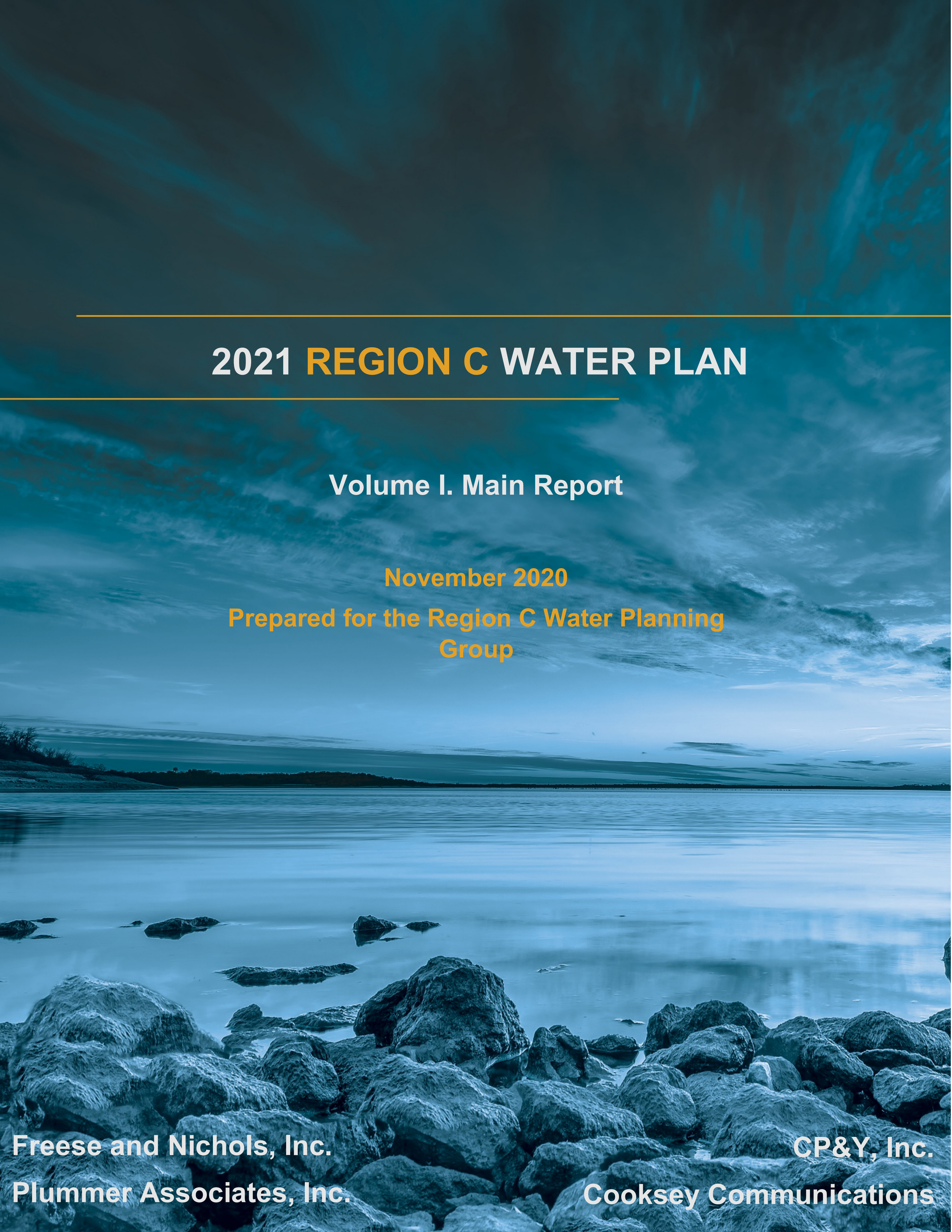

2021 REGION C WATER PLAN

Volume I. Main Report

November 2020

Prepared for the Region C Water Planning Group

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2021 REGION C WATER PLAN

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2021
REGION C
WATER PLAN

November 2020

Prepared for the Region C Water Planning Group

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List of Acronyms

Acronym	Description
AMI	Advanced Metering Infrastructure
ASR	Aquifer Storage and Recovery
AWWA	American Water Works Association
BEG	Bureau of Economic Geology
BMP	Best Management Practices
CFS	Cubic Feet per Second
CGMA	Collin-Grayson Municipal Alliance
CRU	Collective Reporting Units
DB22	TWDB's Regional Water Planning Database
DBP	Disinfection Byproduct
DCP	Drought Contingency Plan
DFC	Desired Future Conditions
DOR	Drought of Record
DPR	Direct Potable Reuse
EA	Executive Administrator of the TWDB
EPA	Environmental Protection Agency
GAM	Groundwater Availability Model
GCD	Groundwater Conservation District
GMA	Groundwater Management Area
GPCD	Gallons per Capita per Day
GPF	Gallons per Flush
GPM	Gallons per minute
HOA	Homeowners Association
IBT	Interbasin Transfer
ICI	Industrial, Commercial, Institutional
IPP	Initially Prepared Plan
IWA	International Water Association
LLC	Limited Liability Company
MAG	Modeled Available Groundwater
MGD	Million Gallons per Day
MSL	Mean Sea Level
MWP	Major Water Provider
NRCS	Natural Resources Conservation Service (formerly the Soil Conservation Service)
NRNWR	Neches River National Wildlife Refuge
OCR	Off Channel Reservoir
PDSI	Palmer Drought Severity Index
RO	Reverse Osmosis
RWP	Regional Water Plan
RWPA	Regional Water Planning Area
RWPG	Regional Water Planning Group
SB1	Senate Bill One
SB2	Senate Bill Two
SB3	Senate Bill Three

Acronym	Description
SDWA	Safe Drinking Water Act
SEP	Steam Electric Power
SUD	Special Utility District
SWCQP	Statewide Water Conservation Quantification Project
SWIFT	State Water Implementation Fund
SWIRFT	State Water Implementation Revenue Fund
SWP	State Water Plan
TAC	Texas Administrative Code
TCEQ	Texas Commission on Environmental Quality
TDS	Total Dissolved Solids
TNRIS	Texas Natural Resources Information System
TPWD	Texas Parks and Wildlife Department
TWDB	Texas Water Development Board
UCM	Uniform Costing Model
USACE	United States Army Corps of Engineers
USDA	United States Department of Agriculture
WAM	Water Availability Model
WCAC	Water Conservation Advisory Council
WCCAP	Water Conservation and Condition Assessment Program
WCP	Water Conservation Plan
WIF	Water Infrastructure Fund
WMS	Water Management Strategy
WMSP	Water Management Strategy Project
WSC	Water Supply Corporation
WSD	Water Supply District
WTP	Water Treatment Plant
WUG	Water User Group
WWP	Wholesale Water Provider
WWTP	Wastewater Treatment Plant
Water Providers	
ANRA	Angelina and Neches River Authority
BRA	Brazos River Authority
DWU	Dallas Water Utilities
GTUA	Greater Texoma Utility Authority
NTMWD	North Texas Municipal Water District
RRA	Red River Authority
SRA	Sabine River Authority
SRBA	Sulphur River Basin Authority
SRMWD	Sulphur River Municipal Water District
TRWD	Tarrant Regional Water District
TRA	Trinity River Authority
UNRMWA	Upper Neches River Municipal Water Authority
UTRWD	Upper Trinity Regional Water District

Glossary of Terms

Term	Meaning
Aquifer Storage and Recovery	Aquifer storage and recovery (ASR) is the storage of water in a suitable aquifer through a well during times when water is available, and the recovery of water from the same aquifer during times when it is needed.
Best Management Practice	Best Management Practices (BMPs) are a menu of options for which entities within a water use sector can choose to implement in order to achieve benchmarks and goals through water conservation. Best management practices are voluntary efficiency measures that are intended to save a quantifiable amount of water, either directly or indirectly, and can be implemented within a specified timeframe.
Desired Future Condition	Criteria which is used to define the amount of available groundwater from an aquifer.
Drought of Record	A drought of record is the worst recorded drought since the comipliation of meterologic and hydraulic began.
Groundwater Availability Model	Numerical groundwater flow model. GAMs are used to determine the aquifer response to pumping scenarios. These are the preferred models to assess groundwater availability.
Groundwater Conservation District	Generic term for all or individual state recognized Districts that oversee the groundwater resources within a specified political boundary.
Groundwater Management Area	Sixteen GMAs in Texas. Tasked by the Legislature to define the desired future conditions for major and minor aquifers within the GMA.
Gallons per capita per day	Unit of measure that accounts for water use in the number of gallons a person uses each day.
Interbasin Transfer	In an interbasin water transfer, surface water is taken from one river basin and conveyed into another river basin for use there.
Modeled Available Groundwater	The MAG is the amount of groundwater that can be permitted by a GCD on an annual basis. It is determined by the TWDB based on the DFC approved by the GMA. Once the MAG is established, this value must be used as the available groundwater in regional water planning.
Major Water Provider	A water user group or a wholesale water provider of particular significance to the region's water supply as determined by the regional water planning group.
Palmer Drought Severity Index	A measure of dryness based on precipitation, temperature, soil moisture and other factors.
Regional Water Planning Group	The generic term for the planning groups that oversee the regional water plan development in each respective region in the State of Texas
Senate Bill One	Legislation passed by the 75th Texas Legislature that is the basis for the current regional water planning process.
Texas Commission on Environmental Quality	Agency charged with oversight of Texas surface water rights and WAM program.
Total Dissolved Solids	A measure of the combined total organic and ingorganic substances contained in the water.
Total Maximum Daily Load	A Total Maximum Daily Load (TMDL) is a regulatory term in the U.S. Clean Water Act, describing a plan for restoring impaired waters that

Term	Meaning
	identifies the maximum amount of a pollutant that a body of water can receive while still meeting water quality standards.
Texas Water Development Board	Texas Agency charged with oversight of regional water plan development and oversight of GCDs
Water Availability Model	Computer model of a river watershed that evaluates surface water availability based on Texas water rights.
Water Management Strategy	Strategies available to RWPG to meet water needs identified in the regional water plan.
Water User Group	A group that uses water. Six major types of WUGs: municipal, manufacturing, mining, steam electric power, irrigation and livestock.
Wholesale Water Provider	Entity that has or is expected to have contracts to sell 1,000 ac-ft./yr. or more of wholesale water.

Executive Summary

This report presents the *2021 Region C Water Plan* developed in the fifth round of the Senate Bill One regional water planning process. Region C covers all or part of 16 North Central Texas counties, as shown in **Figure ES.1**. The Region C water plan was developed under the direction of the 22-member Region C Water Planning Group. The initially prepared regional water plan was adopted by the Region C Water Planning Group on February 10, 2020 and made publicly available at that time. A public hearing was held on May 26, 2020. Public comment was accepted through July 27, 2020 and the state agency comment period extended through August 24, 2020. A final *2021 Region C Water Plan* was produced based on the initially prepared plan, comments, and other updates. The final plan was adopted by the Region C Water Planning Group on September 21, 2020 and submitted to the Texas Water Development Board on November 5, 2020.

This Executive Summary focuses on current water needs and supplies in Region C, the projected need for water, the identification and selection of recommended water management strategies, the costs and impacts of the selected strategies, and county summaries for each county in the region. Other elements of the plan are covered in the main text and the appendices.

Chapter Outline

Section ES.1 – Current Water Use and Supplies in Region C

Section ES.2 – Projected Need for Water

Section ES.3 – Identification and Selection of Water Management Strategies

Attachment 1 – Water Management Strategies DB22 Report

Related Appendices

Appendix D – DB22 Reports (Volume II)

Required Chapters for Plan:

1. Description of Region C
2. Population and Water Demand Projections
3. Water Availability and Existing Water Supplies in Region C
4. Identification of Water Needs
5. Water Management Strategies
6. Impacts of the Region C Water Plan
7. Drought Response Information, Activities, and Recommendations
8. Unique Stream Segments and Reservoir Sites, and Policy Recommendations
9. Reporting of Financing for Water Management Strategies
10. Adoption of Plan and Public Participation
11. Implementation and Comparison to the Previous Region C Water Plan

ES.1 Current Water Use and Supplies in Region C

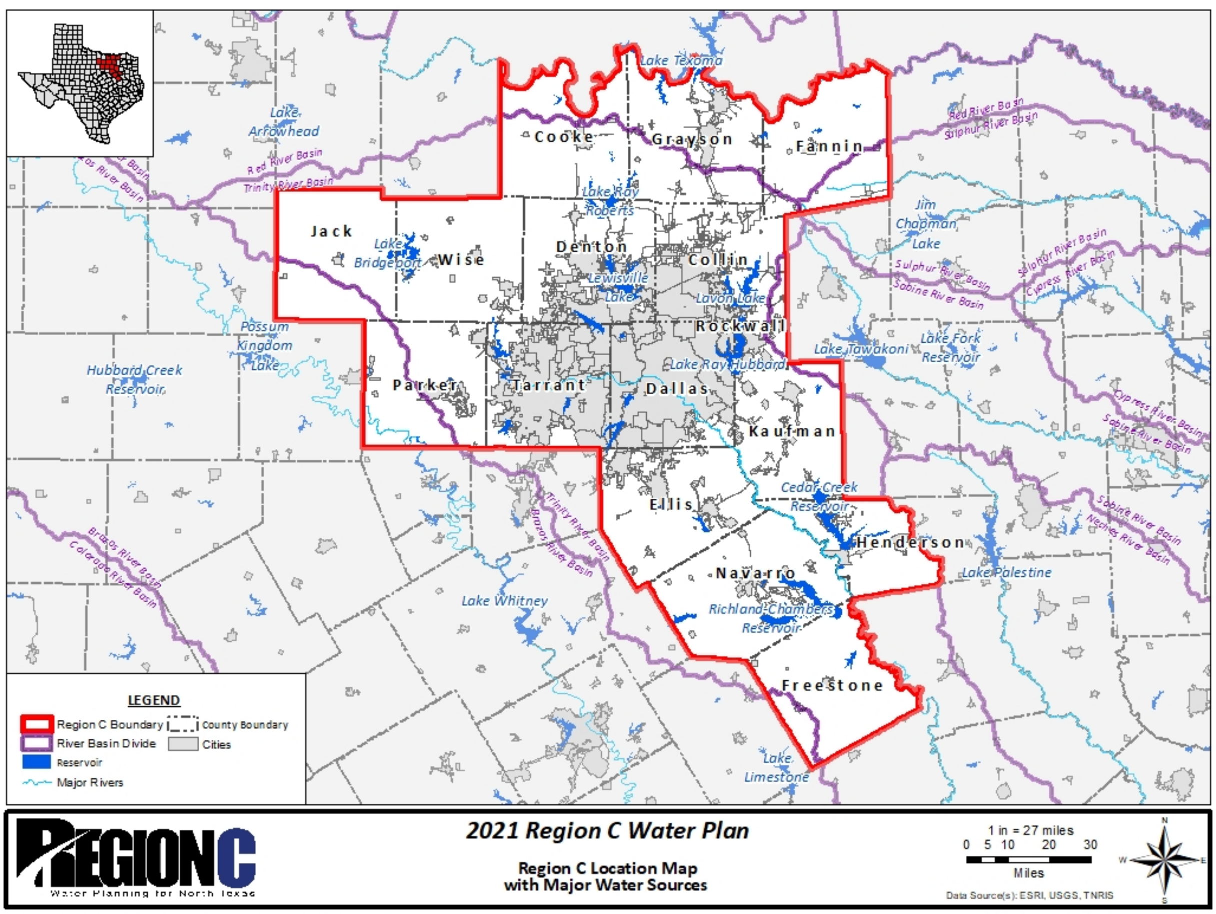
As of the 2010 census, the population of Region C was 6,477,835, which represented about 25 percent of Texas' total population. The estimated population as of July 2016 was 7,233,415, an increase of over 750,000 (11.7 percent) in six years. The two most populous counties in Region C, Dallas and Tarrant, have 63 percent of the region's population. Region C is heavily urbanized, with 84 percent of the population located in cities of more than 20,000 people.

ES.1.1 Physical Setting

Most of Region C is in the upper portion of the Trinity River Basin, with smaller parts in the Red, Brazos, Sulphur, and Sabine River Basins. Precipitation increases from west to east in the region. The average runoff in the region also increases from the west to the east, while evaporation is higher to the west. These patterns of rainfall, runoff, and evaporation result in more abundant water supplies in the eastern part of Region C than in the west.

There are thirty-four major reservoirs in Region C with conservation storages in excess of 5,000 acre-feet. These reservoirs and others outside of Region C provide most of the region's water supply. Aquifers in the region include the Trinity, Woodbine, Carrizo-Wilcox, Nacatoch, and Queen City.

Figure ES.1 Region C Location Map with Major Water Sources



ES.1.2 **Water Use**

Water use in Region C has increased significantly in recent years, primarily in response to increasing population. The regional water use in the year 2016 was approximately 1,340,000 acre-feet. It is interesting to note that Region C, with over 25 percent of Texas' population, had only 9.4 percent of the state's water use in 2016. About 90 percent of the current water use in Region C is for municipal supply.

ES.1.3 **Current Sources of Water Supply**

About 90 percent of the water use in Region C is supplied by surface water, but groundwater can also be important, especially in rural areas. Most of the surface water supply in Region C comes from major reservoirs in and outside of the region. The Trinity aquifer is the largest source of groundwater in Region C, with some use from the Woodbine, Carrizo-Wilcox and other minor aquifers. The current use of groundwater is close to or greater than the long-term reliable supply available in some parts of Region C.

About half of the water used for municipal supply in Region C is discharged as treated effluent from wastewater treatment plants, making wastewater reclamation and reuse a significant source of water supply for the region. Reuse supplies are increasing rapidly in the region, with several major projects recently completed or under development. It is clear that the reuse of treated wastewater will be a significant source of future water supplies for the region.

ES.1.4 **Water Providers in Region C**

Water providers in Region C include over 30 wholesale water providers (with six of them being designated as major water providers) and over 360 water user groups. In 2016, the three largest wholesale water providers in Region C (Dallas Water Utilities, Tarrant Regional Water District, and North Texas Municipal Water District) provided the majority of the water used in the region. Cities and towns provide most of the retail water service in Region C.

ES.2 Projected Need for Water

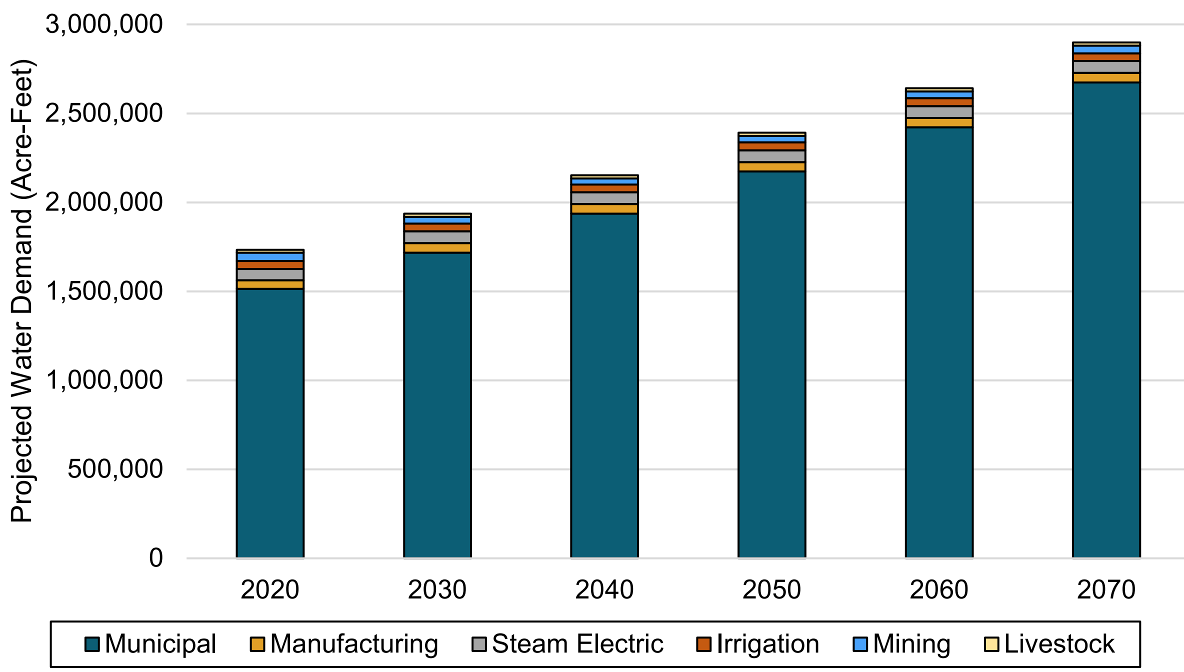
ES.2.1 Population Projections

The population of Region C is projected to grow from 7,233,415 in the year 2016 to 10,150,077 in 2040 and 14,684,790 in 2070. This projected 2070 population is about 330,000 (or 2.24 percent) more than was projected in the 2016 Region C Water Plan. These projections have been approved by the Texas Water Development Board, as required by TWDB planning guidelines. This projection reflects a substantial slowing in the rate of growth that has been experienced in Region C over the last 50 years. The distribution of the projected population by county and city is discussed in **Chapter 2**.

ES.2.2 Demand Projections

Figure ES.2 shows the projected dry-year demands for water in Region C, which total 2.15 million acre-feet per year in 2040 and 2.90 million acre-feet per year in 2070. As has been the case historically, municipal demands are projected to make up the majority of the water use in Region C. Dry-year demands are significantly higher than normal year demands, especially for municipal use (because of increased lawn irrigation use). Normal-year demands in Region C might be 10 to 15 percent lower than dry-year demands.

