effect immediately from and after its passage in accordance with the provisions of the Charter of the City of Dallas and it is accordingly so resolved.

0122g/trh

APPROVED BY  
CITY COUNCIL

DEC 19 1984



CITY SECRETARY

APPROVED   
HEAD OF DEPARTMENT

APPROVED \_\_\_\_\_  
DIRECTOR OF FINANCE

APPROVED   
CITY MANAGER

CONDITIONS OF SERVICE FOR NEW TREATED WATER WHOLESALE CUSTOMERSBACKGROUND

The Dallas water system currently serves 16 wholesale customer cities and the Dallas/Fort Worth Airport. The Water Management Advisory Committee, made up of representatives from each of the wholesale customer cities and D/FW Airport, has developed proposed minimum guidelines for new wholesale water customers. Dallas anticipates that future growth and development in the service area defined by the May 9, 1980, Peat, Marwick, Mitchell and Company study, "Analysis of Water Service Area" will necessitate sales to new wholesale customers.

PURPOSE

These minimum conditions will help to insure that the provision of water service is equitable; that issues related to the public health and well-being are addressed; that water resources in the service area are protected and maintained for the benefit of those who depend on them; and that adequate infrastructures within the Dallas water system are built thus protecting the level and quality of service to existing as well as new customers.

In addition, these guidelines are provided to assist entities in their planning, financing and political actions in as far as water resource and water supply issues are concerned.

SERVICE CONDITIONS

The essential service conditions shall be:

- ... New customers bear up-front costs for all delivery and metering facilities.
- ... No new customers be accepted for service if unplanned expansions of the system would be required.
- ... Rates are to be established by Dallas' cost-of-service studies and will be charged on either a two-part or flat rate basis. Transportation charges (when applicable) shall be negotiated separately with customer entities, shall be in addition to the rates established for water, and shall be subject to approval by Dallas.
- ... New customers must have an adequate water storage and distribution system and adequate wastewater collection and treatment facilities or definitive plans therefor.
- ... Water and wastewater master plans must be provided and revised at least every five years.

ADOPTED STRATEGY  
FOR  
GROUND WATER

It is common knowledge that ground water supplies are limited. Indications of diminishing ground water tables have become evident. Regional and state programs are urging a transition to surface water supplies as a means of meeting future needs without overtaxing valuable ground water supplies.

In Denton County, it is expected that most water utilities have or will have surface water supplies available within a reasonable period of time. The cost of acquiring surface water supplies can require the incurrence of substantial costs. However, the reliability of surface water supplies to support population growth and provide adequate supply during drought periods justifies the cost of surface water supplies. Those utilities serving the low density rural areas may have the most difficulty in converting to surface supplies.

For purposes of this planning study, it appears reasonable to assume that the Municipal Systems can transition to surface supplies by the year 2010. Many cities may want to retain their wells for peaking or back-up purposes.

A reasonable goal is for the cities now using ground water supplies to achieve by 2010 conversion to surface supplies to such an extent that 75% of their total annual requirement will be met by surface supplies. Achievement of this goal will make maximum supplies of ground water available for rural areas or cities who can not reasonably convert to surface supplies.