Figure ES.2 Adopted Projections for Dry-Year Water Use by Category in Region C



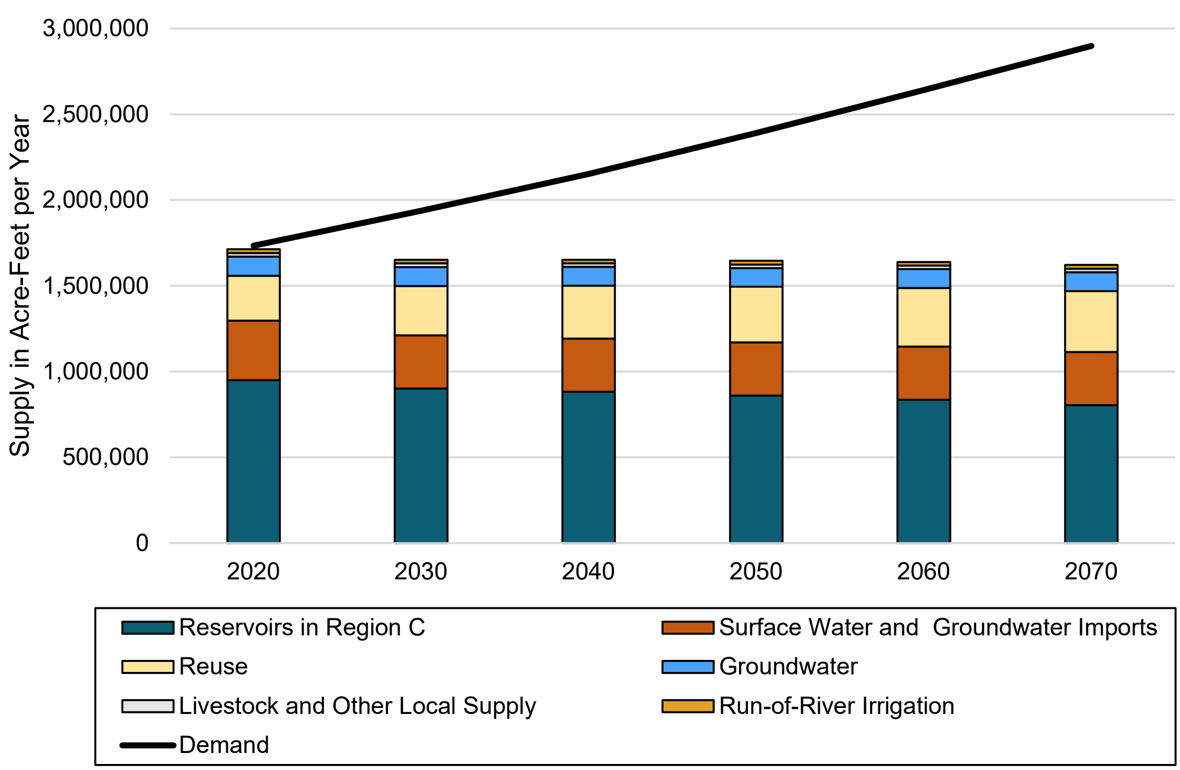
ES.2.3 Comparison of Supply and Demand

Figure ES.3 shows a comparison of supplies currently available to Region C (those that are connected) and projected demands. Currently available supplies are almost constant over time at 1.6 million acre-feet per year, as sedimentation in reservoirs is offset by increases in reuse supplies due to increased return flows. With the projected 2070 demand of 2.9 million acre-feet per year, the region has a shortage (called water needs in regional planning) of 1.3 million acre-feet per year by 2070. Meeting the projected water needs and leaving a reasonable reserve of planned supplies beyond projected demands will require the development of significant new water supplies for Region C over the next 50 years.

ES.2.4 Socio-Economic Impacts of Not Meeting Projected Water Needs

The Texas Water Development Board conducted an analysis of the socio-economic impacts of not meeting the projected water needs in Region C. By not meeting water needs in Region C, TWDB estimates the annual combined lost income for a single year in 2070 would be $48.1 billion and that 2070 employment would be reduced by over 473,000 jobs. More information on the socio-economic analysis is included in **Chapter 6**.

Figure ES.3 Comparison of Currently Available Supplies and Projected Demands



ES.3 Identification and Selection of Water Management Strategies

The Region C Water Planning Group identified and evaluated a wide variety of potentially feasible water management strategies to develop this plan. Water supply availability, costs and environmental impacts were determined for conservation and reuse efforts, the connection of existing supplies, and the development of new supplies. As required by TWDB regulations, the evaluation of water management strategies was an equitable comparison of all feasible strategies and considered the following factors:

- Evaluation of quantity, reliability, and cost of water delivered and treated
- Environmental factors
- Impacts on other water resources and on threats to agricultural and natural resources
- Other factors deemed relevant by the planning group (including consistency with the plans of water providers in the region)
- Consideration of interbasin transfer requirements and third-party impacts of voluntary redistributions of water.

ES.3.1 **Water Conservation and Reuse**

The Region C Water Planning Group considered the municipal water conservation strategies suggested as best management practices by the Conservation Implementation Task Force and recommended a water conservation program and reuse projects for Region C that accomplish the following:

- Including the 249,646 acre-feet per year of conservation built into the demand projections, a total conservation and reuse supply of over 1.35 million acre-feet per year by 2070, which represents a 42.8 percent reduction of the region's demand on other supplies.
- A dry-year per capita municipal use for the region (after crediting for conservation and reuse) ranging from 121 gpcd in 2020 to 96 gpcd by 2070.

Chapter 5B includes a more detailed discussion of conservation and reuse for the region.

ES.3.2 **Recommended Water Management Strategies**

Table ES.1 lists the major recommended water management strategies for Region C. In total, the Region C plan includes water management strategies to develop 1.86 million acre-feet per year of new supplies, for a total available supply of 3.48 million acre-feet per year in 2070. The supply is about 20 percent greater than the projected demand, leaving a reasonable reserve to provide for difficulties in developing strategies in a timely manner, droughts worse than the drought of record, greater than expected growth, and supply for needs beyond this planning horizon.

Figure ES.4 shows the makeup of the 3.48 million acre-feet per year of supplies proposed to be available to the region by 2070. About 37 percent of the supply is already available to the region from surface water and groundwater; almost a third (32 percent) is developed from conservation and reuse efforts, 13 percent is from the connection of existing supplies, and 18 percent is from the development of new supply including reservoirs and run-of-river projects.

The plan includes only five major new reservoirs (compared to more than 25 developed to supply water for Region C over the last 60 years.)

ES.3.3 Cost of the Proposed Plan

Most of the new supplies for Region C will be developed by the major water providers in the region. **Table ES.2** shows the amount of new supply proposed for the major water providers in Region C (plus one regional water provider) and the cost to develop that supply. The total cost of implementing all of the water management strategies in the plan is $30.44 billion. **Table ES.3** provides a summary of all recommended water management strategies for Region C. The recommended water management strategies are discussed in greater detail in **Chapter 5D** and **5E** of the report.

Table ES.1 Recommended Major Water Management Strategies for Region C

Strategy	Supplier	Supply in 2070 (Acre-Feet per Year)	Date to be Developed	Supplier Capital Cost (Millions)
Conservation	Multiple	202,676	ongoing	$333
Main Stem Balancing Reservoir (Reuse)	Dallas	95,829	2050	$773
Connect Lake Palestine (IPL)	Dallas	105,370	2030	$717
Neches Run-of-River	Dallas	47,250	2060	$262
Lake Columbia	Dallas	56,000	2070	$322
Bois d'Arc Lake	NTWMD	120,200	2020	$940
Lake Texoma Blending	NTWMD	113,933	2040 Phase I 2060 Phase II	$575
Marvin Nichols Reservoir	NTWMD	167,524	2050	$1,703
	TRWD	167,524	2050	$2,361
	UTRWD	26,152	2050	$404
Wright Patman Flood Storage Reallocation	NTWMD	56,676	2070	$731
	TRWD	56,676	2070	$765
	UTRWD	8,848	2070	$150
Oklahoma	NTWMD	50,000	2070	$260
Cedar Creek Wetland Reuse	TRWD	88,059	2030	$226
Reuse from TRA Central WWTP	TRWD	60,000	2030	$154
Lake Tehuacana	TRWD	21,070	2040	$325
Lake Ralph Hall and Associated Reuse	UTRWD	54,299	2030	$469
GTUA Regional Water System (Lake Texoma Desalination)	GTUA	35,872	2020 Phase I 2030 Phase II	$468

Figure ES.4 Sources of Water Available to Region C as of 2070

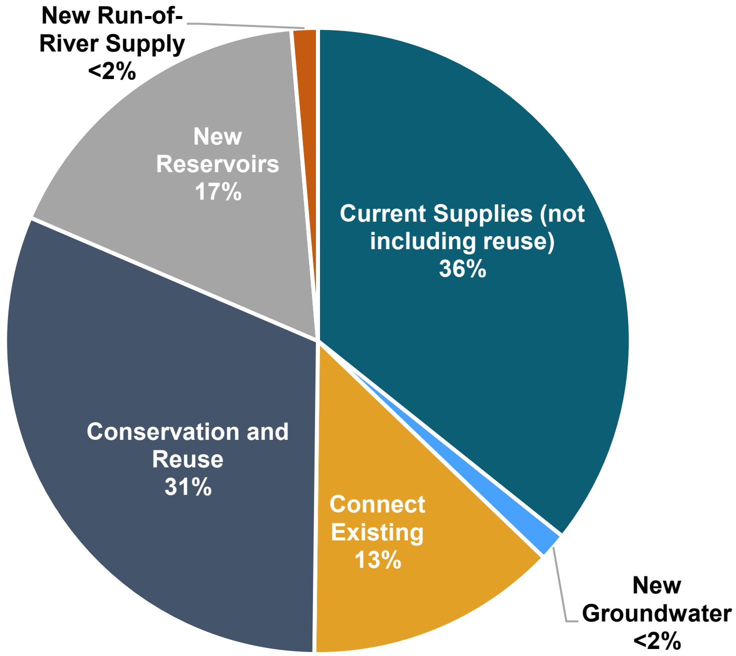


Table ES.2 2070 Supplies for the Major and Regional Water Providers in Region C

Wholesale Water Provider	Supplies Available in 2070 from Current Sources [(a)]	Supplies Available in 2070 from New Strategies [(a)]	Total Supplies Available in 2070[(a)]	% of Total Supply from Conservation and Reuse	Cost of Strategies (Millions)
Dallas Water Utilities	500,097	436,063	936,160	33.1%	$5,137
Tarrant Regional Water District	471,897	539,990	1,011,887	31.4%	$6,311
North Texas Municipal Water District	400,272	635,961	1,036,233	28.9%	$10,035
City of Fort Worth	282,992	250,890	533,882	31.0%	$2,191
Trinity River Authority	155,466	156,582	312,048	36.2%	$0
Upper Trinity Regional Water District	54,586	141,328	195,914	27.1%	$2,143
Greater Texoma Utility Authority	22,679	75,549	98,228	15.1%	$240
Total for Region C[(b)]	**1,590,440**	**1,869,546**	**3,459,986**		**$30,334**
2070 Demand in Region C			**2,898,540**		
Management Supply Factor for Region C			**1.194**		

a. *Current sources include only those that are connected. Some supplies are used by more than one supplier. For example, TRWD supplies water to TRA and Fort Worth, DWU supplies water to UTRWD, etc.*

b. *Total for Region C is not a sum of the numbers above. It includes other providers as well. Some supplies serve multiple suppliers.*

Table ES.3 All Recommended Water Management Strategies in Region C
*volumes shown in gray italics are infrastructure projects to utilize the supply volumes from other strategies

Entity	Recommended Strategy	Capital Cost	Cost Table	First Decade of Water Strategy	First Decade Water Supply Volume (Acre-Feet/Year)	Year 2070 Water Supply Volume (Acre-Feet/Year)	Annual Average Unit Cost with Debt Service ($/Acre-Foot/Year)	Annual Average Unit Cost without Debt Service ($/Acre-Foot/Year)	Annual Average Unit Cost with Debt Service ($/1,000 gal)	Annual Average Unit Cost without Debt Service ($/1,000 gal)
Multiple	Conservation - Municipal	$332,573,107	H.11	2020	94,063	192,404	$305	$104	$0.94	$0.32
Multiple	Conservation - Non-Municipal	$0	H.11	2020	6,263	10,272	$150	$150	$0.46	$0.46
Major Water Providers										
Tarrant Regional WD	Aquifer Storage and Recovery Pilot	$14,264,000	H.28	2020	2,500	5,000	$300	$99	$0.92	$0.30
Tarrant Regional WD	Additional Capacity to Convey Richland Chambers Reuse (IPL)	$507,733,000	H.25	2030	60,263	40,703	$311	$157	$0.95	$0.48
Tarrant Regional WD	Cedar Creek Wetland Reuse	$226,318,000	H.29	2030	38,323	88,059	$306	$166	$0.94	$0.51
Tarrant Regional WD	Reuse from TRA Central WWTP	$154,205,000	H.30	2030	20,000	60,000	$650	$510	$1.99	$1.57
Tarrant Regional WD	Tehuacana Reservoir	$325,468,000	H.31	2040	21,070	21,070	$1,069	$314	$3.28	$0.96
Tarrant Regional WD	Carrizo-Wilcox Groundwater	$191,469,000	H.32	2040	32,000	32,000	$798	$375	$2.45	$1.15
Tarrant Regional WD	Marvin Nichols Reservoir	$2,360,638,000	H.20	2050	167,524	167,524	$1,003	$223	$3.08	$0.68
Tarrant Regional WD	Wright Patman Reallocation	$765,040,000	H.23	2070	56,676	56,676	$907	$246	$2.78	$0.75
Tarrant Regional WD	*Additional Transmission Pipeline*	*$1,765,505,000*	*H.33*	*2040*	*2,500*	*5,000*	*$742*	*$207*	*$2.28*	*$0.64*
Dallas	Share of Additional Discharges to Lewisville Lake	No cost.	None	2020	1,166	16,901	$0	$0	$0.00	$0.00
Dallas	Elm Fork Swap	No costs.	None	2020	7,591	16,880	$0	$0	$0.00	$0.00
Dallas	Ray Hubbard Exchange	No costs.	None	2020	20,477	28,778	$0	$0	$0.00	$0.00
Dallas	Main Stem Balancing Reservoir (Reuse)	$772,904,000	H.34	2050	78,447	95,829	$615	$206	$1.89	$0.63
Dallas	Connect Lake Palestine (Dallas Portion of IPL and IPL to Bachman)	$717,381,000	H.25, H.35,	2030	105,370	101,555	$472	$148	$1.45	$0.46
Dallas	Neches Run-of-River	$261,616,000	H.36	2060	47,250	47,250	$617	$316	$1.89	$0.97
Dallas	Lake Columbia	$322,267,000	H.37	2070	56,000	56,000	$576	$279	$1.77	$0.86
Dallas	*Infrastructure to Treat & Deliver to Customers*	*$2,250,435,000*	*H.38*	*2020*	*28,068*	*346,292*	*$401*	*$50*	*$1.23*	*$0.15*
Dallas	Parallel IPL	$795,236,000	H.44	2070					$0.00	$0.00
North Texas MWD	Additional measure to access full Lavon yield	$32,753,000	H.45	2030	13,361	9,510	$248	$75	$0.76	$0.23
North Texas MWD	Bois D'Arc Lake	$939,638,000	H.46	2020	50,000	117,600	$486	$81	$1.49	$0.25
North Texas MWD	Additional Lake Texoma Blend Phase I	$228,206,000	H.47	2040	39,733	39,733	$400	$90	$1.23	$0.28
North Texas MWD	Additional Lake Texoma Blend Phase II	$346,367,000	H.48	2060	55,574	74,200	$340	$105	$1.04	$0.32
North Texas MWD	Marvin Nichols Reservoir (328)	$1,702,936,000	H.20	2050	167,524	167,524	$707	$141	$2.17	$0.43
North Texas MWD	Wright Patman Reallocation	$730,827,000	H.23	2070	56,676	56,676	$834	$206	$2.56	$0.63
North Texas MWD	Oklahoma	$259,924,000	H.49	2070	50,000	50,000	$423	$141	$1.30	$0.43
North Texas MWD	Additional Lavon Watershed Reuse	$300,000	H.50	2050	11,826	38,780	$836	$835	$2.57	$2.56
North Texas MWD	Expanded Wetland Reuse	$625,891,000	H.51	2030	9,164	37,510	$1,640	$749	$5.03	$2.30

Entity	Recommended Strategy	Capital Cost	Cost Table	First Decade of Water Strategy	First Decade Water Supply Volume (Acre-Feet/Year)	Year 2070 Water Supply Volume (Acre-Feet/Year)	Annual Average Unit Cost with Debt Service ($/Acre-Foot/Year)	Annual Average Unit Cost without Debt Service ($/Acre-Foot/Year)	Annual Average Unit Cost with Debt Service ($/1,000 gal)	Annual Average Unit Cost without Debt Service ($/1,000 gal)
North Texas MWD	Fannin County Water Supply System	$131,891,000	H.53	2030	686	9,941	$1,992	$1,058	$6.11	$3.25
North Texas MWD	Treatment and Distribution (CIP)	$5,015,029,000	H.52	2020	50,000	629,043	$505	$136	$1.55	$0.42
North Texas MWD	Chapman Booster Pump Station	$21,659,000	H.26	2020	0	0	$0	$0	$0.00	$0.00
Trinity River Authority	TRWD Water								$0.00	$0.00
Trinity River Authority	Tarrant County WSP	$0	N/A	2020	951	17,353	$1,176	$1,176	$3.61	$3.61
Trinity River Authority	Ellis County WSP	$0	N/A	2030	380	23,457	$411	$411	$1.26	$1.26
Trinity River Authority	Freestone County SEP	$0	N/A	2020	4	2,686	$0	$0	$0.00	$0.00
Trinity River Authority	Joe Pool Lake Reuse	N/A	None	2020	2,107	10,470	N/A	N/A	N/A	N/A
Trinity River Authority	Tarrant and Denton County Direct Reuse	Included in Fort Worth.		2030	0	8,396	$0	$0	$0.00	$0.00
Trinity River Authority	Central Reuse to TRWD	Included in TRWD.		2030	0	0	$0	$0	$0.00	$0.00
Trinity River Authority	Central Reuse to Irving	Included in Irving.		2030	0	27,539	$0	$0	$0.00	$0.00
Upper Trinity RWD	Additional Supplies from DWU (Up to Current Contracts)	$0	None	2020	1,725	16,254	$1,320	$1,320	$4.05	$4.05
Upper Trinity RWD	Additional DWU (Contract Increase)	$0	None	2050	5,605	11,210	$1,320	$1,320	$4.05	$4.05
Upper Trinity RWD	Lake Ralph Hall	$469,158,000	H.62	2030	39,220	38,908	$456	$81	$1.40	$0.25
Upper Trinity RWD	Lake Ralph Hall Indirect Reuse	$0	None	2030	13,944	15,391	$0	$0	$0.00	$0.00
Upper Trinity RWD	Additional Direct Reuse	$17,959,000	H.63	2030	560	2,240	$777	$212	$2.38	$0.65
Upper Trinity RWD	Marvin Nichols Reservoir	$403,904,000	H.20	2050	26,152	26,152	$1,084	$231	$3.33	$0.71
Upper Trinity RWD	Wright Patman Reallocation	$149,844,000	H.23	2070	8,848	8,848	$1,143	$295	$3.51	$0.91
Upper Trinity RWD	Additional Indirect Reuse	$0	None	2050	10,340	13,838	$0	$0	$0.00	$0.00
Upper Trinity RWD	Water Treatment and Distribution Improvements	$1,101,708,000	H.64	2020	**1,725**	**132,841**	$236	$82	$0.72	$0.25
Fort Worth	Alliance Direct Reuse	$23,102,000	H.61	2030	2,800	7,840	$235	$28	$0.72	$0.08
Fort Worth	Village Creek WRF Future Direct Reuse	$97,410,000	H.59	2030	2,442	2,442	$2,084	$336	$6.40	$1.03
Fort Worth	Mary's Creek WRF Future Direct Reuse	$46,576,000	H.60	2030	4,245	4,245	$965	$193	$2.96	$0.59
Fort Worth	Additional TRWD	$0	None	2030	14,814	203,772	$411	$411	$1.26	$1.26
Fort Worth	35 MGD WTP Expansion-Eagle Mountain	$173,564,000	H.13	2030	14,814	19,618	$1,069	$446	$3.28	$1.37
Fort Worth	23 MGD WTP Expansion-West Plant	$118,537,000	H.13	2040	0	12,892	$1,111	$463	$3.41	$1.42
Fort Worth	50 MGD WTP Expansion-Rolling Hills	$242,347,000	H.13	2040	0	28,025	$1,043	$437	$3.20	$1.34
Fort Worth	35 MGD WTP Expansion-West Plant	$173,564,000	H.13	2040	19,618	19,618	$1,069	$446	$3.28	$1.37
Fort Worth	30 MGD WTP Expansion-Eagle Mountain	$150,636,000	H.13	2040	20	16,815	$1,082	$453	$3.32	$1.39
Fort Worth	50 MGD WTP Expansion-1	$242,347,000	H.13	2050	0	28,025	$1,043	$437	$3.20	$1.34
Fort Worth	50 MGD WTP Expansion-2	$242,347,000	H.13	2060	0	28,025	$1,043	$437	$3.20	$1.34
Fort Worth	50 MGD WTP Expansion-3	$242,347,000	H.13	2060	10,445	28,025	$1,043	$437	$3.20	$1.34