Adopted by Project Steering Committee

May 27, 1987

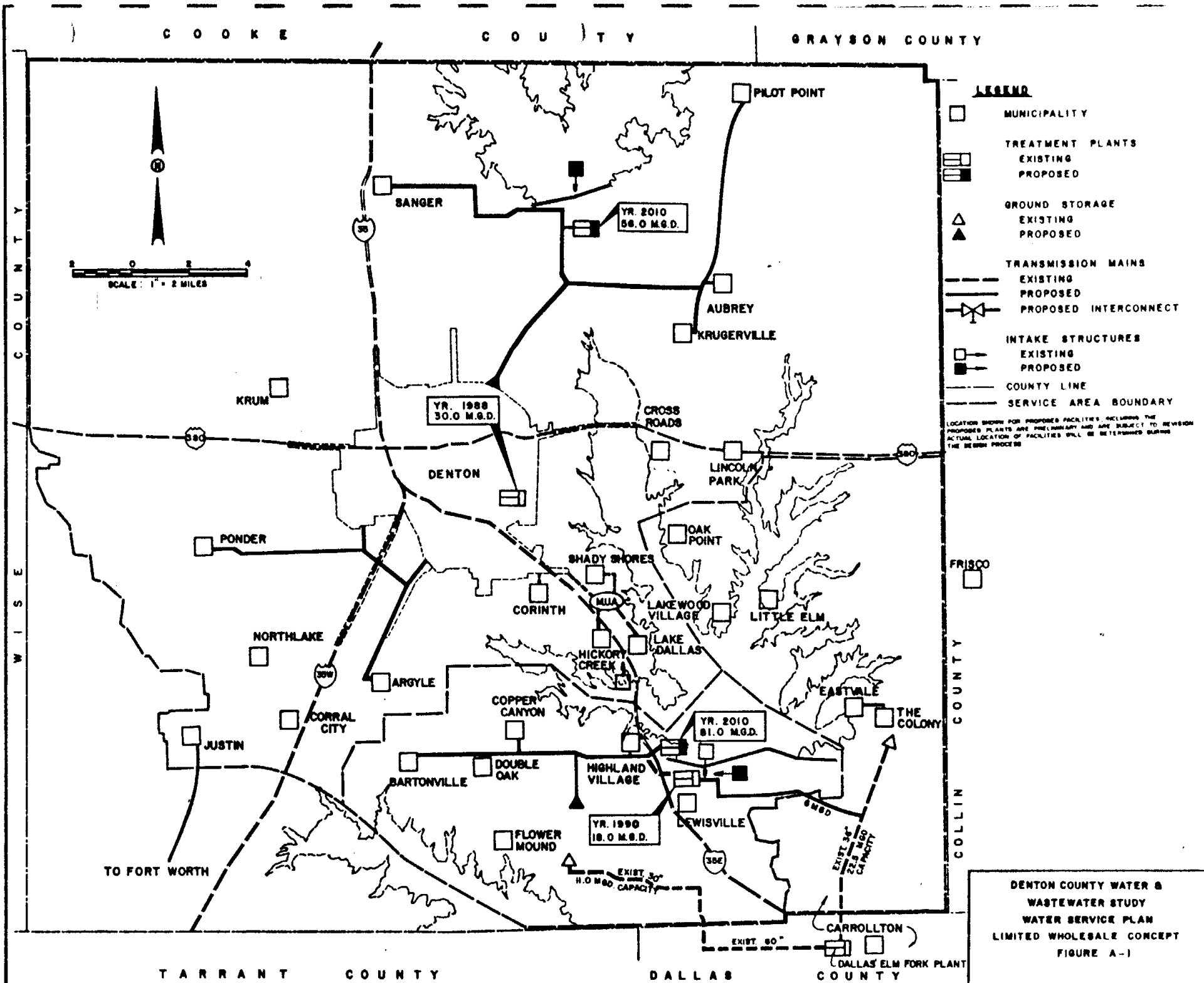
WATER SERVICE PLAN  
ALTERNATIVE 4

The fourth water service plan developed was the "Limited Wholesale Concept." This scheme is similar to the "City Wholesale Concept" with three treated water service areas: Denton, Lewisville and The Colony. This scheme, unlike the "City Wholesale Concept," contemplates that wholesale service will be provided only to those cities whose density and proximity make a connection most cost effective. Emergency interconnections between service areas probably would not be provided. Cities not served by these systems would remain on ground water or find alternative suppliers. Justin could be served by Fort Worth and Carrollton (Denton County portion) would probably obtain its entire treated water supply from Dallas.

It is anticipated that the central city providing the service will demand that the customer city pay the cost of building the facilities to take water from the treatment plant--and possibly to participate in the cost of plant construction. One would expect each customer city to initiate each deal with the wholesale supplier. Each contract would stand on its own merit, and there would be less of a regional, coordinated view. These systems are presented in Figure A-1 and a description of each service system follows.

1. The Denton Wholesale System: This system would provide treated water for Denton and other nearby cities. The exact cities to be served would depend on the need and initiative of each city. The treated water required to serve these cities will be approximately 56 MGD in 2010.
2. The Lewisville Wholesale System: This system would provide treated water to Lewisville and other nearby cities. The system would utilize the 6 MGD of treated water available from Dallas. An 81 MGD treatment plant would be needed by 2010.

3. The Colony Wholesale System: This system would provide treated water for The Colony and immediate vicinity. This system will require approximately 12 MGD treated water in 2010, which is less than the amount available through the Dallas pipeline. Consequently, all of The Colony's needs could be met by their present contract with Dallas.



**LEGEND**

- MUNICIPALITY
- ▭ TREATMENT PLANTS  
EXISTING  
PROPOSED
- △ GROUND STORAGE  
EXISTING  
PROPOSED
- TRANSMISSION MAINS  
EXISTING  
PROPOSED
- ⊕ PROPOSED INTERCONNECT
- ▭ INTAKE STRUCTURES  
EXISTING  
PROPOSED
- COUNTY LINE
- SERVICE AREA BOUNDARY

LOCATION SHOWN FOR PROPOSED FACILITIES INCLUDING THE PROPOSED PLANTS ARE PRELIMINARY AND ARE SUBJECT TO REVISION. ACTUAL LOCATION OF FACILITIES WILL BE DETERMINED DURING THE DESIGN PROCESS.

**DENTON COUNTY WATER & WASTEWATER STUDY  
WATER SERVICE PLAN  
LIMITED WHOLESALE CONCEPT  
FIGURE A-1**

TABLE A-1  
ESTIMATED CONSTRUCTION COST OF WATER SERVICE PLAN  
FOR TRI-REGIONAL CONCEPT

Item	Estimated Cost/Year		
	1990	2000	2010
<u>NORTH REGIONAL SERVICE AREA</u>			
1. Raw Water Intake, 55 MGD	\$ 4,000,000		
2. Plant Land Cost, 30 Ac	270,000		
3. First Stage Treatment Plant, 7.0 MGD	7,000,000		
4. Second Stage Addition to Plant, 24.0 MGD		\$20,400,000	
5. Third Stage Addition to Plant, 24.0 MGD			\$20,500,000
6. Plant Discharge Piping, 72 x 60	40,000		
7. 18" $\phi$ to Sanger, 8.0 mi	1,774,400		
8. 60" $\phi$ Main, 2.0 mi	1,636,800		
9. 54" $\phi$ Main, 4.5 mi	2,851,200		
10. 4.0 M Gallon Ground Storage	3,600,000		
11. 16" $\phi$ Main, Conn. to Argyle, 4.5 mi			712,800
12. 16" $\phi$ Conn. to Aubrey, 4.8 mi		760,320	
13. 12" $\phi$ Conn. to Krugerville, 2.0 mi		232,400	
14. 12" $\phi$ Conn. to Pilot Point, 6.5 mi		755,300	
15. 12" $\phi$ Conn. to Denton, Cross Roads and Lincoln Park, 6.5 mi			755,300
16. 12" $\phi$ Conn. K-ville/Cross Roads, 4.0 mi			464,800
17. 12" $\phi$ Conn. to Krum, 3.0 mi			348,600
18. 12" $\phi$ Conn. to Ponder, 7.3 mi			848,260
19. North Regional Service Area Sub-total Estimated Construction Cost	\$21,172,400	\$22,148,020	\$23,529,760
<u>SOUTH REGIONAL SERVICE AREA</u>			
20. Raw Water Intake, 86 MGD	\$ 6,020,000		
21. 72" $\phi$ Raw Water, 3.5 mi	3,418,800		
22. Plant Land Cost, 30 Ac	450,000		
23. First Stage Treatment Plant, 9.0 MGD	9,000,000		
24. Second Stage Plant Addition, 46.0 MGD		\$36,800,000	
25. Third Stage Plant Addition, 39.0 MGD			\$31,200,000
26. 72" $\phi$ Plant/Dist., 1.0 mi	976,800		
27. 54" $\phi$ to Highland Village, 1.7 mi	1,077,100		
28. 30" $\phi$ to Copper Canyon, 2.0 mi	897,600		
29. 24" $\phi$ to Double Oak, 1.3 mi	\$ 446,200		
30. 20" $\phi$ to Bartonville, 3.8 mi	1,103,500		