Entity	Recommended Strategy	Capital Cost	Cost Table	First Decade of Water Strategy	First Decade Water Supply Volume (Acre-Feet/Year)	Year 2070 Water Supply Volume (Acre-Feet/Year)	Annual Average Unit Cost with Debt Service ($/Acre-Foot/Year)	Annual Average Unit Cost without Debt Service ($/Acre-Foot/Year)	Annual Average Unit Cost with Debt Service ($/1,000 gal)	Annual Average Unit Cost without Debt Service ($/1,000 gal)
Fort Worth	*50 MGD WTP Expansion-4*	*$242,347,000*	*H.13*	*2070*	*0*	*22,729*	*$1,043*	*$437*	*$3.20*	*$1.34*
Corsicana	New 8 MGD WTP, Halbert-Richland Chambers	$47,722,000	H.13	2030	2,242	2,242	$2,591	$1,092	$7.95	$3.35
Corsicana	8 MGD WTP Expansion, Halbert-Richland Chambers-1	$27,697,000	H.13	2050	4,484	4,484	$756	$319	$2.32	$0.98
Corsicana	8 MGD WTP Expansion, Halbert-Richland Chambers-2	$27,697,000	H.13	2070	4,484	4,484	$756	$319	$2.32	$0.98
Greater Texoma UA	GTUA Regional Water System - Phase 1	$243,986,000	H.72	2020	15,332	15,332	$1,863	$997	$5.72	$3.06
Greater Texoma UA	GTUA Regional Water System - Phase 2	$224,083,000	H.73	2030	20,540	20,540	$1,546	$953	$4.75	$2.93
Greater Texoma UA	Connection from Sherman to CGMA	$31,115,000	H.71	2030	4,484	4,484	$578	$90	$1.78	$0.28
Greater Texoma UA	Parallel CGMA Pipeline (NTMWD)	$89,989,000	H.70	2030	4,947	30,775	$1,157	$885	$3.55	$2.72
All MWPs		**$26,295,886,000**								
WWPs and WUGs by County										
Collin County										
WWPs										
Princeton	Additional NTMWD	$0	None	2030	645	4,260	$906	$906	$2.78	$2.78
WUGs										
Allen	NTMWD	$0	None	2030	2,063	8,526	$906	$906	$2.78	$2.78
Anna	New Well(s) in Woodbine Aquifer	$2,846,000	H.14	2020	200	200	$1,665	$665	$5.11	$2.04
Anna	Sherman through GTUA (CGMA)	$0	None	2030	1,235	1,207	$1,134	$1,134	$3.48	$3.48
Anna	NTMWD through GTUA (CGMA)	$0	None	2030	420	10,915	$163	$163	$0.50	$0.50
Anna	*CGMA*	*See GTUA in Chapter 5D.*								
B H P WSC	NTMWD	$0	None	2020	2	502	$906	$906	$2.78	$2.78
B H P WSC	*Connection to NTMWD*	*$3,108,000*	*H.75*	*2020*	*2*	*502*	*$512*	*$78*	*$1.57*	*$0.24*
Bear Creek SUD	NTMWD	$0	None	2030	0	1,327	$906	$906	$2.78	$2.78
Blue Ridge	NTMWD	$0	None	2020	567	14,573	$906	$906	$2.78	$2.78
Blue Ridge	*Connection to NTMWD*	*$5,795,000*	*H.76*	*2030*	*567*	*2,242*	*$212*	*$30*	*$0.65*	*$0.09*
Blue Ridge	*Upsize connection to NTMWD*	*$6,890,000*	*H.77*	*2040*	*3,688*	*12,331*	*$49*	*$10*	*$0.15*	*$0.03*
Blue Ridge	*Upsize connection to NTMWD*	*$6,871,000*	*H.78*	*2060*	*0*	*12,284*	*$49*	*$10*	*$0.15*	*$0.03*
Caddo Basin SUD	NTMWD	$0	None	2020	5	1,848	$906	$906	$2.78	$2.78
Carrollton	DWU	See Denton County			0	0			$0.00	$0.00
Celina	UTRWD	$0	None	2030	2,780	29,147	$978	$978	$3.00	$3.00
Celina	GTUA Regional Water System	$0	H.72	2030	5,605	5,605	$1,863	$997	$5.72	$3.06
Celina	NTMWD	$0	None	2030	1,500	5,000	$906	$906	$2.78	$2.78
Celina	*Connect to NTMWD*	*$17,491,000*	*H.79*	*2030*	*1,500*	*5,000*	*$290*	*$42*	*$0.89*	*$0.13*
Copeville SUD	NTMWD	$0	None	2030	49	718	$906	$906	$2.78	$2.78

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Culleoka WSC	NTMWD	$0	None	2030	86	608	$906	$906	$2.78	$2.78
East Fork SUD	NTMWD	$0	None	2030	213	993	$906	$906	$2.78	$2.78
East Fork SUD	*Additional Delivery Infrastructure from NTWMD*	*$5,308,000*	*H.80*	*2030*	*213*	*993*	*$415*	*$39*	*$1.27*	*$0.12*
Fairview	NTMWD	$0	None	2030	543	2,579	$906	$906	$2.78	$2.78
Farmersville	NTMWD	$0	None	2030	356	6,968	$906	$906	$2.78	$2.78
Frisco	Direct reuse	$77,241,000	H.81	2020	325	1,379	$4,402	$461	$13.51	$1.42
Frisco	NTMWD	$0	None	2020	4,494	30,149	$906	$906	$2.78	$2.78
Josephine	NTMWD	$0	None	2030	64	396	$906	$906	$2.78	$2.78
Lucas	NTMWD	$0	None	2030	109	1,290	$906	$906	$2.78	$2.78
Marilee SUD	GTUA Regional Water System	$0	None	2030	1,376	1,535	$1,863	$997	$5.72	$3.06
McKinney	NTMWD	$0	None	2030	3,619	25,492	$906	$906	$2.78	$2.78
Melissa	NTMWD	$0	None	2030	208	20,910	$906	$906	$2.78	$2.78
Melissa	*Additional Delivery Infrastructure from NTWMD*	*$2,754,000*	*H.82*	*2030*	*59*	*201*	*$112*	*$17*	*$0.34*	*$0.05*
Melissa	Sherman through GTUA (CGMA)	$0	None	2030	3,172	2,974	$1,134	$1,134	$3.48	$3.48
Melissa	NTMWD through GTUA (CGMA)	$0	None	2020	208	20,709	$163	$163	$0.50	$0.50
Milligan WSC	NTMWD	$0	None	2030	74	381	$906	$906	$2.78	$2.78
Murphy	NTMWD	$0	None	2030	437	1,537	$906	$906	$2.78	$2.78
Nevada SUD	NTMWD	$0	None	2030	34	1,723	$906	$906	$2.78	$2.78
North Collin SUD	NTMWD	$0	None	2030	132	661	$906	$906	$2.78	$2.78
North Farmersville WSC	NTMWD	$0	$0	2030	9	69	$906	$906	$2.78	$2.78
Parker	NTMWD	$0	None	2020	142	1,804	$906	$906	$2.78	$2.78
Parker	*Additional Delivery Infrastructure from NTWMD*	*$4,309,000*	*H.83*	*2020*	*143*	*1,669*	*$353*	*$66*	*$1.08*	*$0.20*
Plano	NTMWD	$0	None	2030	7,388	26,402	$906	$906	$2.78	$2.78
Prosper	NTMWD	$0	None	2030	1,077	6,592	$906	$906	$2.78	$2.78
Prosper	*Additional Delivery Infrastructure from NTWMD*	*$4,608,000*	*H.84*	*2030*	*1,077*	*6,592*	*$64*	*$15*	*$0.20*	*$0.05*
Seis Lagos UD	NTMWD	$0	None	2030	62	215	$906	$906	$2.78	$2.78
Verona SUD	New Well(s) in Woodbine Aquifer	$2,163,000	H.14	2030	31	286	$1,167	$635	$3.58	$1.95
Wylie	NTMWD	$0	None	2030	729	3,318	$906	$906	$2.78	$2.78
Wylie Northeast SUD	NTMWD	$0	None	2030	114	1,294	$906	$906	$2.78	$2.78
Wylie Northeast SUD	*Additional Delivery Infrastructure from NTWMD*	*$5,731,000*	*H.85*	*2030*	*114*	*1,294*	*$369*	*$58*	*$1.13*	*$0.18*
County Other, Collin	GTUA Regional Water System through Sherman	$0	H.72	2030	550	1,099	$1,863	$997	$5.72	$3.06
County Other, Collin	NTMWD	$0	None	2030	11	517	$906	$906	$2.78	$2.78
Irrigation, Collin	DWU	$0	None	2020	114	856	$1,320	$1,320	$4.05	$4.05
Manufacturing, Collin	New Well(s) in Woodbine Aquifer	$437,000	H.14	2030	78	78	$466	$72	$1.43	$0.22

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Manufacturing, Collin	NTMWD	$0	None	2030	0	1,026	$906	$906	$2.78	$2.78
Collin County Total		**$145,552,000**								
Cooke County										
WWPs										
Gainesville	5 MGD WTP Expansion-1	$30,985,000	H.13	2050	35	2,803	$1,372	$593	$4.21	$1.82
Gainesville	5 MGD WTP Expansion-2	$30,985,000	H.13	2070	2,337	2,337	$1,372	$593	$4.21	$1.82
Gainesville	*Infrastructure to deliver to customers*	*$33,043,000*	*H.87*	*2050*	*35*	*5,140*	*$2,290*	*$311*	*$7.03*	*$0.96*
Gainesville	Expand Direct Reuse	$2,026,000	H.86	2020	169	150	$2,414	$371	$7.41	$1.14
Gainesville	GTUA Regional Water System	$0	H.73	2030	1,632	5,605	$1,546	$953	$4.75	$2.93
WUGs										
Lake Kiowa SUD	GTUA Regional Water System through Sherman	$0	None	2,030	875	866	$1,863	$997	$5.72	$3.06
Lindsay	Gainesville	$0	None	2030	5	188	$1,473	$1,473	$4.52	$4.52
Mountain Springs WSC	Gainesville	$0	None	2060	246	683	$1,473	$1,473	$4.52	$4.52
Muenster	Muenster Lake	$9,998,000	H.90	2020	280	280	$4,139	$1,628	$12.70	$5.00
Woodbine WSC	GTUA Regional Water System through Sherman	$0	H.73	2030	716	942	$1,546	$953	$4.75	$2.93
County Other, Cooke	Gainesville	$0	None	2060	178	1,744	$1,473	$1,473	$4.52	$4.52
Irrigation, Cooke	Gainesville	$0	None	2020	70	529	$1,473	$1,473	$4.52	$4.52
Manufacturing, Cooke	Gainesville	$0	None	2060	36	82	$1,473	$1,473	$4.52	$4.52
Mining, Cooke	Connect to Gainesville	$0	None	2020	583	136	$1,473	$1,473	$4.52	$4.52
Cooke County Total		**$107,037,000**								
Dallas County										
WWPs										
Dallas County PCMUD	None									
Garland	NTMWD	$0	None	2030	4,215	17,003	$906	$906	$2.78	$2.78
Grand Prairie	DWU	$0	None	2020	1,344	11,202	$1,320	$1,320	$4.05	$4.05
Grand Prairie	*Additional Delivery Infrastructure*	*$72,782,000*	*H.93*	*2020*	*1,344*	*11,202*	*$564*	*$107*	*$1.73*	*$0.33*
Grand Prairie	Midlothian (TRWD)	$0	None	2020	290	2,208	$1,287	$1,287	$3.95	$3.95
Grand Prairie	Mansfield (TRWD)	$0	None	2020	46	1,711	$978	$978	$3.00	$3.00
Grand Prairie	Arlington (TRWD)	$0	None	2030	2,242	2,074	$1,101	$1,101	$3.38	$3.38
Grand Prairie	Connect to Arlington (TRWD)	$5,679,000	H.92	2030	2,242	2,074	$229	$50	$0.70	$0.15
Seagoville	DWU	$0	None	2020	99	1,933	$1,320	$1,320	$4.05	$4.05
WUGs										
Addison	DWU	$0	None	2030	162	1,837	$1,320	$1,320	$4.05	$4.05
Balch Springs	DWU	$0	None	2020	15	971	$1,320	$1,320	$4.05	$4.05
Cedar Hilla	DWU	$0	None	2030	85	3,439	$1,320	$1,320	$4.05	$4.05
Cockrell Hill	DWU	$0	None	2030	0	319	$1,320	$1,320	$4.05	$4.05

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Coppella	DWU	$0	None	2030	102	2,389	$1,320	$1,320	$4.05	$4.05
DeSoto	DWU	$0	None	2030	112	2,786	$1,320	$1,320	$4.05	$4.05
Duncanville	DWU	$0	None	2020	4	1,614	$1,320	$1,320	$4.05	$4.05
Farmers Branch	DWU	$0	None	2030	42	2,501	$1,320	$1,320	$4.05	$4.05
Glenn Heights	DWU	$0	None	2020	55	1,729	$1,320	$1,320	$4.05	$4.05
Glenn Heights	*Additional Delivery Infrastructure*	*$1,926,000*	*H.91*	*2060*	*112*	*1,729*	*$104*	*$26*	*$0.32*	*$0.08*
Hutchins	DWU	$0	None	2030	101	1,552	$1,320	$1,320	$4.05	$4.05
Irving	TRA Central Reuse Project	$46,730,000	H.95	2030	27,539	27,539	$557	$294	$1.71	$0.90
Irving	Lake Chapman Booster Pump Station	$21,659,000	H.26	2020	0	0	$0	$0	$0.00	$0.00
Irving	Additional DWU supplies	$0	None	2020		0	$1,320	$1,320	$4.05	$4.05
Lancaster	DWU	$0	None	2030	269	3,549	$1,320	$1,320	$4.05	$4.05
Mesquite	NTMWD	$0	None	2030	2,203	11,351	$906	$906	$2.78	$2.78
Richardson	NTMWD	$0	None	2030	2,840	10,595	$906	$906	$2.78	$2.78
Rowlett	NTMWD	$0	None	2030	1,215	4,833	$906	$906	$2.78	$2.78
Rowlett	*Additional Delivery Infrastructure*	*$4,105,000*	*H.97*	*2030*	*1,215*	*4,833*	*$90*	*$30*	*$0.28*	*$0.09*
Sachsea	NTMWD	$0	None	2030	427	1,701	$906	$906	$2.78	$2.78
Sunnyvale	NTMWD	$0	None	2030	342	1,683	$906	$906	$2.78	$2.78
Sunnyvale	*Additional Delivery Infrastructure*	*$2,575,000*	*H.98*	*2030*	*342*	*1,683*	*$134*	*$26*	*$0.41*	*$0.08*
Wilmer	DWU	$0	None	2030	34	897	$1,320	$1,320	$4.05	$4.05
Wilmer	*Increase Capacity of Connection with Lancaster*	*$5,280,000*	*H.100*	*2020*	*34*	*897*	*$464*	*$50*	*$1.42*	*$0.15*
Wilmer	*Direct Connection to Dallas 36" Transmission Line*	*$18,621,000*	*H.99*	*2070*	*129*	*129*	*$6,899*	*$662*	*$21.17*	*$2.03*
County Other, Dallas	DWU	$0	None	2030	6	70	$1,320	$1,320	$4.05	$4.05
County Other, Dallas	TRWD through Fort Worth	$0	None	2030	75	227	$531	$531	$1.63	$1.63
Manufacturing, Dallas	DWU	$0	None	2020	613	4,875	$1,320	$1,320	$4.05	$4.05
Manufacturing, Dallas	NTMWD	$0	None	2020	16	1,438	$906	$906	$2.78	$2.78
Manufacturing, Dallas	Grand Prairie	$0	None	2020	130	473	$978	$978	$3.00	$3.00
Steam Electric Power, Dallas	DWU	$0	None	2020	40	301	$660	$660	$2.03	$2.03
Dallas County Total		**$179,357,000**								
Denton County										
WWPs										
Denton	30 MGD WTP Plant Expansion-Ray Roberts	$150,569,000	H.13	2030	4,076	16,815	$1,082	$453	$3.32	$1.39
Denton	20 MGD WTP Plant Expansion-Ray Roberts	$104,736,000	H.13	2050	8,820	11,210	$1,127	$472	$3.46	$1.45
Denton	30 MGD WTP Plant Expansion-Ray Roberts	$150,569,000	H.13	2060	16,815	16,815	$1,082	$453	$3.32	$1.39

Entity	Recommended Strategy	Capital Cost	Cost Table	First Decade of Water Strategy	First Decade Water Supply Volume (Acre-Feet/Year)	Year 2070 Water Supply Volume (Acre-Feet/Year)	Annual Average Unit Cost with Debt Service ($/Acre-Foot/Year)	Annual Average Unit Cost without Debt Service ($/Acre-Foot/Year)	Annual Average Unit Cost with Debt Service ($/1,000 gal)	Annual Average Unit Cost without Debt Service ($/1,000 gal)
Denton	25 MGD WTP Plant Expansion	$127,652,000	H.13	2060	3,145	14,013	$1,101	$459	$3.38	$1.41
Denton	20 MGD WTP Plant Expansion	$104,736,000	H.13	2070	6,013	6,013	$1,127	$472	$3.46	$1.45
Mustang SUD	UTRWD	$0	None	2030	3,322	16,823	$3	$3	$0.01	$0.01
WUGs										
Argyle WSC	UTRWD	$0	None	2030	573	1,937	$978	$978	$3.00	$3.00
Argyle WSC	New Well(s) in Trinity Aquifer	$2,955,000	H.14	2020	250	250	$1,313	$482	$4.03	$1.48
Aubrey	Connect to UTRWD	$0	None	2030	255	1,151	$978	$978	$3.00	$3.00
Black Rock WSC	New Well(s) in Trinity Aquifer	$2,259,000	H.14	2050	8	154	$1,694	$661	$5.20	$2.03
Bolivar WSC	New Well(s) in Trinity Aquifer	$2,955,000	H.14	2020	250	250	$1,313	$482	$4.03	$1.48
Bolivar WSC	Connect to UTRWD	$0	None	2030	975	1,700	$978	$978	$3.00	$3.00
Bolivar WSC	Connect to Gainesville	$0		2030	49	146			$0.00	$0.00
Carrollton	DWU	$0	None	2030	717	5,549	$1,320	$1,320	$4.05	$4.05
Corinth	UTRWD	$0	None	2030	1,181	2,638	$978	$978	$3.00	$3.00
Cross Timbers WSC	New Well(s) in Trinity Aquifer	$2,955,000	H.14	2020	250	250	$1,313	$482	$4.03	$1.48
Cross Timbers WSC	UTRWD	$0	None	2030	337	943	$978	$978	$3.00	$3.00
Cross Timbers WSC	*Additional Delivery Infrastructure*	*$8,374,000*	*H.101*	*2030*	*337*	*943*	*$689*	*$65*	*$2.12*	*$0.20*
Denton County FWSD 1-A	UTRWD	$0	None	2030	1,039	2,842	$978	$978	$3.00	$3.00
Denton County FWSD 1-A	DWU through Lewisville	$0	None	2030	130	781	$978	$978	$3.00	$3.00
Denton County FWSD 10	UTRWD through Mustang	$0	None	2030	533	1,414	$978	$978	$3.00	$3.00
Denton County FWSD 10	UTRWD	$0	None	2030	207	550	$978	$978	$3.00	$3.00
Denton County FWSD 7	UTRWD	$0	None	2030	798	1,808	$978	$978	$3.00	$3.00
Flower Mound	DWU	$0	None	2030	231	1,509	$1,320	$1,320	$4.05	$4.05
Flower Mound	UTRWD	$0	None	2030	3,615	9,063	$978	$978	$3.00	$3.00
Flower Mound	Direct reuse	$1,638,000	H.61	2030	556	556	$235	$28	$0.72	$0.08
Hackberry	NTMWD	$0	None	2030	47	442	$906	$906	$2.78	$2.78
Hackberry	*Additional Delivery Infrastructure*	*$2,182,000*	*H.102*	*2050*	*56*	*442*	*$424*	*$75*	*$1.30*	*$0.23*
Highland Village	UTRWD	$0	None	2030	370	1,380	$978	$978	$3.00	$3.00
Justin	UTRWD	$0	None	2030	224	875	$978	$978	$3.00	$3.00
Justin	New Well(s) in Trinity Aquifer	$2,377,000	H.14	2020	244	244	$1,154	$469	$3.54	$1.44
Krum	UTRWD	$0	None	2030	159	1,492	$978	$978	$3.00	$3.00
Krum	New Well(s) in Trinity Aquifer	$1,805,000	H.14	2020	202	202	$1,101	$472	$3.38	$1.45
Lake Cities MUA	UTRWD	$0	None	2030	704	1,761	$978	$978	$3.00	$3.00
Lewisville	DWU	$0	None	2030	1,793	10,939	$1,320	$1,320	$4.05	$4.05
Lewisville	*6 MGD WTP Expansion-1*	*$36,568,000*	*H.13*	*2030*	*896*	*3,363*	*$1,339*	*$573*	*$4.11*	*$1.76*
Lewisville	*6 MGD WTP Expansion-2*	*$22,264,000*	*H.13*	*2040*	*715*	*3,363*	*$824*	*$358*	*$2.53*	*$1.10*
Lewisville	*6.5 MGD WTP Expansion*	*$23,626,000*	*H.13*	*2050*	*438*	*3,316*	*$802*	*$345*	*$2.46*	*$1.06*
Little Elm	NTMWD	$0	None	2030	518	1,605	$906	$906	$2.78	$2.78
Northlake	TRWD through Fort Worth	$0	None	2030	105	1,238	$531	$531	$1.63	$1.63
Northlake	UTRWD	$0	None	2030	738	4,068	$978	$978	$3.00	$3.00