TABLE A-1 (Concluded)

Item	Estimated Cost/Year		
	1990	2000	2010
<u>SOUTH REGIONAL SERVICE AREA (Cont'd)</u>			
31. 16" $\phi$ to Argyle, 3.3 mi	522,700		
32. 12" $\phi$ Justin, H. Lake, Corral City, 8.8 mi			\$ 1,022,560
33. 36" $\phi$ to Flower Mound, 1.4 mi		\$ 702,240	
34. 4.0 M Gallon Ground Storage		<u>3,600,000</u>	
35. Total South Regional Service Area	\$23,912,700	\$41,102,240	\$32,222,560
<u>EAST REGIONAL SERVICE AREA</u>			
36. Raw Water Intake, 23 MGD		\$ 2,300,000	
37. 42" $\phi$ Raw Water, 5.5 mi		3,194,400	
38. Plant Land Cost, 20 Ac		240,000	
39. First Stage Plant, 11.5 MGD		11,000,000	
40. Second Stage Plant, 11.5 MGD			\$10,000,000
41. 42" $\phi$ to Carrollton, 7.5 mi		4,356,000	
42. 4.0 M Gallon Ground Storage		3,600,000	
43. 12" $\phi$ to Little Elm, 6.5 mi		755,300	
44. 12" $\phi$ to Lakewood Village and Oak Point, 5.0 mi			581,000
45. 12" $\phi$ Interconnection to Lincoln Park,			<u>464,800</u>
46. East Regional Service Area Subtotal	\$ 0.00	\$25,445,700	\$11,045,800



TABLE A-2  
ESTIMATED CONSTRUCTION COST OF WATER SERVICE PLAN  
FOR COMPREHENSIVE REGIONAL CONCEPT

Item	Estimated Cost/Year		
	1990	2000	2010
<u>NORTH REGIONAL SERVICE AREA</u>			
1. Raw Water Intake, 60 MGD	\$ 4,200,000		
2. Plant Land Cost, 30 Ac	270,000		
3. First Stage Treatment Plant, 7.0 MGD	7,000,000		
4. Second Stage Addition to Plant, 24.0 MGD		\$20,400,000	
5. Third Stage Addition to Plant, 28.0 MGD			\$22,400,000
6. Plant Discharge Piping, 72 x 60	40,000		
7. 18" $\phi$ to Sanger, 8.0 mi	1,774,400		
8. 60" $\phi$ Main, 2.0 mi	1,636,800		
9. 54" $\phi$ Main, 4.5 mi	2,851,200		
10. 4.0 M Gallon Ground Storage	3,600,000		
11. 16" $\phi$ Main, Conn. to Argyle, 4.5 mi	712,800		
12. 16" $\phi$ Conn. to Aubrey, 4.8 mi		760,320	
13. 12" $\phi$ Conn. to Krugerville, 2.0 mi		232,400	
14. 12" $\phi$ Conn. to Pilot Point, 6.5 mi		755,300	
15. 12" $\phi$ Conn. to Denton, Cross Roads and Lincoln Park, 6.5 mi			755,300
16. 12" $\phi$ Conn. K-ville/Cross Roads, 4.0 mi			464,800
17. 12" $\phi$ Conn. to Krum, 3.0 mi			348,600
18. 12" $\phi$ Conn. to Ponder, 7.3 mi			848,260
19. North Regional Area Total Cost	\$21,172,400	\$22,148,020	\$24,816,960
<u>SOUTH-EAST REGIONAL SERVICE AREA</u>			
20. Raw Water Intake, 138 MGD	\$ 9,660,000		
21. 90" $\phi$ Raw Water Line, 6.0 mi	9,102,000		
22. Plant Land Cost, 50 Ac	600,000		
23. First Stage Treatment Plant, 30 MGD	27,000,000		
24. Second Stage Treatment Plant Addition, 62 MGD		\$46,500,000	
25. Third Stage Treatment Plant Addition, 46 MGD			\$34,500,000
26. 90" $\phi$ Transmission, 5.2 mi	7,888,400		
27. 54" $\phi$ to Carrollton, 2.1 mi	1,330,600		
28. 4.0 M Gallon Ground Storage,	3,600,000		
29. 72" $\phi$ to Lewisville, 6.2 mi	6,056,200		
30. 54" $\phi$ to Hi-Village, 2.8 mi	1,774,100		

TABLE A-2 (Concluded)

Item	Estimated Cost/Year		
	1990	2000	2010
<u>SOUTH-EAST REGIONAL SERVICE AREA (Cont'd)</u>			
31. 48" $\phi$ to Ground Storage, 2.5 mi	\$ 1,518,000		
32. Pump Station and Ground Storage, 3.6 + 2.4	6,000,000		
33. 36" $\phi$ to Flower Mound, 1.5 mi		\$ 752,400	
34. 30" $\phi$ to Copper Canyon, 1.5 mi	733,200		
35. 24" $\phi$ to Double Oak, 1.3 mi	446,200		
36. 20" $\phi$ to Bartonville, 3.8 mi	1,103,500		
37. 16" $\phi$ to Argyle, 3.3 mi	522,700		
38. 12" $\phi$ to Justin, N. Lake and Corral, 8.8 mi		702,240	
39. 12" $\phi$ to Little Elm, 6.5 mi		755,300	
40. 12" $\phi$ to Lakewood Village and Oak Point			\$ 581,000
41. 12" $\phi$ In-Connect Lincoln Park, 4.0 mi			<u>464,800</u>
42. South-East Regional Service Area Total	\$77,334,900	\$48,709,940	\$35,545,800

TABLE A-3  
ESTIMATED CONSTRUCTION COST OF WATER SERVICE PLAN  
FOR CITY WHOLESALE CONCEPT

Item	Estimated Cost/Year		
	1990	2000	2010
<b>DENTON SERVICE AREA</b>			
1. Raw Water Intake, 60 MGD	\$ 4,200,000		
2. Plant Land Cost, 30 Ac	270,000		
3. First Stage Treatment Plant, 7.0 MGD	7,000,000		
4. Second Stage Addition to Plant, 24.0 MGD		\$20,400,000	
5. Third Stage Addition to Plant, 28.0 MGD			\$22,400,000
6. Plant Discharge Piping, 72 x 60	40,000		
7. 18" $\phi$ to Sanger, 8.0 mi	1,774,400		
8. 60" $\phi$ Main, 2.0 mi	1,636,800		
9. 54" $\phi$ Main, 4.5 mi	2,851,200		
10. 4.0 M Gallon Ground Storage	3,600,000		
11. 16" $\phi$ Main, Conn. to Argyle, 4.5 mi	712,800		
12. 16" $\phi$ Conn. to Aubrey, 4.8 mi		760,320	
13. 12" $\phi$ Conn. to Krugerville, 2.0 mi		232,400	
14. 12" $\phi$ Conn. to Pilot Point, 6.5 mi		755,300	
15. 12" $\phi$ Conn. to Denton, Cross Roads and Lincoln Park, 6.5 mi			755,300
16. 12" $\phi$ Conn. K-ville/Cross Roads, 4.0 mi			464,800
17. 12" $\phi$ Conn. to Krum, 3.0 mi			348,600
18. 12" $\phi$ Conn. to Ponder, 7.3 mi			848,260
19. 12" $\phi$ Conn. Justin, Northlake and Corral City to Argyle, 8.8 mi			1,022,560
20. 14" $\phi$ Argyle-Bartonville Inter-Connection, 3.5 mi			462,000
21. Denton Service Area Sub-Total Estimated Construction Cost	\$22,084,400	\$22,148,020	\$26,301,520
<b>LEWISVILLE SERVICE AREA</b>			
22. Raw Water Intake, 82 MGD	\$ 5,740,000		
23. 72" $\phi$ Raw Water, 3.5 mi	3,418,800		
24. Plant Land Cost, 30 Ac	450,000		
25. First Stage Treatment Plant, 9.0 MGD	9,000,000		
26. Second Stage Plant Addition, 45.0 MGD		\$36,000,000	
27. Third Stage Plant Addition, 37.0 MGD			\$29,600,000
28. 72" $\phi$ Plant/Dist., 1.75 mi	1,709,400		
29. 42" $\phi$ to Copper Canyon, 3.8 mi	\$ 2,207,000		