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Paloma Creek North CRU	UTRWD through Mustang SUD	$0	None	2030	544	1,225	$978	$978	$3.00	$3.00
Paloma Creek South CRU	UTRWD through Mustang SUD	$0	None	2030	276	622	$978	$978	$3.00	$3.00
Pilot Point	New Well(s) in Trinity Aquifer	$4,127,000	H.14	2020	313	313	$1,437	$508	$4.41	$1.56
Pilot Point	GTUA Regional Water System through Sherman	$0	H.72	2030	975	1,256	$1,863	$997	$5.72	$3.06
Pilot Point	Connect to UTRWD	$0	None	2030	301	2,943	$978	$978	$3.00	$3.00
Ponder	UTRWD	$0	None	2030	171	1,092	$978	$978	$3.00	$3.00
Providence Village WCID	UTRWD	$0	None	2030	271	553	$978	$978	$3.00	$3.00
Roanoke	TRWD through Fort Worth	$0	None	2030	229	1,106	$531	$531	$1.63	$1.63
Sanger	UTRWD	$0	None	2030	134	1,438	$978	$978	$3.00	$3.00
The Colony	DWU	$0	None	2020	132	1,791	$1,320	$1,320	$4.05	$4.05
The Colony	NTMWD through Plano	$0	None	2030	265	844	$906	$906	$2.78	$2.78
Trophy Club MUD 1	Fort Worth	$0	None	2030	222	1,368	$531	$531	$1.63	$1.63
County Other, Denton	UTRWD	$0	None	2030	331	7,251	$978	$978	$3.00	$3.00
County Other, Denton	New Well(s) in Woodbine Aquifer	$8,554,000	H.14	2020	817	817	$1,202	$466	$3.69	$1.43
County Other, Denton	New Well(s) in Trinity Aquifer	$5,387,000	H.14	2020	504	504	$1,238	$486	$3.80	$1.49
Irrigation, Denton	DWU	$0	None	2020	63	476	$1,320	$1,320	$4.05	$4.05
Irrigation, Denton	Direct Reuse from UTRWD	See UTRWD		2030	560	2,240			$0.00	$0.00
Manufacturing, Denton	Denton	$0	None	2030	63	228	$978	$978	$3.00	$3.00
Manufacturing, Denton	DWU	$0	None	2020	1	8	$1,320	$1,320	$4.05	$4.05
Manufacturing, Denton	NTMWD	$0	None	2030	4	11	$906	$906	$2.78	$2.78
Manufacturing, Denton	UTRWD	$0	None	2030	11	31	$978	$978	$3.00	$3.00
Manufacturing, Denton	Northlake	$0	None	2030	3	11	$978	$978	$3.00	$3.00
Mining, Denton	UTRWD	$0	None	2030	71	2,982	$978	$978	$3.00	$3.00
Denton County Total		**$766,288,000**								
Ellis County										
WWPs										
Ennis	Indirect Reuse	$55,899,000	H.103	2040	2,025	3,696	$1,450	$386	$4.45	$1.19
Ennis	TRWD through TRA	$0	None	2030	0	8,590	$411	$411	$1.26	$1.26
Ennis	6 MGD WTP Expansion	$22,264,000	H.13	2050	3,363	3,363	$824	$358	$2.53	$1.10
Ennis	8 MGD WTP Expansion	$47,735,000	H.13	2060	1,820	4,484	$1,294	$547	$3.97	$1.68

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Ennis	16 MGD WTP Expansion	$86,402,000	H.13	2070	5,510	5,510	$1,163	$486	$3.57	$1.49
Midlothian	Indirect Reuse-TRA	$0	None	2020	2,107	10,470	$94	$94	$0.29	$0.29
Midlothian	*Expand Tayman WTP to 20 MGD*	*$46,259,000*	*H.13*	*2020*	*2,107*	*10,470*	*$948*	*$222*	*$2.91*	*$0.68*
Midlothian	Add'l TRWD	$0	None	2020	1,081	9,499	$411	$411	$1.26	$1.26
Midlothian	*Expand Auger WTP to 16 MGD*	*$7,498,000*	*H.13*	*2020*	*1,081*	*2,242*	*$302*	*$66*	*$0.93*	*$0.20*
Midlothian	*Expand Auger WTP to 24 MGD*	*$24,798,000*	*H.13*	*2030*	*3,789*	*4,484*	*$451*	*$62*	*$1.38*	*$0.19*
Midlothian	*Expand Auger WTP to 32 MGD*	*$24,798,000*	*H.13*	*2050*	*1,080*	*2,773*	*$451*	*$62*	*$1.38*	*$0.19*
Rockett SUD	Additional TRWD	$0	None	2030	607	13,793	$1	$1	$0.00	$0.00
Rockett SUD	*10 MGD WTP Expansion at Sokoll-1*	*$58,903,000*	*H.13*	*2030*	*607*	*5,605*	*$4*	*$2*	*$0.01*	*$0.01*
Rockett SUD	*10 MGD WTP Expansion at Sokoll-2*	*$58,903,000*	*H.13*	*2050*	*1,800*	*5,605*	*$4*	*$2*	*$0.01*	*$0.01*
Rockett SUD	*3 MGD WTP Expansion at Sokoll*	*$14,095,000*	*H.13*	*2070*	*1,682*	*1,682*	*$3*	*$2*	*$0.01*	*$0.00*
Waxahachie	Dredge Lake Waxahachie	$37,120,000	H.116	2040	810	810	$11	$0	$0.03	$0.00
Waxahachie	Add'l TRA/TRWD	$0	None	2030	1,103	10,430	$1	$1	$0.00	$0.00
Waxahachie	*8 MGD Expansion WTP-Howard Rd*	*$47,735,000*	*H.13*	*2030*	*1,103*	*4,484*	*$4*	*$2*	*$0.01*	*$0.01*
Waxahachie	*12 MGD Expansion WTP-Howard Rd*	*$68,069,000*	*H.13*	*2070*	*0*	*5,946*	*$4*	*$2*	*$0.01*	*$0.00*
Waxahachie	*36" Raw water line from IPL to Lake Waxahachie*	*$1,302,000*	*H.113*	*2040*	*1,103*	*10,430*	*$0*	*$0*	*$0.00*	*$0.00*
Waxahachie	*30" Raw water line from IPL to Howard Road Water Treatment Plant*	*$4,343,000*	*H.112*	*2040*	*1,103*	*10,430*	*$0*	*$0*	*$0.00*	*$0.00*
Waxahachie	*36" Raw water line from Lake Waxahachie to Howard Rd WTP*	*$6,461,000*	*H.114*	*2040*	*1,103*	*10,430*	*$0*	*$0*	*$0.00*	*$0.00*
Waxahachie	*Phase I Delivery Infrastructure to Customers in South Ellis County*	*$16,338,000*	*H.118*	*2030*	*548*	*1,121*	*$2*	*$0*	*$0.00*	*$0.00*
Waxahachie	*Phase II Delivery Infrastructure to Customers in South Ellis County*	*$26,982,000*	*H.119*	*2040*	*76*	*2,520*	*$2*	*$0*	*$0.01*	*$0.00*
Waxahachie	*48" TRWD Parallel Supply Line to Sokoll WTP*	*$3,954,000*	*H.115*	*2040*	*1,103*	*10,430*	*$0*	*$0*	*$0.00*	*$0.00*
Waxahachie	*Increase delivery infrastructure to Rockett SUD (30" Raw water Line)*	*$14,096,000*	*H.117*	*2040*	*1,103*	*10,430*	*$0*	*$0*	*$0.00*	*$0.00*
Waxahachie	*Raw Water Intake Improvements at Lake Bardwell*	*$4,400,000*	*H.120*	*2040*	*1,103*	*10,430*	*$0*	*$0*	*$0.00*	*$0.00*
WUGs										
Avalon Water Supply and Sewer Service	TRWD through Waxahachie	$0	None	2030	24	378	$1,391	$1,391	$4.27	$4.27

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Buena Vista-Bethel SUD	Waxahachie	$0	None	2040	67	1,517	$1,391	$1,391	$4.27	$4.27
East Garrett WSC	Ennis	$0	None	2050	83	902	$978	$978	$3.00	$3.00
Ferris	Rockett SUD	$0	None	2030	59	933	$1,580	$1,580	$4.85	$4.85
Ferris	*Additional Delivery Infrastructure from Rockett SUD*	*$1,370,000*	*H.104*	*2050*	*554*	*554*	*$1,046*	*$176*	*$3.21*	*$0.54*
Files Valley WSC	Connect to Waxahachie	$0	None	2030	53	70	$1,391	$1,391	$4.27	$4.27
Italy	Waxahachie	$0	None	2030	166	768	$1,391	$1,391	$4.27	$4.27
Mountain Peak SUD	Midlothian	$0	None	2020	412	6,096	$978	$978	$3.00	$3.00
Ovilla	DWU	$0	None	2040	44	663	$1,320	$1,320	$4.05	$4.05
Ovilla	*Additional Delivery Infrastructure from DWU*	*$1,810,000*	*H.107*	*2070*	*663*	*663*	*$248*	*$55*	*$0.76*	*$0.17*
Palmer	Rockett SUD	$0	None	2030	25	760	$1,580	$1,580	$4.85	$4.85
Palmer	*Additional Delivery Infrastructure from Rockett SUD*	*$8,910,000*	*H.108*	*2050*	*246*	*760*	*$1,183*	*$163*	*$3.63*	*$0.50*
Red Oak	DWU	$0	None	2020	15	1,277	$1,320	$1,320	$4.05	$4.05
Rice WSC	Ennis	$0	None	2040	2	35	$978	$978	$3.00	$3.00
Rice WSC	Corsicana	$0	None	2050	149	715	$1,352	$1,352	$4.15	$4.15
Rice WSC	*Additional Delivery Infrastructure from Corsicana*	*$12,214,000*	*H.109*	*2030*	*185*	*1,552*	*$652*	*$98*	*$2.00*	*$0.30*
Sardis-Lone Elm WSC	Rockett SUD	$0	None	2030	0	723	$1,580	$1,580	$4.85	$4.85
Sardis-Lone Elm WSC	Supplies from TRWD	$0	None	2020	767	2,002	$411	$411	$1.26	$1.26
Sardis-Lone Elm WSC	*Connect to TRWD*	*$11,696,000*	*H.111*	*2020*	*767*	*2,002*	*$1,415*	*$1,050*	*$4.34*	*$3.22*
Sardis-Lone Elm WSC	Midlothian	$0	None	2020	193	1,943	$916	$916	$2.81	$2.81
South Ellis County WSC	Connect to Waxahachie	$0	None	2050	60	217	$1,391	$1,391	$4.27	$4.27
Venus	Midlothian	$0	None	2020	92	651	$1,287	$1,287	$3.95	$3.95
County Other, Ellis	Ennis	$0	None	2040	3	858	$978	$978	$3.00	$3.00
County Other, Ellis	Waxahachie	$0	None	2040	4	1,415	$1,391	$1,391	$4.27	$4.27
County Other, Ellis	Rockett SUD	$0	None	2030	7	2,379	$1,580	$1,580	$4.85	$4.85
County Other, Ellis	Grand Prairie	$0	None	2020	61	721	$978	$978	$3.00	$3.00
Manufacturing, Ellis	Ennis	$0	None	2030	8	464	$978	$978	$3.00	$3.00
Manufacturing, Ellis	Waxahachie	$0	None	2040	212	958	$1,391	$1,391	$4.27	$4.27
Manufacturing, Ellis	Midlothian	$0	None	2020	373	1,588	$978	$978	$3.00	$3.00
Steam Electric Power, Ellis	Midlothian	$0	None	2020	48	170	$978	$978	$3.00	$3.00
Ellis County Total		**$714,354,000**								
Fannin County										

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Arledge Ridge WSC	New Well(s) in Woodbine Aquifer	$4,537,000	H.14	2040	350	350	$1,548	$635	$4.75	$1.95
Bois D Arc MUD	Connect to NTMWD	$4,108,000	H.121	2030	23	623	$534	$534	$1.64	$1.64
Bonham	Fannin County Water Supply Project	See NTMWD			167	3,538			$0.00	$0.00
Desert WSC	New Well(s) in Woodbine Aquifer	$1,469,000	H.14	2070	112	112	$1,623	$697	$4.98	$2.14
Hickory Creek SUD (Region C portion only)	None	See Region D Plan.							$0.00	$0.00
Honey Grove	Fannin County Water Supply Project	See NTMWD			280	269			$0.00	$0.00
Ladonia	Infrastructure and treatment for water from Ralph Hall	$14,774,000	H.122	2030	75	294	$6,263	$2,739	$19.22	$8.40
Leonard	Fannin County Water Supply Project	See NTMWD		2030					$0.00	$0.00
Leonard	Water System Improvements	$3,281,000	H.123	2030	343	382	$1,349	$259	$4.14	$0.80
Southwest Fannin Co SUD	New Well(s) in Woodbine Aquifer	$1,148,000	H.14	2030	100	100	$1,365	$557	$4.19	$1.71
Southwest Fannin Co SUD	Fannin County Water Supply Project	See NTMWD		2040	8	574	-	-	$0.00	$0.00
Trenton	New Well(s) in Woodbine Aquifer	$1,341,000	H.14	2030	25	25	$4,741	$968	$14.55	$2.97
Trenton	Fannin County Water Supply Project	See NTMWD			182	1,492	-	-	$0.00	$0.00
White Shed WSC	New Well(s) in Woodbine Aquifer	$6,299,000	H.14	2030	22	676	$1,186	$531	$3.64	$1.63
County Other, Fannin	Fannin County Water Supply Project	See NTMWD							$0.00	$0.00
Irrigation, Fannin	New Well(s) in Trinity Aquifer	$234,000	H.14	2020	1,592	1,592	$29	$20	$0.09	$0.06
Manufacturing, Fannin	Bonham	$0	None	2040	1	6	$978	$978	$3.00	$3.00
Fannin County Total		**$37,191,000**								
Freestone County										
Fairfield	TRWD	$0	None	2050	534	1,483	$411	$411	$1.26	$1.26
Fairfield	*New WTP and Transmission*	*$35,205,000*	*H.124*	*2050*	*534*	*1,483*	*$2,581*	*$909*	*$7.92*	*$2.79*
Pleasant Grove WSC	New Well(s) in Carrizo-Wilcox Aquifer	$600,000	H.14	2070	26	26	$2,356	$733	$7.23	$2.25
South Freestone County WSC	New Well(s) in Carrizo-Wilcox Aquifer	$6,485,000	H.14	2020	16	571	$1,297	$495	$3.98	$1.52
Teague	New Well(s) in Carrizo-Wilcox Aquifer	$3,978,000	H.14	2020	13	822	$736	$394	$2.26	$1.21
Wortham	Mexia	$0	H.11	2020	10	181	$3,584	$3,584	$11.00	$11.00

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County Other, Freestone	Corsicana	$0	None	2050	17	72	$1,352	$1,352	$4.15	$4.15
County Other, Freestone	*Additional Delivery Infrastructure from Corsicana*	*$2,868,000*	*H.125*	*2050*	*17*	*72*	*$3,193*	*$391*	*$9.80*	*$1.20*
County Other, Freestone	TRWD	$0	None	2050	889	2,354	$411	$411	$1.26	$1.26
County Other, Freestone	*New Delivery and Treatment Facilities*	*$46,660,000*	*H.126*	*2050*	*889*	*2,354*	*$2,245*	*$850*	*$6.89*	*$2.61*
Steam Electric Power, Freestone	TRWD through TRA	$0	None	2020	4	2,686	$1,176	$1,176	$3.61	$3.61
Freestone County Total		**$95,796,000**								
Grayson County										
WWPs										
Denison	New 4 MGD Desalination WTP	$36,137,000	H.13	2020	343	2,242	$2,388	$1,255	$7.33	$3.85
Denison	10 MGD Desalination WTP Expansion	$82,213,000	H.12	2060	1,281	4,531	$2,105	$1,075	$6.46	$3.30
Denison	Expand Raw Water delivery from Lake Texoma - Phase I	$17,674,000	H.127	2030	699	6,773	$636	$82	$1.95	$0.25
Denison	Expand Raw Water delivery from Lake Texoma - Phase II	$9,022,000	H.128	2060	5,605	5,605	$133	$19	$0.41	$0.06
Sherman	GTUA Regional Water System	See GTUA							$0.00	$0.00
Sherman	10 MGD WTP Expansion (desal)	$82,213,000	H.13	2020	5,605	5,605	$2,105	$1,075	$6.46	$3.30
Sherman	10 MGD WTP Expansion (desal)	$82,213,000	H.13	2040	5,605	5,605	$2,105	$1,075	$6.46	$3.30
Sherman	10 MGD WTP Expansion (desal)	$82,213,000	H.13	2060	5,605	5,605	$2,105	$1,075	$6.46	$3.30
Sherman	20 MGD WTP Expansion (desal)	$149,002,000	H.13	2070	11,210	11,210	$1,923	$987	$5.90	$3.03
WUGs										
Bells	Connect to Sherman	$0	None	2030	8	571	$1,134	$1,134	$3.48	$3.48
Bells	New Well(s) in Woodbine Aquifer	$822,000	H.14	2030	55	55	$1,926	$873	$5.91	$2.68
Collinsville	GTUA Regional Water System through Sherman	$0	None	2030	87	398	$1,546	$953	$4.75	$2.93
Dorchester	New Well(s) in Trinity Aquifer	$1,845,000	H.14	2030	0	90	$2,063	$619	$6.33	$1.90
Gunter	New Well(s) in Trinity Aquifer	$1,835,000	H.14	2020	50	50	$3,392	$808	$10.41	$2.48
Gunter	GTUA Regional Water System	$0	None	2030	273	2,840	$1,863	$997	$5.72	$3.06
Howe	NTMWD through GTUA (CGMA)	$0	None	2040	9	66	$163	$163	$0.50	$0.50
Howe	Sherman through GTUA (CGMA)	$0	None	2030	7	20	$1,134	$1,134	$3.48	$3.48
Kentuckytown WSC	Connect to Sherman	$0	None	2,030	42	470	$1,134	$1,134	$3.48	$3.48
Luella SUD	Connect to Sherman	$0	None	2,030	35	264	$1,134	$1,134	$3.48	$3.48
Northwest Grayson County WCID 1	GTUA Regional Water System through Sherman	$0	H.73	2030	194	572	$1,546	$953	$4.75	$2.93

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Northwest Grayson County WCID 1	New Well(s) in Trinity Aquifer	$2,730,000	H.14	2020	29	247	$1,362	$587	$4.18	$1.80
Oak Ridge South Gale WSC	Denison	$0	None	2020	12	225	$978	$978	$3.00	$3.00
Pink Hill WSC	New Well(s) in Woodbine Aquifer	$1,088,000	H.14	2030	6	124	$1,212	$596	$3.72	$1.83
Pink Hill WSC	New Well(s) in Trinity Aquifer	$1,088,000	H.14	2030	6	124	$1,212	$596	$3.72	$1.83
Pottsboro	Denison	$0	None	2020	68	1,009	$978	$978	$3.00	$3.00
Pottsboro	Connect to Sherman	$0	None	2070	915	915	$1,134	$1,134	$3.48	$3.48
South Grayson SUD	Connect to Sherman	$0	None	2030	44	337	$1,134	$1,134	$3.48	$3.48
Southmayd	Connect to Sherman	$0	None	2020	48	223	$1,134	$1,134	$3.48	$3.48
Tioga	Connect to Sherman	$0	None	2050	10	329	$1,134	$1,134	$3.48	$3.48
Tom Bean	Connect to Sherman	$0	None	2060	46	185	$1,134	$1,134	$3.48	$3.48
Two Way SUD	GTUA Regional Water System through Sherman	$0	None	2030	857	1,636	$1,134	$1,134	$3.48	$3.48
Van Alstyne	Sherman through GTUA (CGMA)	$0	None	2030	61	280	$1,134	$1,134	$3.48	$3.48
Van Alstyne	NTMWD through GTUA (CGMA)	$0	None	2040	59	1,067	$163	$163	$0.50	$0.50
Van Alstyne	Water System Improvements	$2,844,000	H.129	2040	59	1,067	$236	$49	$0.72	$0.15
Whitesboro	GTUA Regional Water System through Sherman	$0	None	2030	448	456	$1,546	$953	$4.75	$2.93
Whitewright	Connect to Sherman	$0	None	2040	47	94	$1,134	$1,134	$3.48	$3.48
Woodbine WSC	GTUA Regional Water System through Sherman	$0	$0	2030	716	942	$0	$0	$0.00	$0.00
County Other, Grayson	Sherman	$0	None	2030	760	1,719	$1,134	$1,134	$3.48	$3.48
Manufacturing, Grayson	Sherman	$0	None	2060	417	1,144	$1,134	$1,134	$3.48	$3.48
Manufacturing, Grayson	NTMWD through GTUA (CGMA)	$0	None	2030	4	13	$163	$163	$0.50	$0.50
Manufacturing, Grayson	Sherman through GTUA (CGMA)	$0	None	2030	9	3	$1,134	$1,134	$3.48	$3.48
Mining, Grayson	New Well(s) in Trinity Aquifer	$806,000	H.14	2020	100	100	$665	$94	$2.04	$0.29
Grayson County Total		**$553,745,000**								
Henderson County										
WWPs										
Athens MWA	Expanded Groundwater Supply	$2,573,000	H.14	2020	200	200	$1,090	$185	$3.34	$0.57
Athens MWA	New Wells in Carrizo-Wilcox	$15,151,000	H.14	2020	2,000	2,000	$942	$411	$2.89	$1.26
Athens MWA	Fish Hatchery Reuse	$0	None	2020	2,872	2,872	$33	$33	$0.10	$0.10
Athens MWA	*Infrastructure Improvements at WTP*	*$65,000*	*H.131*	*2020*	*450*	*450*	*$127*	*$116*	*$0.39*	*$0.35*
WUGs										