TABLE A-3 (Concluded)

Item	Estimated Cost/Year		
	1990	2000	2010
<u>LEWISVILLE SERVICE AREA (Cont'd)</u>			
30. 36" $\phi$ to Flower Mound, 1.5 mi		\$ 752,000	
31. 24" $\phi$ to Double Oak, 1.3 mi	446,200		
32. 14" $\phi$ to Bartonville, 2.5 mi	330,000		
33. 24" $\phi$ Tie to Colony Line, 5.2 mi	1,784,600		
34. 4.0 M Gallon Ground Storage,		<u>3,600,000</u>	
35. Lewisville Service Area Subtotal	<u>\$25,086,000</u>	<u>\$40,352,400</u>	<u>\$29,600,000</u>
<u>COLONY SERVICE AREA</u>			
36. Raw Water Intake, 23 MGD		\$ 2,300,000	
37. 42" $\phi$ Raw Water, 5.5 mi		3,194,400	
38. Plant Land Cost, 20 Ac		240,000	
39. First Stage Plant, 11.5 MGD		11,000,000	
40. Second Stage Plant, 11.5 MGD			\$10,000,000
41. 42" $\phi$ to Carrollton, 7.5 mi		4,356,000	
42. 4.0 M Gallon Ground Storage		3,600,000	
43. 12" $\phi$ to Little Elm, 6.5 mi		755,300	
44. 12" $\phi$ to Lakewood Village and Oak Point, 5.0 mi			581,000
45. 12" $\phi$ Interconnection to Lincoln Park, 4.0 mi			<u>464,800</u>
46. Colony Service Area Subtotal	<u>\$ 0.00</u>	<u>\$25,445,700</u>	<u>\$11,045,800</u>

TABLE 7-14  
 SERVICE SCHEDULE FOR THE  
 WASTEWATER SERVICE PLAN  
 CITIES WITHIN THE LAKE CITIES MUA SERVICE AREA

City	Average Daily Flow (MGD)		
	1990	2000	2010
Hickory Creek <sup>1</sup>	0.21	0.26	0.30
Lake Dallas	0.38	0.44	0.47
Shady Shore	<u>0.12</u>	<u>0.16</u>	<u>0.18</u>
Required Treatment Plant Capacity	0.71	0.86	0.95

<sup>1</sup> The wastewater flow from that portion of Hickory Creek east of IH-35.

8-27-1987

Document No. 870759  
EH&A Job No. 10128

DRAFT  
EXECUTIVE SUMMARY

DENTON COUNTY  
WATER AND WASTEWATER STUDY  
REGIONAL MASTER PLAN  
FOR YEAR 2010

8-483-523

Submitted to:

Denton County Steering Committee

Denton County	City of Highland Village
City of Argyle	City of Justin
City of Aubrey	Lake Cities Municipal Utility Authority
Town of Bartonville	City of Lewisville
Bartonville Water Supply Corporation	Town of Little Elm
Black Rock Water Supply Corporation	Mustang Water Supply Corporation
Bolivar Water Supply Corporation	City of Pilot Point
City of Carrollton	Town of Ponder
Town of Copper Canyon	City of Sanger
Town of Corinth	T.S.W. Incorporated Water Company
City of Dallas	The Colony
City of Denton	Wren Water Supply Corporation
Town of Flower Mound	

Prepared by:

Espey, Huston & Associates, Inc.  
17811 Waterview Parkway  
Dallas, Texas 75252

October 1987

DRAFT  
EXECUTIVE SUMMARY

DENTON COUNTY  
WATER AND WASTEWATER STUDY  
REGIONAL MASTER PLAN  
FOR YEAR 2010

In 1986, twenty-five agencies, including the County of Denton and the City of Dallas, joined together to document and plan for the future water and wastewater needs of the County. The project actually started several years earlier. Interest in a regional strategy to respond to continued growth began to gain momentum when construction started on Ray Roberts Lake. Most people are aware that three major water supply reservoirs (Grapevine, Lewisville and Ray Roberts) are located in Denton County. However, few people are aware that water rights from these reservoirs belong primarily to the City of Dallas. A more critical fact is that no regional entity has the responsibility to develop water supplies and deliver potable water to the various communities and utilities in Denton County.

The three major reservoirs in Denton County have an estimated dependable yield of 183.98 million gallons per day (MGD), of which the City of Denton holds rights to 24.06 MGD. The remaining rights belong to: Dallas, 150.71 MGD; City of Grapevine, 3.17 MGD and Park Cities MUD, 6.04 MGD. Within the study area (all of Denton County except for that portion south and west of Denton Creek), the estimated drought demand for water supply for the year 2010 is 137 MGD. The report that accompanies this summary documents the basis for the 137 MGD estimate and outlines alternative strategies for meeting the water needs of the Denton County area.

Naturally, one tends to assign a high priority to water supply. By contrast, one tends to assign a low priority to the need to plan for wastewater--especially in the rural areas and in the smaller communities. But, this plan addresses both water and wastewater needs. It addresses both with a conviction that an abundant water supply and an equally adequate wastewater system are necessary to sustain quality growth and to protect the environment.

The study was conducted under the general guidance of a 25-member Steering Committee consisting of one representative from each participating agency. The study began with seventeen entities; eight others joined during the study. The Texas Water Development Board participated and awarded a matching grant to help fund the project. The North Central Texas Council of Governments (NCTCOG) provided assistance and encouragement. The study was conducted and the master plan prepared by Espey, Huston & Associates, Inc. (EH&A); it was coordinated with the entities referenced above plus the Texas Water Commission and nearby regional utility agencies.

Specific findings and recommendations include the following:

1. Population for the study area was 139,986 in 1980 and is expected to increase at an average annual rate of 5.3%, achieving a population of 651,609 by the year 2010.
2. Of the 511,623 increase in population, 91% is expected to occur in urban areas.
3. The present per capita use of water is approximately 153 gallons per day, but is expected to increase to 188 gallons per capita per day by the year 2010.



4. Total average daily water usage in 1986 was estimated to be 34.7 MGD.
5. By 2010, average water usage under normal conditions is projected to increase to 119 MGD.
6. A sustained drought would impose greater demands--estimated at 15% above normal. The 2010 demand under drought conditions is projected to be 137 MGD.
7. The Steering Committee and EH&A recommend that the regional system be planned and designed to provide an adequate supply of water during a drought equal to the drought of record (1950-1957).
8. Present per capita wastewater flows (including infiltration and inflow) were estimated to be 119 gallons per day. By 2010, wastewater flows are projected to increase to 131 gallons per capita per day.
9. Total average daily wastewater flow in 1986 was estimated to be 30 MGD and is projected to increase to 83 MGD by the year 2010.
10. Present usage of ground water is estimated to be approximately equal to the available supply. Therefore, new supplies to accommodate growth will need to be surface water supplies.
11. The Steering Committee and EH&A recommend that all water utilities convert to surface supplies as soon as feasible--and specifically that the cities convert to surface water supplies no later than 2010; the limited supply of ground water would be reserved for peaking and back-up purposes and for use by those

entities for whom conversion to surface supplies is not feasible, especially for small or remote rural systems.