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Athens	Other WMSs	See Athens MWA			950	3,210			$0.00	$0.00
Dogwood Estates Water	New well(s) in Carrizo-Wilcox	$1,296,000	H.14	2040	5	144	$1,157	$521	$3.55	$1.60
East Cedar Creek FWSD	TRWD	$0	None	2020	182	1,081	$411	$411	$1.26	$1.26
Eustace	New well(s) in Carrizo-Wilcox	$1,469,000	H.14	2050	41	150	$1,173	$482	$3.60	$1.48
Malakoff	TRWD	$0	None	2040	3	20	$411	$411	$1.26	$1.26
County Other, Henderson (Region C only)	TRWD	$0	None	2030	18	22	$411	$411	$1.26	$1.26
Livestock, Henderson (Region C only)	New well(s) in Carrizo-Wilcox	$3,469,000	H.14	2020	403	403	$740	$134	$2.27	$0.41
Manufacturing, Henderson (Region C only)	Athens	$0	None	2030	0	0	$978	$978	$3.00	$3.00
Mining, Henderson (Region C only)	TRWD	$0	None	2030	19	56	$411	$411	$1.26	$1.26
Steam Electric Power, Henderson (Region C only)	TRWD (Cedar Creek Reservoir)	$0	None	2030	78	263	$531	$531	$1.63	$1.63
Henderson County Total		**$24,023,000**								
Jack County										
County Other, Jack	Jacksboro (Lost Creek/Lake Jacksboro)	$0	None	2020	7	7	$176	$0	$0.54	$0.00
County Other, Jack	*Infrastructure to connect to Jacksboro*	*$2,152,000*	*H.132*	*2020*	*7*	*7*	*$978*	*$978*	*$3.00*	*$3.00*
County Other, Jack	Walnut Creek SUD	$0	None	2020	55	58	$23,719	$2,092	$72.79	$6.42
County Other, Jack	*Infrastructure to connect to Walnut Creek SUD*	*$5,002,000*	*H.133*	*2020*	*55*	*58*	*$1,991*	*$1,991*	*$6.11*	*$6.11*
Mining, Jack	Indirect reuse (Jacksboro)	$0	None	2020	330	359	$978	$978	$3.00	$3.00
Mining, Jack	TRWD	$0	None	2030	131	450	$411	$411	$1.26	$1.26
Steam Electric Power, Jack	TRWD	$0	None	2030	448	1,506	$411	$411	$1.26	$1.26
Jack County Total		**$7,154,000**								
Kaufman County										
WWPs										
Forney	Additional NTMWD	$0	None	2020	1,236	10,720	$3	$3	$0.01	$0.01
Forney	*Increase delivery infrastructure from NTWMD (pump station)*	*$13,054,000*	*H.135*	*2020*	*0*	*10,720*	*$91*	*$37*	*$0.28*	*$0.11*
Terrell	NTMWD	$0	None	2020	***452***	***13,079***	$906	$906	$2.78	$2.78

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Terrell	*Infrastructure Upgrades to Deliver water to Wholesale Customers*	*$11,472,000*	*H.137 & H.138*	*2020*	*452*	*13,079*	*$162*	*$15*	*$0.50*	*$0.05*
WUGs										
Ables Springs WSC	NTMWD	$0	None	2030	68	488	$906	$906	$2.78	$2.78
Becker Jiba WSC	NTMWD	$0	None	2030	57	488	$906	$906	$2.78	$2.78
College Mound WSC	NTMWD	$0	None	2030	81	636	$906	$906	$2.78	$2.78
College Mound WSC	Terrell	$0	None	2030	54	698	$1,923	$1,923	$5.90	$5.90
College Mound WSC	*Additional delivery from Terrell*	*$5,078,000*	*H.134*	*2070*	*109*	*109*	*$3,825*	*$547*	*$11.74*	*$1.68*
Combine WSC	DWU through Seagoville	$0	None	2020	22	320	$978	$978	$3.00	$3.00
Crandall	NTMWD	$0	None	2020	119	679	$906	$906	$2.78	$2.78
Elmo WSC	NTMWD through Terrell	$0	None	2030	39	308	$1,923	$1,923	$5.90	$5.90
Forney Lake WSC	NTMWD	$0	None	2030	153	1,878	$906	$906	$2.78	$2.78
Gastonia Scurry SUD	NTMWD	$0	None	2030	124	1,387	$906	$906	$2.78	$2.78
High Point WSC	NTMWD through Forney	$0	None	2030	38	288	$1,665	$1,665	$5.11	$5.11
High Point WSC	NTMWD through Terrell	$0	None	2030	38	289	$1,923	$1,923	$5.90	$5.90
Kaufman	NTMWD	$0	None	2030	163	1,801	$906	$906	$2.78	$2.78
Kaufman County Development District 1	NTMWD	$0	None	2030	104	1,153	$906	$906	$2.78	$2.78
Kaufman County MUD 11	NTMWD	$0	None	2030	67	557	$906	$906	$2.78	$2.78
Kemp	TRWD	$0	None	2020	168	914	$411	$411	$1.26	$1.26
Mabank	TRWD	$0	None	2020	645	4,309	$411	$411	$1.26	$1.26
Mabank	*3 MGD WTP Expansion*	*$19,817,000*	*H.13*	*2020*	*645*	*1,682*	*$1,509*	*$681*	*$4.63*	*$2.09*
Mabank	*5 MGD WTP Expansion*	*$30,984,000*	*H.13*	*2060*	*1,084*	*2,628*	*$1,372*	*$593*	*$4.21*	*$1.82*
Mabank	*Additional Delivery Infrastructure from TRWD (Cedar Creek Reservoir)*	*$1,622,000*	*H.136*	*2030*	*782*	*4,309*	*$42*	*$13*	*$0.13*	*$0.04*
MacBee SUD	SRA	See Region D Plan.							$0.00	$0.00
Markout WSC	NTMWD	$0	None	2020	87	1,133	$906	$906	$2.78	$2.78
North Kaufman WSC	NTMWD through Kaufman	$0	None	2030	5	45	$978	$978	$3.00	$3.00
North Kaufman WSC	NTMWD through Terrell	$0	None	2030	29	249	$1,923	$1,923	$5.90	$5.90
Poetry WSC	NTMWD	$0	None	2030	64	503	$906	$906	$2.78	$2.78
Rose Hill SUD	NTMWD	$0	None	2030	75	616	$906	$906	$2.78	$2.78
Talty SUD	NTMWD	$0	None	2030	188	2,176	$906	$906	$2.78	$2.78
West Cedar Creek MUD	TRWD	$0	None	2030	135	814	$411	$411	$1.26	$1.26
County Other, Kaufman	NTMWD	$0	None	2030	43	1,207	$906	$906	$2.78	$2.78
County Other, Kaufman	TRWD through Mabank	$0	None	2020	49	48	$978	$978	$3.00	$3.00
County Other, Kaufman	TRWD	$0	None	2020	9	161	$411	$411	$1.26	$1.26

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County Other, Kaufman	*0.5 MGD WTP for TRWD water*	*$11,016,000*	*H.139*	*2020*	*9*	*161*	*$7,576*	*$2,760*	*$23.25*	*$8.47*
Irrigation, Kaufman	TRWD	$0	None	2030	14	50	$411	$411	$1.26	$1.26
Irrigation, Kaufman	DWU	$0	None	2020	1	9	$1,320	$1,320	$4.05	$4.05
Manufacturing, Kaufman	NTMWD	$0	None	2020	4	460	$222	$222	$0.68	$0.68
Mining, Kaufman	New Well(s) in Nacatoch Aquifer	$419,000	H.14	2040	49	49	$746	$147	$2.29	$0.45
Steam Electric Power, Kaufman	NTMWD through Forney	$0	None	2020	6	466	$906	$906	$2.78	$2.78
Kaufman County Total		**$93,462,000**								
Navarro County										
B and B WSC	Corsicana	$0	None	2050	24	116	$1,352	$1,352	$4.15	$4.15
Blooming Grove	Corsicana	$0	None	2050	7	52	$1,352	$1,352	$4.15	$4.15
Chatfield WSC	Corsicana	$0	None	2050	44	169	$1,352	$1,352	$4.15	$4.15
Corbet WSC	Corsicana	$0	None	2050	25	96	$1,352	$1,352	$4.15	$4.15
Dawson	Corsicana	$0	None	2050	13	46	$1,352	$1,352	$4.15	$4.15
Kerens	Corsicana	$0	None	2050	21	83	$1,352	$1,352	$4.15	$4.15
M E N WSC	Corsicana	$0	None	2050	50	194	$1,352	$1,352	$4.15	$4.15
M E N WSC	*Additional delivery infrastructure from Corsicana (Upsize Lake Halbert Connection)*	*$4,088,000*	*H.141*	*2050*	*50*	*194*	*$1,710*	*$218*	*$5.25*	*$0.67*
Navarro Mills WSC	Corsicana	$0	None	2050	33	128	$1,352	$1,352	$4.15	$4.15
Navarro Mills WSC	New Well(s) in Woodbine Aquifer	$1,247,000	H.14	2050	8	8	$12,689	$1,724	$38.94	$5.29
Post Oak SUD	Corsicana	$0	None	2050	62	183	$1,352	$1,352	$4.15	$4.15
County Other, Navarro	Corsicana	$0	None	2030	43	355	$1,352	$1,352	$4.15	$4.15
County Other, Navarro	TRWD	$0	None	2040	7	90	$411	$411	$1.26	$1.26
Manufacturing, Navarro	Corsicana	$0	None	2050	5	301	$1,352	$1,352	$4.15	$4.15
Manufacturing, Navarro	TRWD through Winkler WSC	$0	None	2040	2	2	$978	$978	$3.00	$3.00
Navarro County Total		**$5,335,000**								
Parker County										
WWPs										
Walnut Creek SUD	Additional TRWD	$0	None	2030	500	6,760	$411	$411	$1.26	$1.26
Walnut Creek SUD	6 MGD WTP Expansion	$36,582,000	H.13	2030	*500*	*3,363*	$1,339	$573	$4.11	$1.76
Walnut Creek SUD	New 7 MGD WTP-Eagle Mountain	$42,167,000	H.13	2070	***1,233***	***3,397***	$1,313	$557	$4.03	$1.71

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Weatherford	Additional Indirect Reuse Phase I	$14,840,000	H.147	2020	1,682	2,242	$551	$85	$1.69	$0.26
Weatherford	Additional Indirect Reuse Phase II	$486,000	H.148	2030	1,121	1,121	$61	$30	$0.19	$0.09
Weatherford	Add'l Water from TRWD	$0	None	2030	0	18,585	$411	$411	$1.26	$1.26
Weatherford	8 MGD WTP Expansion	$47,753,000	H.13	2020	***2,803***	***4,484***	$1,294	$547	$3.97	$1.68
Weatherford	14 MGD WTP Expansion	$77,267,000	H.13	2050	***2,154***	***7,847***	$1,189	$495	$3.65	$1.52
Weatherford	18 MGD WTP Expansion	$95,609,000	H.13	2070	***1,977***	***9,617***	$1,144	$479	$3.51	$1.47
Weatherford	Expand Lake Benbrook PS	$2,299,000	H.149	2020	***448***	***448***	$682	$321	$2.09	$0.99
WUGs										
Aledo	TRWD through Fort Worth	$0	None	2030	139	822	$531	$531	$1.63	$1.63
Aledo	*Parallel pipeline and pump station from Fort Worth*	*$9,382,000*	*H.144*	*2060*	*86*	*299*	*$2,515*	*$308*	*$7.72*	*$0.94*
Annetta	Weatherford	$0	None	2030	195	184	$2,428	$2,428	$7.45	$7.45
Annetta	Connect to Weatherford	$3,985,000	H.143	2030	195	184	$1,728	$292	$5.30	$0.90
Hudson Oaks	Weatherford	$0	None	2030	32	307	$2,428	$2,428	$7.45	$7.45
Hudson Oaks	Fort Worth	$0	None	2020	299	458	$531	$531	$1.63	$1.63
Hudson Oaks	Direct Connection to Fort Worth	$5,500,000	H.145	2020	***299***	***458***	$968	$135	$2.97	$0.42
Parker County SUD	BRA with Treatment Plant Expansion	$32,308,000	H.13	2030	224	1,761	$2,454	$1,297	$7.53	$3.98
Reno	Walnut Creek SUD	$0	None	2020	9	35	$1,991	$1,991	$6.11	$6.11
Springtown	TRWD	$0	None	2020	448	535	$411	$411	$1.26	$1.26
Springtown	*Infrastructure improvements - Surface Water Treatment Plant & Supply Project*	*$4,163,000*	*H.146*	*2020*	*448*	*535*	*$794*	*$267*	*$2.44*	*$0.82*
Willow Park	Fort Worth	$0	None	2020	155	1,911	$531	$531	$1.63	$1.63
Willow Park	*Connect to Fort Worth (TRWD)*	*$4,017,000*	*H.150*	*2020*	*155*	*1,911*	*$176*	*$26*	*$0.54*	*$0.08*
County Other, Parker	Weatherford	$0	None	2050	1,200	4,000	$2,428	$2,428	$7.45	$7.45
County Other, Parker	New Well(s) in Trinity Aquifer	$2,157,000	H.14	2020	235	235	$1,105	$456	$3.39	$1.40
County Other, Parker	TRWD	$0	None	2020	628	7,484	$411	$411	$1.26	$1.26
County Other, Parker	*WTP and Transmission Facilities*	*$119,202,000*	*H.151*	*2020*	*628*	*7,484*	*$1,874*	*$652*	*$5.75*	*$2.00*
Manufacturing, Parker	Weatherford	$0	None	2030	3	8	$2,428	$2,428	$7.45	$7.45
Manufacturing, Parker	Walnut Creek SUD	$0	None	2020	3	12	$1,991	$1,991	$6.11	$6.11
Mining, Parker	New Well(s) in Trinity Aquifer	$2,454,000	H.14	2030	289	624	$339	$62	$1.04	$0.19
Parker County Total		**$500,171,000**								
Rockwall County										
WWPs										
Rockwall	Additional NTMWD	$0	None	2020	2,188	13,682	$906	$906	$2.78	$2.78
Rockwall	Increase delivery infrastructure from NTWMD	$28,750,000	H.155	2020	***2,188***	***13,682***	$179	$33	$0.55	$0.10

Entity	Recommended Strategy	Capital Cost	Cost Table	First Decade of Water Strategy	First Decade Water Supply Volume (Acre-Feet/Year)	Year 2070 Water Supply Volume (Acre-Feet/Year)	Annual Average Unit Cost with Debt Service ($/Acre-Foot/Year)	Annual Average Unit Cost without Debt Service ($/Acre-Foot/Year)	Annual Average Unit Cost with Debt Service ($/1,000 gal)	Annual Average Unit Cost without Debt Service ($/1,000 gal)
WUGs										
Blackland WSC	NTMWD	$0	None	2030	91	435	$906	$906	$2.78	$2.78
Blackland WSC	*Direct Connection to NTMWD*	*$6,804,000*	*H.152*	*2030*	*91*	*435*	*$1,264*	*$163*	*$3.88*	*$0.50*
Cash SUD	SRA	See Region D Plan.							$0.00	$0.00
Cash SUD	NTMWD	$0	None	2020	2	1,006	$906	$906	$2.78	$2.78
Cash SUD	*Additional Delivery Infrastructure from NTWMD*	*$7,888,000*	*H.153*	*2020*	*2*	*1,006*	*$611*	*$60*	*$1.88*	*$0.18*
Cash SUD	WTP Expansion	See Region D Plan.							$0.00	$0.00
Fate	NTMWD	$0	None	2030	354	3,024	$906	$906	$2.78	$2.78
Fate	*Additional Delivery Infrastructure from NTMWD*	*$2,001,000*	*H.154*	*2050*	*974*	*3,024*	*$65*	*$20*	*$0.20*	*$0.06*
Heath	NTMWD	$0	None	2030	492	2,624	$906	$906	$2.78	$2.78
Mount Zion WSC	NTMWD	$0	None	2030	67	446	$906	$906	$2.78	$2.78
R C H WSC	NTMWD	$0	None	2030	114	934	$906	$906	$2.78	$2.78
Royse City	NTMWD	$0	None	2030	332	4,313	$906	$906	$2.78	$2.78
County Other, Rockwall	NTMWD	$0	None	2030	64	335	$906	$906	$2.78	$2.78
Irrigation, Rockwall	DWU	$0	None	2020	14	105	$1,320	$1,320	$4.05	$4.05
Manufacturing, Rockwall	NTMWD	$0	None	2030	0	15	$906	$906	$2.78	$2.78
Rockwall County Total		**$45,443,000**								
Tarrant County										
WWPs										
Arlington	TRWD	$0	None	2030	5,910	37,500	$411	$411	$1.26	$1.26
Mansfield	Add'l TRWD Supply	$0	None	2020	0	37,184	$411	$411	$1.26	$1.26
Mansfield	15 MGD Existing WTP Expansion	$44,021,000	H.13	2030	0	8,408	$632	$264	$1.94	$0.81
Mansfield	35 MGD New WTP	$87,389,000	H.13	2030	1,674	19,618	$538	$225	$1.65	$0.69
Mansfield	20 MGD New WTP Expansion	$54,863,000	H.13	2060	0	9,158	$590	$248	$1.81	$0.76
North Richland Hills	Additional TRA (from TRWD)	$0	None	2030	203	863	$1,176	$1,176	$3.61	$3.61
North Richland Hills	Additional Fort Worth (from TRWD)	$0	None	2020	1,006	4,393	$531	$531	$1.63	$1.63
North Richland Hills	*New Pipeline from Fort Worth (Cost share with Watagua)*	*$9,544,000*	*H.165*	*2020*	*1,006*	*4,393*	*$207*	*$58*	*$0.64*	*$0.18*
WUGs										
Azle	TRWD	$0	None	2020	224	1,767	$411	$411	$1.26	$1.26
Azle	*WTP Expansion*	*$25,410,000*	*H.13*	*2030*	*317*	*1,767*	*$1,424*	*$626*	*$4.37*	*$1.92*
Bedford	TRWD through TRA	$0	None	2040	1,670	3,530	$1,176	$1,176	$3.61	$3.61
Benbrook	TRWD	$0	None	2020	1,292	3,362	$411	$411	$1.26	$1.26
Benbrook	*3 MGD WTP Expansion*	*$14,102,000*	*H.13*	*2030*	*1,682*	*1,682*	*$1,098*	*$508*	*$3.37*	*$1.56*
Bethesda WSC	Arlington	$0	None	2030	138	989	$1,101	$1,101	$3.38	$3.38
Bethesda WSC	Fort Worth	$0	None	2030	271	2,172	$531	$531	$1.63	$1.63

Entity	Recommended Strategy	Capital Cost	Cost Table	First Decade of Water Strategy	First Decade Water Supply Volume (Acre-Feet/Year)	Year 2070 Water Supply Volume (Acre-Feet/Year)	Annual Average Unit Cost with Debt Service ($/Acre-Foot/Year)	Annual Average Unit Cost without Debt Service ($/Acre-Foot/Year)	Annual Average Unit Cost with Debt Service ($/1,000 gal)	Annual Average Unit Cost without Debt Service ($/1,000 gal)
Burleson	TRWD through Fort Worth	$0	None	2030	991	5,063	$531	$531	$1.63	$1.63
Burleson	*Additional delivery infrastructure from Fort Worth*	*$4,688,000*	*H.156*	*2050*	*104*	*2,641*	*$163*	*$39*	*$0.50*	*$0.12*
Colleyville	TRWD through TRA	$0	None	2030	510	3,417	$1,176	$1,176	$3.61	$3.61
Community WSC	TRWD	$0	None	2030	39	186	$411	$411	$1.26	$1.26
Crowley	Fort Worth	$0	None	2030	233	2,975	$531	$531	$1.63	$1.63
Crowley	*Additional delivery infrastructure from Fort Worth*	*$3,274,000*	*H.157*	*2030*	*233*	*2,975*	*$104*	*$26*	*$0.32*	*$0.08*
Dalworthington Gardens	Arlington	$0	None	2030	44	157	$1,101	$1,101	$3.38	$3.38
Dalworthington Gardens	Fort Worth	$0	None	2030	21	176	$531	$531	$1.63	$1.63
Edgecliff Village	Fort Worth	$0	None	2030	36	162	$531	$531	$1.63	$1.63
Euless	TRWD through TRA	$0	None	2030	0	2,099	$1,176	$1,176	$3.61	$3.61
Forest Hill	TRWD through Fort Worth	$0	None	2030	144	1,183	$531	$531	$1.63	$1.63
Grapevine	TRWD through TRA	$0	None	2020	102	3,576	$1,176	$1,176	$3.61	$3.61
Grapevine	DWU	$0	None	2030	12	574	$1,320	$1,320	$4.05	$4.05
Haltom City	TRWD through Fort Worth	$0	None	2030	297	2,169	$531	$531	$1.63	$1.63
Haslet	TRWD through Fort Worth	$0	None	2020	200	1,443	$531	$531	$1.63	$1.63
Hurst	TRWD through Fort Worth	$0	None	2030	359	2,058	$531	$531	$1.63	$1.63
Johnson County SUD	TRWD through Mansfield	$0	None	2020	269	5,046	$978	$978	$3.00	$3.00
Keller	TRWD through Fort Worth	$0	None	2030	616	4,217	$531	$531	$1.63	$1.63
Kennedale	TRWD through Fort Worth	$0	None	2040	68	509	$531	$531	$1.63	$1.63
Kennedale	*Additional Delivery Infrastructure from Ft Worth*	*$4,496,000*	*H.160*	*2040*	*0*	*893*	*$414*	*$62*	*$1.27*	*$0.19*
Kennedale	Arlington	$0	None	2030	280	280	$1,101	$1,101	$3.38	$3.38
Kennedale	*Connect to Arlington*	*$2,004,000*	*H.159*	*2030*	*280*	*280*	*$606*	*$104*	*$1.86*	*$0.32*
Lake Worth	TRWD through Fort Worth	$0	None	2030	71	774	$531	$531	$1.63	$1.63
Lakeside	New Well(s) in Trinity Aquifer	$1,413,000	H.14	2020	58	76	$1,854	$609	$5.69	$1.87
Pantego	Arlington	$0	None	2030	30	26	$1,101	$1,101	$3.38	$3.38
Pantego	*Connect to Arlington*	*$894,000*	*H.161*	*2030*	*30*	*26*	*$2,379*	*$283*	*$7.30*	*$0.87*
Pantego	Fort Worth	$0	None	2030	30	27	$531	$531	$1.63	$1.63
Pantego	*Connect to Fort Worth*	*$1,459,000*	*H.162*	*2030*	*30*	*27*	*$3,904*	*$482*	*$11.98*	*$1.48*
Pelican Bay	TRWD through Azle	$0	None	2030	0	5	$978	$978	$3.00	$3.00
Pelican Bay	*Connect to Azle (TRWD)*	*$1,589,000*	*H.163*	*2030*	*0*	*5*	*$12,272*	*$1,088*	*$37.66*	*$3.34*
Pelican Bay	New Well(s) in Trinity Aquifer	$529,000	H.14	2020	24	24	$1,815	$264	$5.57	$0.81
Richland Hills	TRWD through Fort Worth	$0	None	2030	98	545	$531	$531	$1.63	$1.63
River Oaks	TRWD through Fort Worth	$0	None	2030	85	295	$411	$411	$1.26	$1.26
Saginaw	TRWD through Fort Worth	$0	None	2030	176	1,334	$531	$531	$1.63	$1.63
Sansom Park	TRWD through Fort Worth	$0	None	2050	4	28	$531	$531	$1.63	$1.63
Southlake	TRWD through Fort Worth	$0	None	2030	810	7,227	$531	$531	$1.63	$1.63
Southlake	*Additional Delivery Infrastructure from Ft Worth*	*$12,772,000*	*H.164*	*2040*	*1,807*	*7,845*	*$143*	*$29*	*$0.44*	*$0.09*