12. Conservation of water is necessary but is not an alternative to development of new resources. The report recommends an aggressive water conservation program; a 15% saving is thought to be achievable without hardship.
13. The City of Dallas presently sells, under wholesale contracts, untreated and treated water to various Denton County cities. Dallas has expressed a willingness to assist Denton County in planning for future needs.
14. Based on present contractual commitments, it appears that approximately 90 MGD will be available from Dallas by 2010. Denton has rights to 24 MGD. An additional supply of 23 MGD is needed before 2010 to meet the total requirement of 137 MGD.
15. The report recommends that Denton County participate with others in the development of additional surface water supplies in East Texas and that planning for such supplies should begin within 5 to 10 years.
16. Alternative institutional strategies are available to manage the regional system needed in Denton County. The three most appropriate alternatives appear to be:
  - o creation of a county-wide regional agency;
  - o wholesale contracts between cities, other public agencies and local utilities; and
  - o contracts with existing regional entities based outside Denton County.

It is expected that each of these three alternatives will be employed to some degree.

17. EH&A evaluated alternative infrastructure plans for responding to the projected needs of the participating entities. The recommended plan for water is referred to as the Tri-Regional Strategy, and projects the need for a new water plant in each of three areas. By 2010, the estimated requirements are:
  - o North Service Area - a 55 MGD plant near Ray Roberts Lake;
  - o East Service Area - a 23 MGD plant north of The Colony; and
  - o South Service Area - an 86 MGD plant west of Highland Village.
18. The cities of Lewisville and Denton operate water treatment plants of 12 MGD and 24 MGD, respectively. In addition to the new regional plants, it is expected that Lewisville will expand its plant to 18 MGD and Denton its plant to 30 MGD.
19. The recommended strategy for wastewater is to treat the wastewater at new regional plants to high standards and to return the treated effluent to local lakes for possible use as a water supply resource. The alternative is to discharge the effluent downstream.
20. A new regional wastewater treatment plant is proposed in each of the North, Southeast and Southwest service areas.
21. It is recommended that certain existing local wastewater treatment plants remain in service. Others could be abandoned when regional service is available.

22. Of special concern is the protection of the water supply reservoirs from potential sources of pollution including septic tanks and other point and non-point sources within the watersheds. A special program will be needed for each lake to protect water quality.

23. Projections of growth and demand indicate that the regional system will be needed by 1990.

24. For the water system, estimates of the basic cost (not including engineering, financing, rights-of-way and contingencies) are:

o	1990	\$45 million
o	2000	89 million
o	2010	<u>67 million</u>
	Total	\$201 million

25. For the wastewater system, estimates of the basic cost (not including engineering, financing, rights-of-way and contingencies) are:

o	1990	\$29 million
o	2000	32 million
o	2010	<u>41 million</u>
	Total	\$102 million

General recommendations include the following:

A. Designate the cities of Lewisville and Denton to act in partnership as the interim regional agency to proceed with planning and implementation pending creation of a permanent regional agency. To assure that planning and implementation are pursued effectively

and forthrightly, an interim manager (part- or full-time) will be needed.

- B. Appoint a Blue Ribbon Implementation Committee to assist the Steering Committee with the task of informing the public, the cities, elected officials and the Legislature as to the water needs and strategy for Denton County's future.
- C. Obtain state approval of the county-wide master plan.
- D. City Councils of all participating cities should adopt resolutions of support for the plan. Boards of Directors for other participating agencies should do likewise.
- E. Draft proposed legislation for consideration of the Legislature in 1989 for creation of a regional utility agency for Denton County.
- F. Proceed with a sense of urgency to implement the plan. Any significant delays in implementing the regional plan could force individual entities to develop less cost-effective strategies.
- G. Participating agencies should continue to share in the cost of planning and implementing the system until a self-sufficient regional agency can be established. Potential for grants and loans should be explored.
- H. Commence coordination efforts with other major water supply entities for development of water supply strategies.
- I. Develop a detailed water conservation plan as a guideline for the regional agency and participating entities.

J. Develop detailed plans for managing and financing the system.

This master plan is based on what EH&A and the Steering Committee are convinced are optimistic but reasonable projections of economic development and improvements in quality of life for Denton County communities. If the trends change, appropriate adjustments in the implementation schedule and plan are recommended. We recommend a complete review of the plan in 1990 and at 5-year intervals thereafter.