Entity	Recommended Strategy	Capital Cost	Cost Table	First Decade of Water Strategy	First Decade Water Supply Volume (Acre-Feet/Year)	Year 2070 Water Supply Volume (Acre-Feet/Year)	Annual Average Unit Cost with Debt Service ($/Acre-Foot/Year)	Annual Average Unit Cost without Debt Service ($/Acre-Foot/Year)	Annual Average Unit Cost with Debt Service ($/1,000 gal)	Annual Average Unit Cost without Debt Service ($/1,000 gal)
Watauga	North Richland Hills	$0	None	2030	204	902	$978	$978	$3.00	$3.00
Watauga	*Additional delivery infrastructure North Richland Hills/Fort Worth*	*$1,960,000*	*H.165*	*2030*	*204*	*902*	*$207*	*$58*	*$0.64*	*$0.18*
Westlake	TRWD through Fort Worth	$0	None	2030	581	3,024	$531	$531	$1.63	$1.63
Westover Hills	TRWD through Fort Worth	$0	None	2030	42	290	$531	$531	$1.63	$1.63
Westworth Village	TRWD through Fort Worth	$0	None	2030	45	204	$531	$531	$1.63	$1.63
White Settlement	TRWD through Fort Worth	$0	None	2030	147	1,187	$531	$531	$1.63	$1.63
County Other, Tarrant	TRWD	$0	None	2030	25	294	$411	$411	$1.26	$1.26
County Other, Tarrant	TRWD through Fort Worth	$0	None	2030	189	4,715	$531	$531	$1.63	$1.63
County Other, Tarrant	DWU	$0	None	2020	54	403	$1,320	$1,320	$4.05	$4.05
Irrigation, Tarrant	Arlington	$0	None	2020	12	41	$1,101	$1,101	$3.38	$3.38
Irrigation, Tarrant	TRWD	$0	None	2030	175	590	$411	$411	$1.26	$1.26
Livestock, Tarrant	New Well(s) in Trinity Aquifer	$584,000	H.14	2020	75	75	$681	$134	$2.09	$0.41
Manufacturing, Tarrant	TRWD	$0	None	2020	1,633	5,281	$411	$411	$1.26	$1.26
Mining, Tarrant	TRWD	$0	$0	2030	122	0	$411	$411	$1.26	$1.26
Steam Electric Power, Tarrant	TRWD	$0	None	2030	293	650	$411	$411	$1.26	$1.26
Steam Electric Power, Tarrant	Reuse	$13,150,000	H.167	2030	1,528	2,360	$637	$245	$1.96	$0.75
Tarrant County Total		**$284,141,000**								
Wise County										
WWPs										
Wise County WSD	Additional TRWD	$0	None	2020	396	4,837	$1	$1	$0.00	$0.00
Wise County WSD	*9 MGD WTP Expansion*	*$53,339,000*	*H.13*	*2020*	*396*	*4,837*	*$4*	*$2*	*$0.01*	*$0.01*
WUGs										
Alvord	TRWD through West Wise SUD	$0	None	2030	43	266	$186	$0	$0.57	$0.00
Alvord	*Connect to West Wise SUD*	*$6,790,000*	*H.168*	*2030*	*43*	*266*	*$978*	*$978*	*$3.00*	*$3.00*
Boyd	Walnut Creek SUD	$0	None	2020	11	328	$6	$6	$0.02	$0.02
Bridgeport	TRWD	$0	None	2040	99	2,087	$1	$1	$0.00	$0.00
Bridgeport	*2 MGD WTP Expansion*	*$11,377,000*	*H.13*	*2060*	*670*	*1,121*	*$4*	*$2*	*$0.01*	*$0.01*
Bridgeport	*1 MGD WTP Expansion*	*$8,651,000*	*H.13*	*2070*	*293*	*293*	*$7*	*$3*	*$0.02*	*$0.01*
Bridgeport	*Expand Capacity of Lake intake and Pump Station*	*$1,421,000*	*H.169*	*2060*	*670*	*1,414*	*$0*	*$0*	*$0.00*	*$0.00*
Chico	West Wise SUD	$0	None	2040	5	508	$978	$978	$3.00	$3.00
Chico	*Additional Delivery Infrastructure from West Wise SUD*	*$4,422,000*	*H.170*	*2040*	*5*	*508*	*$723*	*$111*	*$2.22*	*$0.34*
Decatur	Wise County WSD	$0	None	2020	396	4,817	$978	$978	$3.00	$3.00
Newark	Rhome	$0	None	2020	67	715	$978	$978	$3.00	$3.00

Entity	Recommended Strategy	Capital Cost	Cost Table	First Decade of Water Strategy	First Decade Water Supply Volume (Acre-Feet/Year)	Year 2070 Water Supply Volume (Acre-Feet/Year)	Annual Average Unit Cost with Debt Service ($/Acre-Foot/Year)	Annual Average Unit Cost without Debt Service ($/Acre-Foot/Year)	Annual Average Unit Cost with Debt Service ($/1,000 gal)	Annual Average Unit Cost without Debt Service ($/1,000 gal)
Newark	*Connect to Rhome (TRWD through Walnut Creek SUD)*	*$1,584,000*	*H.171*	*2020*	*67*	*715*	*$169*	*$16*	*$0.52*	*$0.05*
Rhome	Walnut Creek SUD	$0	None	2020	31	1,231	$1,991	$1,991	$6.11	$6.11
Runaway Bay	TRWD	$0	None	2020	6	1,534	$411	$411	$1.26	$1.26
Runaway Bay	*3 MGD WTP Expansion-1*	*$19,823,000*	*H.13*	*2020*	*658*	*1,682*	*$1,509*	*$681*	*$4.63*	*$2.09*
Runaway Bay	*3 MGD WTP Expansion-2*	*$19,823,000*	*H.13*	*2060*	*1,537*	*1,537*	*$1,509*	*$681*	*$4.63*	*$2.09*
Runaway Bay	*Increase capacity of Lake Intake-1*	*$8,657,000*	*H.172*	*2020*	*658*	*3,219*	*$238*	*$49*	*$0.73*	*$0.15*
West Wise SUD	TRWD	$0	None	2020	22	717	$411	$411	$1.26	$1.26
West Wise SUD	*1.5 MGD WTP Expansion*	*$10,015,000*	*H.13*	*2050*	*233*	*565*	*$1,649*	*$811*	*$5.06*	*$2.49*
Wise County Other	TRWD through Runaway Bay	$0	None	2020	635	2,746	$978	$978	$3.00	$3.00
Wise County Other	TRWD through Walnut Creek SUD	$0	None	2020	145	889	$1,991	$1,991	$6.11	$6.11
Wise County Irrigation	TRWD	$0	None	2030	70	235	$411	$411	$1.26	$1.26
Wise County Manufacturing	TRWD	$0	None	2030	6	20	$411	$411	$1.26	$1.26
Wise County Manufacturing	New Well(s) in Trinity Aquifer	$502,000	H.14	2020	201	201	$218	$42	$0.67	$0.13
Wise County Mining	TRWD	$0	None	2020	0	2,412	$411	$411	$1.26	$1.26
Wise County Steam Electric	TRWD	$0	None	2030	344	1,156	$411	$411	$1.26	$1.26
Wise County Total		**$146,404,000**								

I Introduction

In 1997, the 75th Texas Legislature passed Senate Bill One, legislation designed to address Texas water issues. Senate Bill One put in place a grass-roots regional process to plan for the future water needs of all Texans. To implement this process, the Texas Water Development Board created 16 regional water planning groups across the state and established regulations governing regional planning efforts. The results of the first round of the Senate Bill One planning effort for Region C can be found in the 2001 Region C Water Plan [1]. The regional plans from each of the 16 regions were compiled by the Texas Water Development Board into the State Water Plan, Water for Texas – 2002.

Since that time, the Texas Legislature has passed funding mechanisms to continue the regional water planning effort, which is updated every five years. Plans produced since the first round of planning include: *2006 Region C Water Plan* [2], *2011 Region C Water Plan* [3], and *2016 Region C Water Plan* [4].

This report gives the results of the latest (5th) round of planning for Region C, which represents 16 counties in and around the Dallas-Fort Worth Metroplex. These counties include all of Collin, Cooke, Dallas, Denton, Ellis, Fannin, Freestone, Grayson, Jack, Kaufman, Navarro, Parker, Rockwall, Tarrant, and Wise Counties and the part of Henderson County that is in the Trinity Basin. The area covered by Region C is the same as in all previous rounds of Senate Bill One planning.

The regional water planning groups created pursuant to Senate Bill One are in charge of the regional planning process. Each regional planning group includes representatives of 12 designated interest groups. **Table I.1** shows the members of the Region C water planning group and the interests they represent. The Region C Water Planning Group (RCWPG) hired a team of consultants to conduct technical analyses and prepare the regional water plan under the supervision of the planning group. The consulting

Required Chapters:

1. Description of Region C
2. Population and Water Demand Projections
3. Water Availability and Existing Water Supplies in Region C
4. Identification of Water Needs
5. Water Management Strategies
6. Impacts of the Region C Water Plan
7. Drought Response Information, Activities, and Recommendations
8. Unique Stream Segments and Reservoir Sites, and Policy Recommendations
9. Reporting of Financing for Water Management Strategies
10. Adoption of Plan and Public Participation
11. Implementation and Comparison to the Previous Region C Water Plan

team for Region C includes Freese and Nichols, Inc., Plummer Associates, Inc., CP&Y, Inc., and Cooksey Communications, Inc.

Texas Water Development Board planning guidelines require the regional water plan to include eleven chapters. In addition to the eleven required sections, this report also includes appendices providing more detailed information on the planning efforts. The elements contained in this plan meet Texas Water Development Board regional planning requirements and guidelines (5). **Appendix A** contains a summary of the requirements of all regional plans and a checklist demonstrating what sections of this report meet those requirements.

The *2021 Region C Water Plan* represents the culmination of five years of working together with the RCWPG, regional and local water providers, and the public. As you read this water plan, the RCWPG would like you to keep in mind the following points:

- The *2021 Region C Water Plan* presents a comprehensive overview of the water supply issues in the region.
- The report presents planning level analyses of the recommended water management strategies. Additional engineering studies and design will be needed prior to the implementation of the strategies.
- The surpluses and needs are estimates based on the best information available at the time of publication. Actual values may vary based on changing conditions or assumptions.
- The RCWPG has no authority to regulate water supplies or implement water management strategies. The identified water management strategies are assumed to be implemented by the respective water user.

Table I.1 Members of the Region C Water Planning Group

Member	Interest
Kevin Ward, Chairman	River Authorities
Russell Laughlin, Vice Chair	Industry
Tom Kula, Secretary (retired)	Water Districts
David Bailey	Groundwater Management Areas (GMA12)
Jay Barksdale	Public
Kenneth Banks	Municipalities
Chris Boyd	Water Utilities
Grace Darling	Environment
John Paul Dineen III	Agriculture
Gary Douglas	Groundwater Management Areas (GMA11)
Chris Harder	Municipalities
Harold Latham	Groundwater Management Areas (GMA8)
John Lingenfelder	Public
G.K. Maenius	Counties
Steve Mundt	Small Business
Bob Riley	Environment
Drew Satterwhite	Water Districts
Rick Shaffer	Municipalities
Gary Spicer	Electric Generating Utilities
Connie Standridge	Water Utilities
Jack Stevens	Water Districts
Richard Wagner	Municipalities

Region C Water Planning Group Officers

Kevin Ward, Chair
River Authorities

Russell Laughlin, Vice Chair
Industry

Tom Kula, Secretary (retired)
Water Districts

Region C Water Planning Group Members

David Bailey
GMA12

Jay Barksdale
Public

Kenneth Banks
Municipalities

Chris Boyd
Water Utilities

Grace Darling
Environment

John Paul Dineen
Agriculture

Gary Douglas
GMA11

Chris Harder
Municipalities

Harold Latham
GMA8

John Lingenfelder
Public

G.K. Maenius
Counties

Steve Mundt
Small Business

Bob Riley
Environment

Drew Satterwhite
Water District

Rick Shaffer
Municipalities

Gary Spicer
Electric Generating Utilities

Connie Standridge
Water Utilities

Jack Stevens
Water Districts

Richard Wagner
Municipalities

Introduction List of References

(1) Freese and Nichols, Inc., Alan Plummer Associates, Inc., Chiang, Patel & Yerby, Inc., and Cooksey Communications, Inc.: *Region C Water Plan*, prepared for the Region C Water Planning Group, Fort Worth, January 2001.

(2) Freese and Nichols, Inc., Alan Plummer Associates, Inc., Chiang, Patel & Yerby, Inc., and Cooksey Communications, Inc.: *2006 Region C Water Plan*, prepared for the Region C Water Planning Group, Fort Worth, January 2006.

(3) Freese and Nichols, Inc., Alan Plummer Associates, Inc., CP&Y, Inc., and Cooksey Communications, Inc.: *2011 Region C Water Plan*, prepared for the Region C Water Planning Group, Fort Worth, October 2010.

(4) Freese and Nichols, Inc., Alan Plummer Associates, Inc., CP&Y, Inc., and Cooksey Communications, Inc.: *2016 Region C Water Plan*, prepared for the Region C Water Planning Group, Fort Worth, December 2015.

(5) Texas Water Development Board, *Exhibit C Second Amended General Guidelines for Regional Water Plan Development* (April 2018), Austin, [Online] Available URL: http://www.twdb.texas.gov/waterplanning/rwp/planningdocu/2021/doc/current_docs/contract_docs/2ndAmendedExhibitC.pdf?d=11541.199999992386, August 21, 2018.

1 Description of Region C

Region C includes all or part of 16 counties in North Texas. The population of the region has grown from 987,925 in 1930 to 7,233,415 as of July 2016. As of 2016, Region C included 26 percent of Texas' total population. The two most populous counties in Region C, Dallas and Tarrant County, have 63 percent of the region's population [(1)]. **Table 1.1** shows the cities in Region C with a population of 20,000 or more in 2016. These cities include 84 percent of the 2016 population of the region.

Chapter Outline

Section 1.1 – Economic Activity in Region C

Section 1.2 – Water-Related Physical Features in Region C

Section 1.3 – Current Water Uses and Demand Centers in Region C

Section 1.4 – Current Sources of Water Supply

Section 1.5 – Water Providers in Region C

Section 1.6 – Pre-Existing Plans for Water Supply Development

Section 1.7 – Preliminary Assessment of Current Preparations for Drought in Region C

Section 1.8 – Other Water-Related Programs

Section 1.9 – Water Loss Audits

Section 1.10 – Agricultural and Natural Resources in Region C

Section 1.11 – Summary of Threats and Constraints to Water Supply in Region C

Section 1.12 – Water-Related Threats to Agricultural and Natural Resources in Region C

Related Appendices

Appendix A – Consistency with TWDB Rules

Appendix B – Water Loss Audit

Appendix E – Water Supply Available

Appendix I – Water Conservation Savings

Region C at a Glance

2016 Population: 7.2 Million

26% of State's Population

31% of State's Economy

9% of State's Water Use

53 Cities over 20,000 population

90% of Demand Met by Surface Water

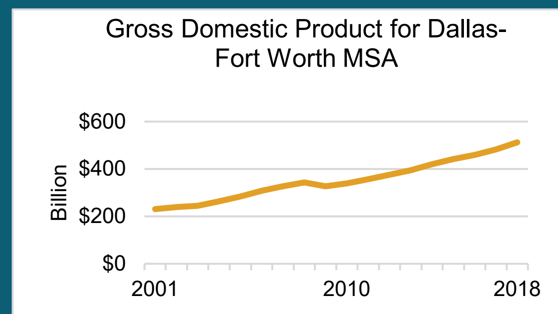
Table 1.1 Cities in Region C with 2016 Population Greater than 20,000

City	Estimated 2016 Population (1)	County(ies)	City	Estimated 2016 Population (1)	County(ies)
Dallas	1,327,496	Collin, Dallas, Denton, Rockwall	**Haltom City**	43,670	Tarrant
Fort Worth	842,584	Denton, Parker, Tarrant, Wise	**The Colony**	43,516	Denton
Arlington	388,598	Tarrant	**Burleson**	43,377	Tarrant, Johnson
Plano	278,164	Collin, Denton	**Coppell**	41,701	Dallas, Denton
Irving	239,711	Dallas	**Sherman**	41,189	Grayson
Garland	237,796	Collin, Dallas, Rockwall	**Little Elm**	40,980	Denton
Grand Prairie	190,257	Dallas, Ellis, Tarrant	**Duncanville**	40,923	Dallas
McKinney	170,500	Collin	**Hurst**	39,238	Tarrant
Frisco	166,824	Collin, Denton	**Lancaster**	38,431	Dallas
Mesquite	143,417	Dallas, Kaufman	**Waxahachie**	34,441	Ellis
Denton	140,082	Denton, Parker, Tarrant, Wise	**Farmers Branch**	33,846	Dallas
Carrollton	135,693	Collin, Dallas, Denton	**Weatherford**	29,648	Parker
Richardson	117,746	Collin, Dallas	**Southlake**	29,530	Denton, Tarrant
Lewisville	107,315	Dallas, Denton	**Colleyville**	25,913	Tarrant
Allen	99,547	Collin	**Sachse**	25,142	Collin, Dallas
Flower Mound	73,521	Denton, Tarrant	**Balch Springs**	25,076	Dallas
North Richland Hills	69,292	Tarrant	**Watauga**	24,534	Tarrant
Mansfield	64,774	Ellis, Tarrant, Johnson	**Corsicana**	24,390	Navarro
Rowlett	62,134	Dallas, Rockwall	**University Park**	24,162	Dallas
Euless	54,095	Tarrant	**Benbrook**	23,557	Tarrant
DeSoto	52,300	Dallas	**Denison**	23,444	Grayson
Grapevine	51,609	Tarrant	**Corinth**	22,316	Denton
Cedar Hill	49,671	Dallas, Ellis	**Midlothian**	21,982	Ellis
Wylie	49,469	Collin, Dallas, Rockwall	**Saginaw**	21,852	Tarrant
Bedford	49,355	Tarrant	**Murphy**	20,912	Collin
Rockwall	44,737	Rockwall	**Ennis**	20,470	Ellis
Keller	44,527	Tarrant			

1.1 Economic Activity in Region C

Region C includes most of the Dallas and Fort Worth-Arlington metropolitan statistical areas (MSA). The largest employment sector in the Dallas and Fort Worth-Arlington MSA is trade, transportation, and utilities [(2)], all of which are heavily dependent on water resources.

Region C accounts for nearly 1/3 of Texas' economy, making it the single largest economic engine in the State.

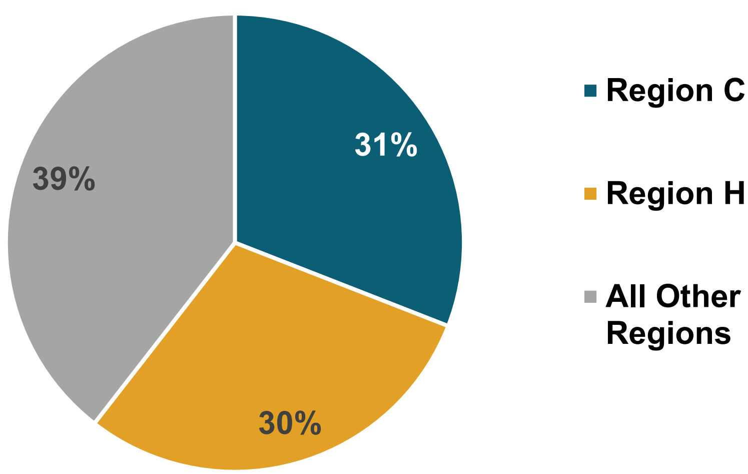


Payroll and employment in Region C are concentrated in the central urban counties of Dallas and Tarrant, which have 75 percent of the region's total payroll and 66 percent of the employment. Economic activity is more concentrated than population because many workers commute from outlying counties to work in Dallas and Tarrant Counties.

For regional planning, the TWDB performed a socio-economic impact analysis for each region using the IMPLAN model. Using this model, TWDB estimates that in 2016 Region C supported more than 4.8 million jobs and generated more than $533 billion in Gross Domestic Product (GDP) in 2018 dollars. Texas' total 2016 GDP was $1.73 trillion, making Region C account for almost one-third (31%) of the state's economy, as shown in **Figure 1.1**.

Chapter 6 of this plan has additional information on the Socio-Economic Study.

Figure 1.1 Gross Domestic Product by Regional Planning Area (2021 TWDB Socio-Economic Studies)



The DFW metro area is home to over 20 Fortune 500 companies. Additionally, 69 companies headquartered in the area posted revenue of $1 billion or more in 2018 [(3)]. Among the companies with corporate headquarters in DFW are Exxon Mobil, AT&T, American Airlines, Kimberly-Clark, Bank of America, and McKesson Corp, a pharmaceutical company which recently relocated from California to Irving/Las Colinas.

Region C is also home to Dallas-Fort Worth International Airport which handles around 67 million passengers per year, making it the 4th busiest airport in the US [(4)]. The DFW area attracts many visitors from around the state and country with its medical facilities and entertainment venues, including UT Southwestern Medical Center, Baylor Scott & White, Children's Medical Center, Cook Children's Hospital, AT&T Stadium, Globe Life Park, the Texas State Fair, and Texas Motor Speedway.

Food Production Companies in Region C

- Frito-Lay
- Borden Dairy
- Bimbo Bakeries (Mrs. Baird's)
- Mission Foods
- DFW Dr. Pepper Bottling Company
- PepsiCo
- Coors Miller
- Nestle Waters North America
- Daisy Brand
- Americas Beverage Company

Major Universities in Region C

- Southern Methodist University (SMU)
- Texas Christian University (TCU)
- University of North Texas
- University of Texas at Arlington
- University of Texas at Dallas
- Texas A&M Law School

Other Large Employers in Region C

- Lockheed Martin Aero
- Raytheon
- Bell Helicopter Textron
- Alcon Laboratories
- Naval Air Station (Ft Worth)

Margaret Hunt Hill Bridge in Dallas

1.2 Water-Related Physical Features in Region C

Most of Region C is located in the upper portion of the Trinity River Basin, with smaller parts in the Red, Brazos, Sulphur, and Sabine Basins. With the exception of the Red River Basin, the predominant flow of the streams is from northwest to southeast, as is true for most of Texas. The Red River flows west to east, forming the north border of Region C, and its major tributaries in Region C flow southwest to northeast. Major streams in Region C include the Brazos River, Red River, Trinity River, Clear Fork Trinity River, West Fork Trinity River, Elm Fork Trinity River, East Fork Trinity River, and numerous other tributaries of the Trinity River.

Average annual precipitation in Region C increases west to east from slightly more than 30 inches per year in western Jack County to more than 43 inches per year in the northeast corner of Fannin County [(5)]. **Table 1.2** lists the 22 reservoirs in Region C with conservation storage over 5,000 acre-feet (see **Figure 1.2**). These reservoirs and others outside of Region C provide most of the region's water supply. Reservoirs are necessary to provide a reliable surface water supply in this part of the state because of the wide variations in natural streamflow. Reservoir storage serves to capture high flows when they are available and save them for use during times of normal or low flow.

Figure 1.3 shows major and minor aquifers in Region C. The most heavily used aquifer in Region C is the Trinity aquifer, which supplies most of the groundwater used in the region. The Carrizo-Wilcox aquifer also outcrops in Region C in Navarro, Freestone, and Henderson Counties. Minor aquifers in Region C include the Woodbine aquifer, the Nacatoch aquifer, the Cross Timbers aquifer and a small part of the Queen City aquifer.

Table 1.2 Major Reservoirs in Region C (Over 5,000 Acre-Feet of Conservation Storage)

Reservoir	Basin	Stream	County(ies)	Permitted Conservation Storage [a] (Acre-Feet)	Owner	Water Right Holder(s)
Moss	Red	Fish Creek	Cooke	23,210	Gainesville	Gainesville
Texoma	Red	Red River	Grayson, Cooke	2,915,365	Corps of Engineers	Red River Authority, Greater Texoma UA, Denison, NTMWD, Luminant
Randell	Red	Unnamed Trib. Shawnee Creek	Grayson	5,400	Denison	Denison
Valley	Red	Sand Creek	Fannin, Grayson	15,000	Luminant	Luminant
Bonham	Red	Timber Creek	Fannin	13,000	Bonham MWA	Bonham
Coffee Mill	Red	Coffee Mill Creek	Fannin	8,000	USDA	U.S. Department of Agriculture
Kiowa	Trinity	Indian Creek	Cooke	7,000	Lake Kiowa POA Inc.	Lake Kiowa Property Owners Association, Inc.
Ray Roberts	Trinity	Elm Fork Trinity River	Denton, Cooke, Grayson	799,600	Corps of Engineers	Dallas and Denton
Lost Creek	Trinity	Lost Creek	Jack	11,961	Jacksboro	Jacksboro
Bridgeport	Trinity	West Fork Trinity River	Wise, Jack	387,000	TRWD	Tarrant Regional Water District
Lewisville	Trinity	Elm Fork Trinity River	Denton	618,400	Corps of Engineers	Dallas and Denton
Lavon	Trinity	East Fork Trinity River	Collin	443,800	Corps of Engineers	NTMWD
Weatherford	Trinity	Clear Fork Trinity River	Parker	19,470	Weatherford	Weatherford
Grapevine	Trinity	Denton Creek	Tarrant, Denton	161,250	Corps of Engineers	Dallas County Park Cities MUD, Dallas, Grapevine
Eagle Mountain	Trinity	West Fork Trinity River	Tarrant, Wise	210,000	TRWD	Tarrant Regional Water District
Worth	Trinity	West Fork Trinity River	Tarrant	38,124	Fort Worth	Fort Worth
Benbrook	Trinity	Clear Fork Trinity River	Tarrant	72,500	Corps of Engineers	Tarrant Regional Water District
Arlington	Trinity	Village Creek	Tarrant	45,710	Arlington	Arlington and Luminant
Joe Pool	Trinity	Mountain Creek	Dallas, Tarrant	176,900	Corps of Engineers	Trinity River Authority
Mountain Creek	Trinity	Mountain Creek	Dallas	22 ,840	Exelon	Exelon
North	Trinity	South Fork Grapevine Creek	Dallas	17,100	Coppell	Coppell
White Rock	Trinity	White Rock Creek	Dallas	21,345	Dallas	Dallas

[a]Data are from TCEQ water rights list [(6)] and other sources

Figure 1.2 Region C Location Map with Major Water Sources

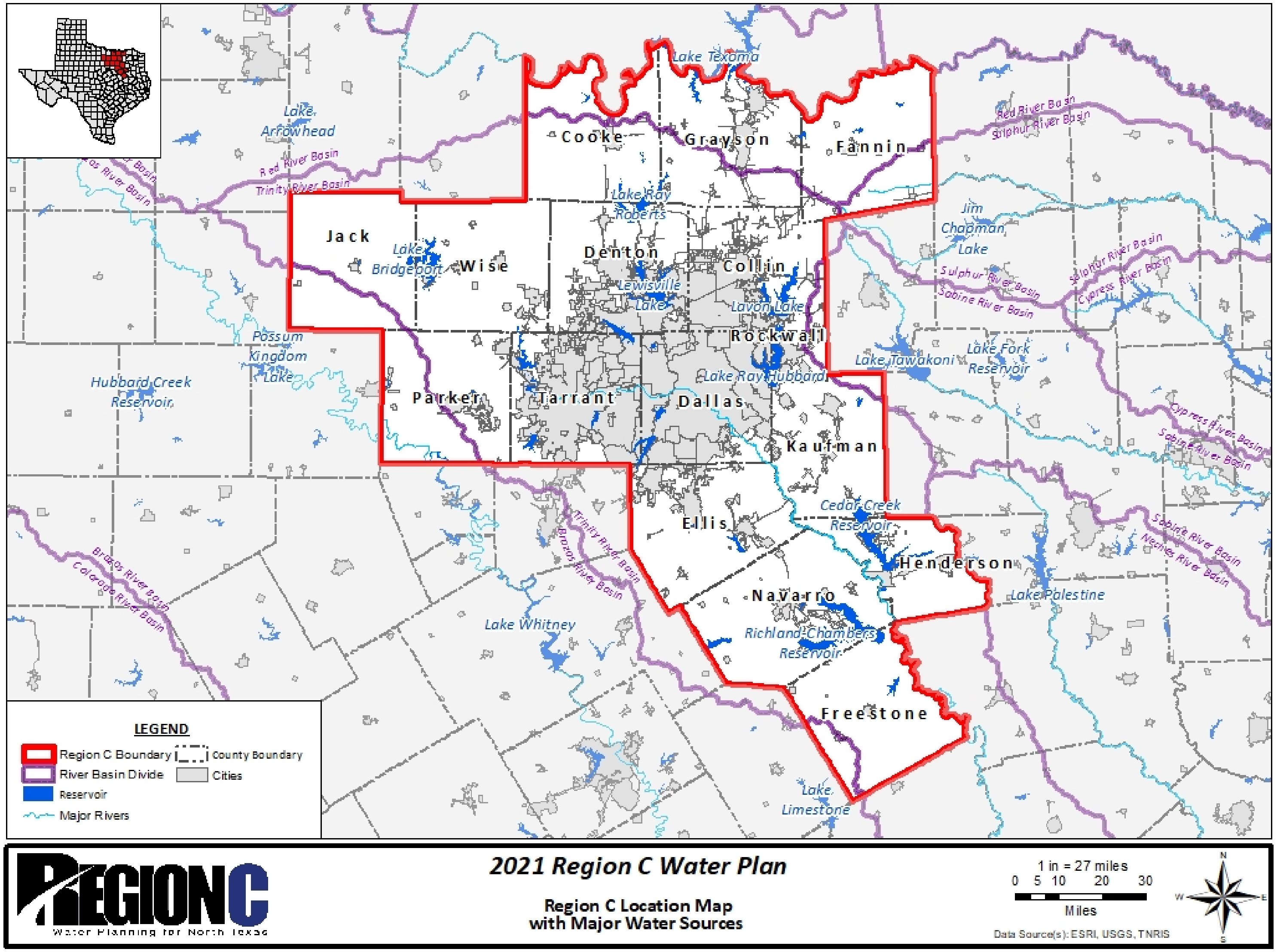


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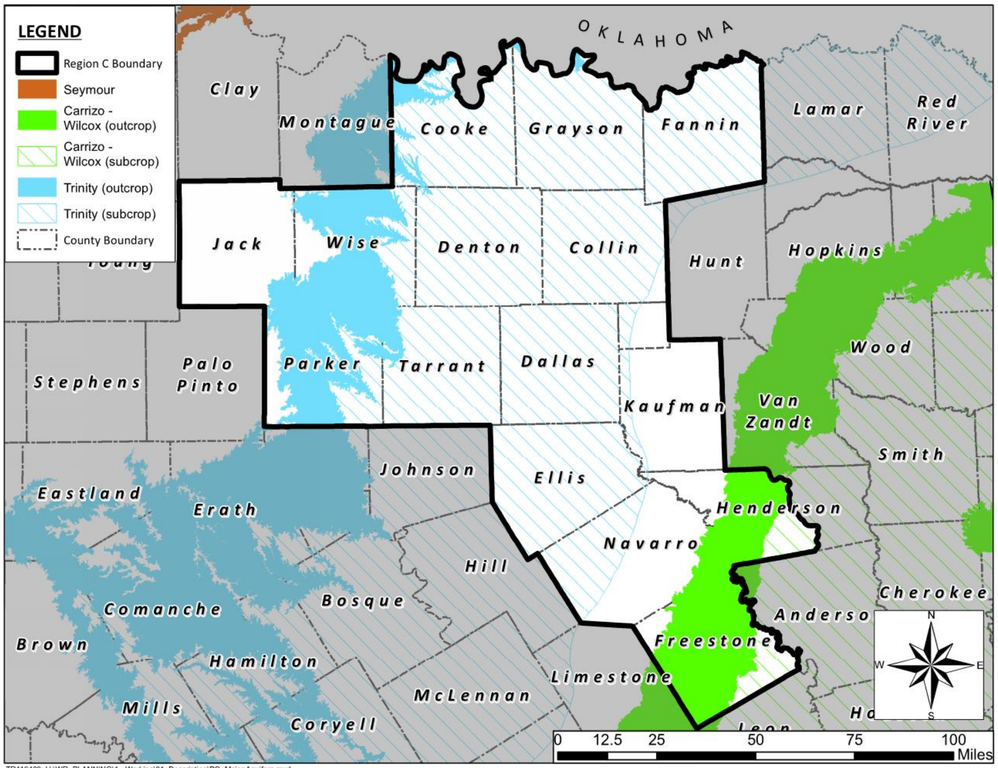
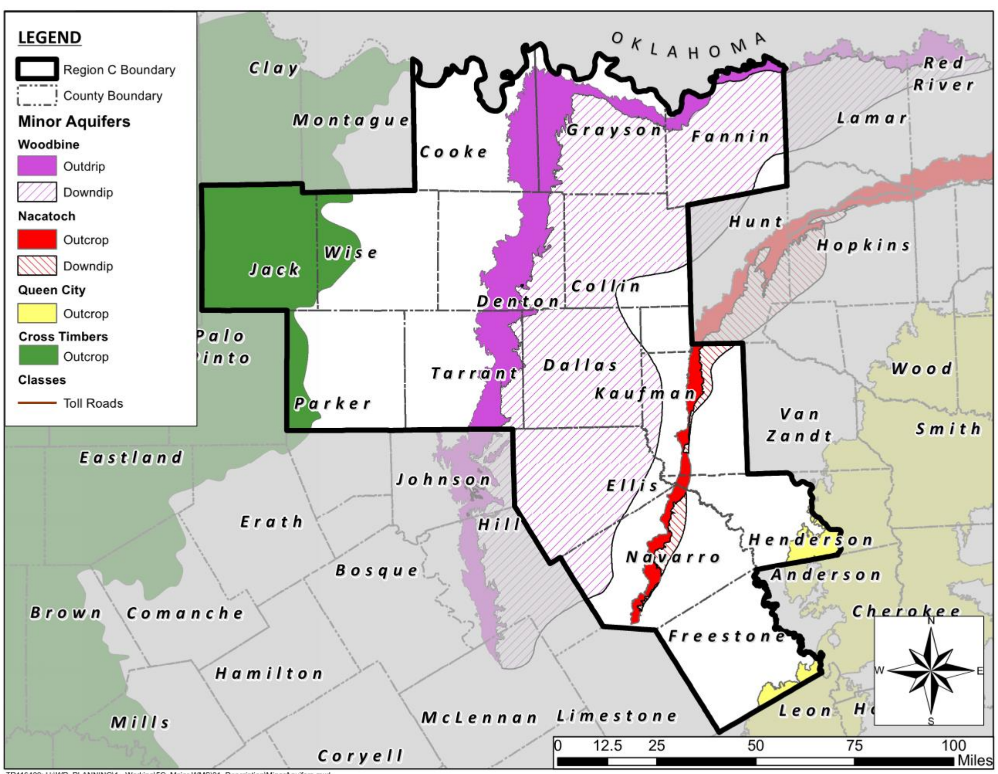
Figure 1.3 Major and Minor Aquifers in Region C





1.3 Current Water Uses and Demand Centers in Region C

Water use in Region C has increased in recent years, primarily in response to increasing population. The historical record shows years of high use, including 1996, 1998, 1999, 2000, 2006, and 2011. High use years have historically been associated with dry weather, which causes higher municipal use due to increased outdoor water use (lawn watering). While this has historically been the case, the water use characteristics during dry years are now beginning to change in Region C due to major changes in conservation practices across the region. Many water providers are now imposing permanent restrictions on outdoor watering, the most common restrictions being limiting the hours for lawn watering in the summer, limiting lawn watering to no more than twice per week, and prohibiting water waste.

The TWDB categorizes water use as municipal, manufacturing, steam electric power generation, mining, irrigation, and livestock. Municipal use is by far the largest category in Region C, accounting for 90 percent of the total use in 2016. There is limited steam electric, mining, manufacturing, irrigation, and livestock use in Region C. **Table 1.3** shows Region C water use by category for 2016 and Region C use as a percent of statewide use. It is interesting to note that Region C, with 26 percent of Texas' population, had only 9.4 percent of the state's water use in 2016. This is primarily because Region C has very limited water use for irrigation, while irrigation use is more than 55 percent of the total use for the state as a whole.

Table 1.4 shows the 2016 water use in Region C by category and by county. About 90 percent of the current water use in Region C is for municipal supply, with manufacturing use as the second largest category. The irrigation water use in Region C primarily represents the use of raw water for golf course irrigation, which TWDB classifies as irrigation, rather than municipal use. The 2016 water use in Tarrant and Dallas Counties was 60 percent of the total Region C use. In the same year, these two counties had 63 percent of the region's population and accounted for 66 percent of the employment of the region. The reuse shown in **Table 1.4** is mostly direct reuse. Most of the large-scale indirect reuse in Region C is included with surface water in the table.

In addition to the consumptive water uses discussed above, water is used for recreation and other purposes in Region C. Reservoirs for which records of visitors are maintained (primarily the U.S. Army Corps of Engineers lakes with recreational facilities) draw millions of visitors each year in Region C. In addition, smaller lakes and streams in the region draw many visitors for fishing, boating, swimming, and other water-related recreational activities. Water in streams and lakes is also important to fish and wildlife in the region.

Table 1.3 Historical Water Use by County and Category in 2016 for Region C

County	Values in Acre-Feet						
	Municipal	Manufacturing	Mining	Steam Electric Power	Irrigation	Livestock	Total
Collin	193,216	3,199	0	19	1,560	790	198,784
Cooke	4,625	51	0	5	462	1,516	6,659
Dallas	453,526	17,219	75	1,040	6,939	333	479,132
Denton	124,001	311	232	68	3,078	789	128,479
Ellis	24,089	4,741	0	734	2,934	934	33,432
Fannin	4,487	0	2,373	0	8,507	1,406	16,773
Freestone	2,583	31	114	15,019	341	1,173	19,261
Grayson	17,653	1,980	3	2,134	2,061	1,352	25,183
Henderson[(a)]	10,202	819	171	53	905	3,784	15,934
Jack	942	0	38	3,772	68	700	5,520
Kaufman	12,857	910	0	9,309	392	1,336	24,804
Navarro	7,334	638	606	0	2,016	1,473	12,067
Parker	15,137	49	360	0	1,162	1,523	18,231
Rockwall	13,064	5	0	0	7	137	13,213
Tarrant	314,159	9,598	337	875	3,694	413	329,076
Wise	6,851	169	1,526	1,944	1,123	1,325	12,938
Region C	**1,204,726**	**39,720**	**5,835**	**34,972**	**35,249**	**18,984**	**1,339,486**
Texas Total							**14,232,231**
Region C Total Water Use as a Percent of Statewide Water Use							**9.4%**

[a]*Data for Henderson County includes the entire county, not just the Region C portion.*
[b]*Data are from the Texas Water Development Board* [(7)].

Table 1.4 Historical Use by County and Category in 2016 for Region C

		Values in Acre-Feet						
County	**Water Type**	**Municipal**	**Manufacturing**	**Mining**	**Steam Electric Power**	**Irrigation**	**Livestock**	**Total**
Collin	Ground	4,908	278	0	0	644	40	5,870
	Surface	188,136	2,921	0	19	916	750	192,742
	Direct Reuse	172	0	0	0	0	0	172
	Total	193,216	3,199	0	19	1,560	790	198,784
Cooke	Ground	4,542	49	0	5	335	227	5,158
	Surface	83	2	0	0	127	1,289	1,501
	Direct Reuse	0	0	0	0	0	0	0
	Total	4,625	51	0	5	462	1,516	6,659
Dallas	Ground	5,194	674	8	63	3,522	283	9,744
	Surface	448,322	15,140	65	977	3,405	50	467,959
	Direct Reuse	10	1,405	2	0	12	0	1,429
	Total	453,526	17,219	75	1,040	6,939	333	479,132
Denton	Ground	11,712	0	44	0	952	237	12,945
	Surface	111,884	311	176	7	2,126	552	115,056
	Direct Reuse	405	0	12	61	0	0	478
	Total	124,001	311	232	68	3,078	789	128,479
Ellis	Ground	6,052	2,122	0	0	2,934	19	11,127
	Surface	17,395	2,619	0	734	0	915	21,663
	Direct Reuse	642	0	0	0	0	0	642
	Total	24,089	4,741	0	734	2,934	934	33,432
Fannin	Ground	2,962	0	0	0	1,650	1,266	5,878
	Surface	1,525	0	2,373	0	6,857	140	10,895
	Direct Reuse	0	0	0	0	0	0	0
	Total	4,487	0	2,373	0	8,507	1,406	16,773
Freestone	Ground	2,543	31	112	137	341	117	3,281
	Surface	40	0	2	14,882	0	1,056	15,980
	Direct Reuse	0	0	0	0	0	0	0
	Total	2,583	31	114	15,019	341	1,173	19,261

County	Water Type	Values in Acre-Feet Municipal	Manufacturing	Mining	Steam Electric Power	Irrigation	Livestock	Total
Grayson	Ground	8,410	753	2	0	1,879	338	11,382
	Surface	9,243	1,227	1	2,134	182	1,014	13,801
	Direct Reuse	0	0	0	0	0	0	0
	Total	17,653	1,980	3	2,134	2,061	1,352	25,183
Henderson [a]	Ground	4,512	146	160	0	770	481	6,069
	Surface	5,674	672	9	53	135	3,303	9,846
	Direct Reuse	16	1	2	0	0	0	19
	Total	10,202	819	171	53	905	3,784	15,934
Jack	Ground	285	0	7	2	18	105	417
	Surface	657	0	29	3,770	50	595	5,101
	Direct Reuse	0	0	2	0	0	0	2
	Total	942	0	38	3,772	68	700	5,520
Kaufman	Ground	411	819	0	0	63	67	1,360
	Surface	12,424	91	0	15	329	1,269	14,128
	Direct Reuse	22	0	0	9,294	0	0	9,316
	Total	12,857	910	0	9,309	392	1,336	24,804
Navarro	Ground	252	0	26	0	16	74	368
	Surface	7,082	638	579	0	2,000	1,399	11,698
	Direct Reuse	0	0	1	0	0	0	1
	Total	7,334	638	606	0	2,016	1,473	12,067
Parker	Ground	7,103	18	2	0	875	152	8,150
	Surface	7,992	31	358	0	287	1,371	10,039
	Direct Reuse	42	0	0	0	0	0	42
	Total	15,137	49	360	0	1,162	1,523	18,231
Rockwall	Ground	53	0	0	0	7	2	62
	Surface	13,011	5	0	0	0	135	13,151
	Direct Reuse	0	0	0	0	0	0	0
	Total	13,064	5	0	0	7	137	13,213

County	Water Type	Municipal	Manufacturing	Mining	Steam Electric Power	Irrigation	Livestock	Total
		Values in Acre-Feet						
Tarrant	Ground	13,368	83	56	0	2,137	62	15,706
	Surface	300,115	9,509	266	875	1,557	351	312,673
	Direct Reuse	676	6	15	0	0	0	697
	Total	314,159	9,598	337	875	3,694	413	329,076
Wise	Ground	3,522	113	18	0	1,080	265	4,998
	Surface	3,329	56	867	1,944	43	1,060	7,299
	Direct Reuse	0	0	641	0	0	0	641
	Total	6,851	169	1,526	1,944	1,123	1,325	12,938
Region C	**Ground**	**75,829**	**5,086**	**435**	**207**	**17,223**	**3,735**	**102,515**
	Surface	**1,126,912**	**33,222**	**4,725**	**25,410**	**18,014**	**15,249**	**1,223,532**
	Direct Reuse	**1,985**	**1,412**	**675**	**9,355**	**12**	**0**	**13,439**
	Total	**1,204,726**	**39,720**	**5,835**	**34,972**	**35,249**	**18,984**	**1,339,486**

[a]*Data for Henderson County include all of Henderson County, not just the Region C portion* [(7)].
[b]*Data are from the Texas Water Development Board* [(8)]*. Indirect reuse is included in Surface Water.*

1.4 Current Sources of Water Supply

Table 1.4 shows the groundwater, surface water, and direct reuse use by county and category for 2016. Note that indirect reuse in Region C is included as surface water in this table.

Table 1.4 illustrates some interesting points about water use in Region C in 2016.

- Although groundwater provided only 7.7 percent of the overall water use in Region C, it provided 49 percent of the irrigation use, 20 percent of the livestock use, and 13 percent of the manufacturing use.
- Groundwater provided the majority of the total water use in Cooke County and over 33 percent in Ellis, Fannin, Grayson, Henderson, Parker, and Wise Counties.
- Groundwater provided the majority of the municipal use in Cooke, Fannin, Freestone, and Wise Counties.
- Dallas and Tarrant Counties had 64 percent of the municipal water use in the region.
- Dallas and Tarrant Counties had 68 percent of the manufacturing water use in the region.
- Freestone County had almost 43 percent of the steam electric power water use in the region, with Kaufman County having the next highest steam electric power use at 27 percent.
- Dallas and Tarrant Counties had 30 percent of the irrigation use in the region.
- Fannin, Navarro, and Wise Counties had 77 percent of the mining use in the region.

1.4.1 Surface Water Sources

Most of the surface water in Region C comes from major reservoirs.

Table 1.5 lists the permitted conservation storage, and the permitted diversion for major reservoirs with over 5,000 acre-feet of conservation storage in the region.

Another major source of supply in Region C is surface water imported from other regions. **Table 1.6** lists currently permitted imports of water to Region C from other regions. No special permit is required if importation from another region does not involve interbasin transfers, but all significant imports to Region C, except for TRA's upstream sale from Lake Livingston, currently involve interbasin transfers and thus require interbasin transfer permits.

Figure 1.2 shows the surface water reservoirs that provide these imports. There is also small-scale importation of treated water in parts of the region, where suppliers purchase water that originates in other regions.

Lake Mineral Wells

Table 1.5 Water Rights, Storage, and Diversion for Major Reservoirs in Region C

Reservoir	County(ies)	Water Right Number(s) [a]	Permitted Conservation Storage [b] (Acre-Feet)	Permitted Diversion [b] (Acre-Feet/Yr)
Moss	Cooke	4881	23,210	7,740
Texoma	Grayson, Cooke	4301B, 4301C, 4898, 4899, 4901, 4900, 5003	2,915,365	306,600
Randell	Grayson	4901	5,400	5,280
Valley	Fannin, Grayson	4900	15,000	16,400
Bonham	Fannin	4925	13,000	5,340
Coffee Mill	Fannin	4915	8,000	0
Kiowa	Cooke	2334A, 2334C	7,000	234
Ray Roberts	Denton, Cooke, Grayson	2335A, 2455B	799,600	799,600
Lewisville	Denton	2348,2456	618,400	608,400
Lost Creek	Jack	3313A	11,961	1,440
Bridgeport	Wise, Jack	3808B,	387,000	17,000[c]
Eagle Mountain	Tarrant, Wise	3809	210,000	159,600[f]
Lavon	Collin	2410G	443,800	118,670[d]
Weatherford	Parker	3356	19,470	5,220[e]
Grapevine	Tarrant, Denton	2362A, 2363A, 2458C	161,250	160,750
Benbrook	Tarrant	5157A	72,500	6,833
Arlington	Tarrant	3391	45,710	23,120
Joe Pool	Dallas, Tarrant	3404C	176,900	17,000[d]
Mountain Creek	Dallas	3408	22,840	6,400
White Rock	Dallas	2461B	21,345	8,703
Ray Hubbard	Dallas, Kaufman, Rockwall	2462H	490,000	89,700
Terrell	Kaufman	4972	8,712	6,000
Bardwell	Ellis	5021A	54,900	9,600[d]
Waxahachie	Ellis	5018	13,500	3,570
Cedar Creek	Henderson, Kaufman	4976C	678,900	175,000[d]

Reservoir	County(ies)	Water Right Number(s) [a]	Permitted Conservation Storage [b] (Acre-Feet)	Permitted Diversion [b] (Acre-Feet/Yr)
Teague City Lake	Freestone	5291	1,160	605
Clark	Ellis	5019	1,549	450
Forest Grove	Henderson	4983	20,038	9,500[g]
Trinidad	Henderson	4970	6,200	4,000
Navarro Mills	Navarro	4992	63,300	19,400
Richland-Chambers	Freestone, Navarro	5030, 5035C	1,135,000	223,650[d]
Fairfield	Freestone	5040	50,600	14,150
Mineral Wells	Parker	4039	7,065	2,520
Muenster	Cooke	2323	4,700	500

[a]*Water rights numbers are Certificate of Adjudication (or application) numbers.*
[b]*Permitted conservation storage and permitted diversion are from TCEQ permits [(6)].*
[c]*Release of 78,000 acre-feet per year for diversion and use from Eagle Mountain Lake is also authorized.*
[d]*Permitted diversion does not include reuse.*
[e]*Diversion does not include 59,400 acre-feet per year of non-consumptive industrial use.*
[f]*Permitted diversion includes water releases from Lake Bridgeport.*
[g]*Permitted diversion does not include non-consumptive use.*

Table 1.6 Permitted Importation of Surface Water to Region C

Region C Supplier	Source	Source Region	Source Basin	Destination Basin	Permitted Amount (6) (Acre-Feet per Year)	Raw or Treated	Status
NTMWD	Chapman Lake[a]	D	Sulphur	Trinity	57,214	Raw	Operating
Irving	Chapman Lake[a]	D	Sulphur	Trinity	54,000	Raw	Operating
UTRWD	Chapman Lake[a]	D	Sulphur	Trinity	16,106	Raw	Operating
Dallas	Lake Tawakoni	D	Sabine	Trinity	184,600	Raw	Operating
Dallas	Lake Fork Reservoir	D	Sabine	Trinity	120,000	Raw	Operating
Dallas	Lake Palestine	I	Neches	Trinity	114,337	Raw	Not Yet Developed
Athens[b]	Lake Athens	I	Neches	Trinity	5,477	Treated	Operating
NTMWD	Lake Tawakoni	D	Sabine	Trinity	11,098	Raw	Operating
NTMWD	Lake Tawakoni and Lake Fork	D	Sabine	Trinity	40,000[d]	Raw	Operating
TXU Big Brown Plant	Lake Livingston[c]	H	Trinity	Trinity	20,000	Raw	Operating

[a]Chapman Lake was formerly Cooper Lake.
[b]Most of Athens is in the Trinity Basin.
[c]Use is an upstream diversion based on Lake Livingston water right. Contract allows 20,000 acre-feet per year, with a maximum of 48,000 acre-feet over 3 years.
[d]This is an interim supply.

1.4.2 Groundwater Sources

Table 1.7 lists the 2016 groundwater pumping by county and aquifer for Region C. Note that the pumping totals do not match use totals given in **Table 1.4**. The Texas Water Development Board (TWDB) supplied both sets of data. The discrepancy is assumed to be due to water that is pumped in one county and used in another. The Trinity aquifer is by far the largest source of groundwater in Region C, providing 44 percent of the total groundwater pumped in 2016. (The Trinity aquifer is sometimes called the Trinity Sands and includes the Antlers, Twin Mountain, Glen Rose, and Paluxy formations.) The Woodbine and Carrizo-Wilcox aquifers provided 24.7 and 7.3 percent of the 2016 totals, respectively. The remaining 24 percent came from the Nacatoch, Queen City, Blossom, Unknown/Other aquifers, and undifferentiated aquifers. The counties in which there are known to be several locally undifferentiated formations are Fannin (Red River Alluvium), Jack, and Parker. There may be other counties in which this is the case, but it is believed that the large 2016 use numbers from the unknown, other, and undifferentiated aquifers are likely to be from one of the named aquifers, but were not classified as such in the TWDB data. Groundwater pumping was highest (over 10,000 acre-feet) in Denton, Ellis, Grayson, and Tarrant Counties. These four counties had 51.3 percent of the region's total groundwater pumping in 2016.

Table 1.8 compares the modeled available groundwater supplies for the Trinity and Woodbine aquifers in Region C to 2016 use. The "modeled available groundwater" represents the amount of groundwater that can be pumped while maintaining stated "desired future conditions" in an aquifer. For Region C, the desired future conditions for the Trinity and Woodbine aquifer were set by Groundwater Management Area 8, a consortium of groundwater districts in North-Central and North Texas, covering most Region C and most of the area overlying the Northern Trinity and Woodbine aquifers. Once the desired future conditions were established, the TWDB determined the modeled available water that could be pumped while meeting those conditions. For planning purposes, TWDB regulations governing regional planning require that allocation of groundwater to water user groups be no more than the modeled available groundwater.

Table 1.8 shows that 2016 groundwater pumping exceeds the modeled available groundwater in certain Region C counties and aquifers. Pumping from the Woodbine aquifer in Dallas and Tarrant Counties; and the Trinity aquifer in Jack County exceeded the modeled available groundwater.

In Texas, groundwater conservation districts (GCD) manage groundwater conservation, preservation, protection, recharge, and waste prevention within their borders. Typical GCD responsibilities include permitting wells, developing management plans, and adopting rules to implement management plans.

Seven GCDs exist within the Region C boundaries. These GCDs are shown on **Figure 1.4.** The seven GCDs include:

- Mid-East Texas GCD, which includes Freestone County,
- Neches and Trinity Valley GCD, which includes Henderson County,
- Northern Trinity GCD, which comprises only Tarrant County,
- Upper Trinity GCD, which includes Parker and Wise Counties, as well as Montague County in Region B and Hood County in Region G,

- Prairielands GCD, which includes Ellis County,
- North Texas GCD, which is comprised of Collin, Cooke, and Denton Counties, and
- Red River GCD, which is comprised of Grayson and Fannin Counties.

A portion of Region C is located within the North-Central Texas Trinity and Woodbine Aquifers Priority Groundwater Management Area (PGMA). **Figure 1.5** is a map of this and other PGMAs in Texas. The above mentioned GCDs cover all counties in North-Central Texas Trinity and Woodbine Aquifers PGMA except Dallas County. Section 35.019 of the Texas Water Code allows the commissioners court of a county in a PGMA not covered by a GCD to adopt water availability requirements. As of this time, to the best knowledge of Region C, Dallas County commissioner's court has not promulgated any groundwater regulations or availability values.

1.4.3 Water Reclamation

About half of the water used for municipal supply in Region C is discharged as treated effluent from wastewater treatment plants after use, making wastewater reclamation and reuse a potentially significant source of additional water supply. There are currently a number of water reclamation direct reuse projects in Region C that reuse highly treated wastewater for non-potable uses such as the irrigation of golf courses, or industrial or mining uses. There are also a number of large-scale indirect reuse projects, notably TRWD and NTWMD wetlands reuse projects. In fact, currently authorized reuse makes up about 15 percent of the overall available supply in Region C.

In addition to direct and indirect reuse projects, there are sizable return flows of treated wastewater upstream from many Region C reservoirs. If a reservoir's water rights exceed its firm yield without return flows, as is the case for many Region C reservoirs, return flows will increase the reliable supply from the reservoir. If the reservoir's water rights do not exceed its firm yield, a water right must be obtained to allow indirect reuse of return flows. Many Region C suppliers have obtained or plan to obtain water right permits for these return flows.

1.4.4 Springs in Region C

There are no springs in Region C that are currently used as a significant source of water supply. Springs are further discussed in **Section 1.10** of this report.

Figure 1.4 Groundwater Conservation Districts in Region C

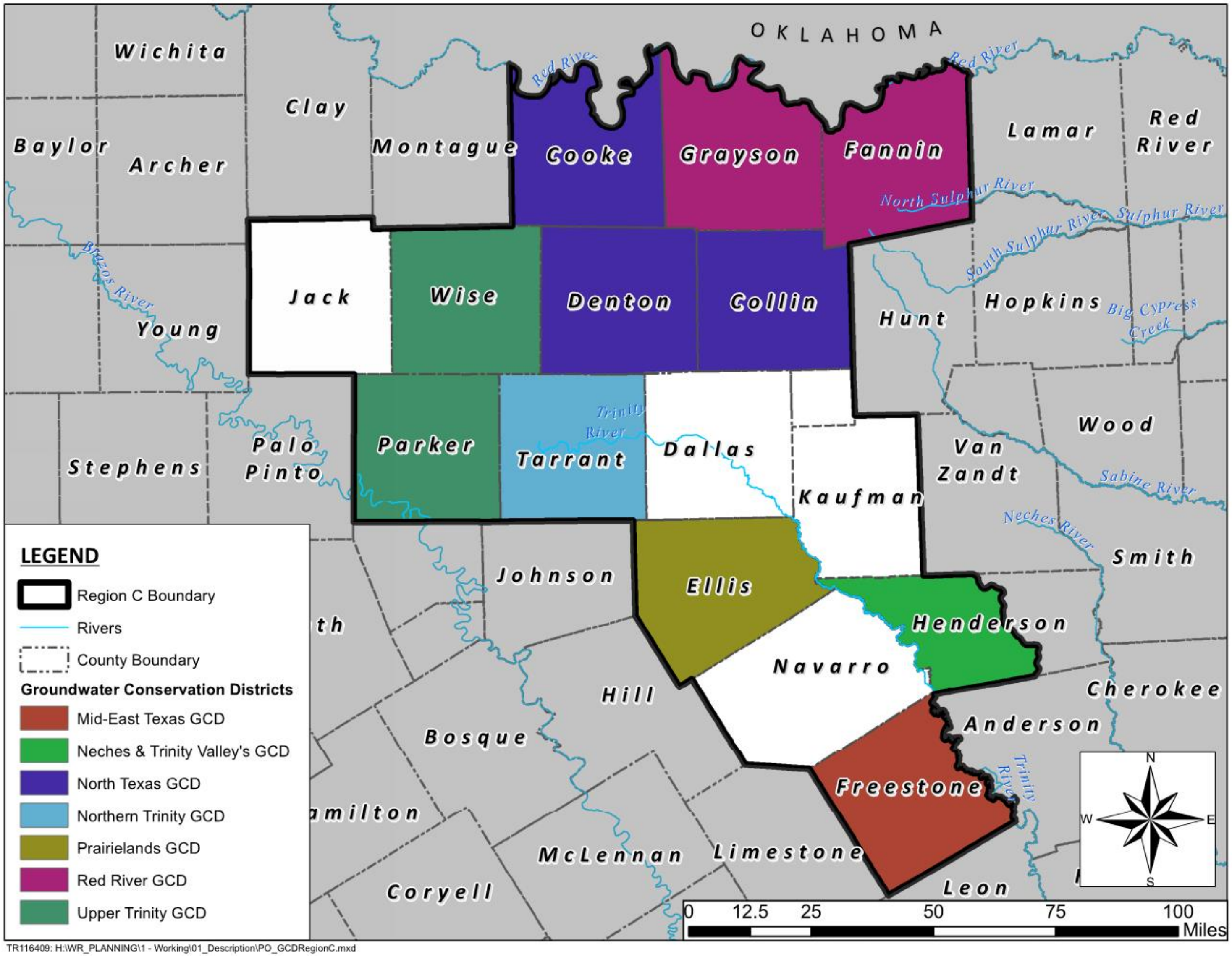


Table 1.7 2016 Groundwater Pumping by County and Aquifer in Region C

County	Values in Acre-Feet per Year[b]								
	Trinity Aquifer	Woodbine Aquifer	Carrizo-Wilcox Aquifer	Nacatoch Aquifer	Queen City Aquifer	Blossom Aquifer	Other Aquifer	Unknown	Total
Collin	1,934	3,091	0	0	0	0	586	0	5,611
Cooke	4,095	191	0	0	0	0	764	0	5,051
Dallas	2,006	5,980	0	0	0	0	1,536	7	9,530
Denton	8,021	2,140	0	0	0	0	2,973	44	13,178
Ellis	3,323	1,610	0	0	0	0	6,653	0	11,585
Fannin	168	3,948	0	0	0	372	1,595	0	6,083
Freestone	0	0	2,406	0	31	0	780	5	3,222
Grayson	4,714	5,548	0	0	0	0	1,704	2	11,968
Henderson [a]	0	0	5,080	3	632	0	167	35	5,918
Jack	4	0	0	0	0	0	406	7	416
Kaufman	0	0	0	93	0	0	448	0	541
Navarro	0	8	18	48	0	0	237	17	328
Parker	7,231	0	0	0	0	0	769	2	8,001
Rockwall	0	0	0	0	0	0	55	7	62
Tarrant	8,681	2,748	0	0	0	0	4,260	56	15,744
Wise	4,390	0	0	0	0	0	574	17	4,981
Total	**44,567**	**25,264**	**7,503**	**144**	**663**	**372**	**23,506**	**199**	**102,219**

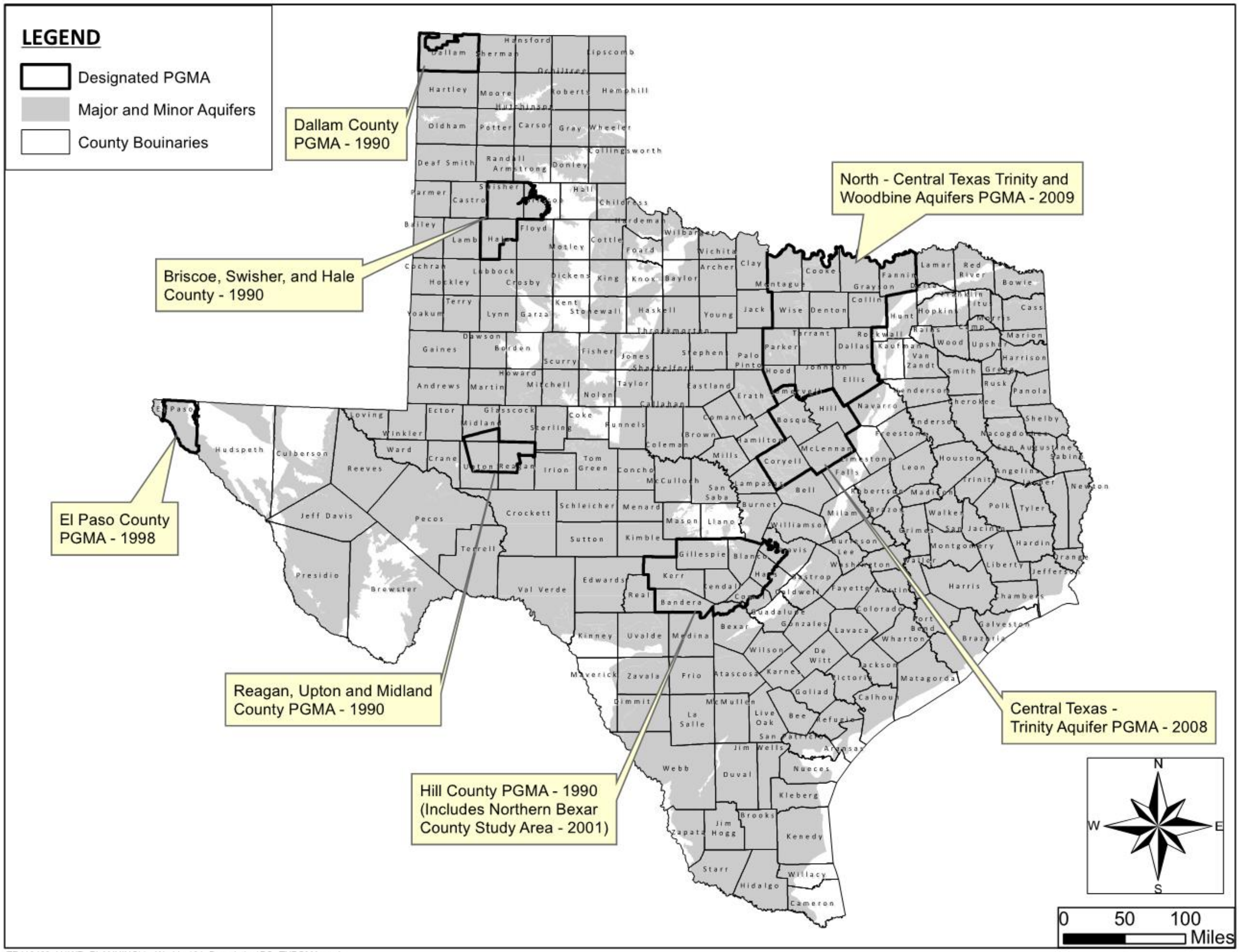
[a]*Includes all of Henderson County*
[b]*Data are from TWDB [(8)].*

Table 1.8 2016 Estimated Groundwater Pumping versus MAG

County	Trinity 2016 Pumping	Trinity Modeled Available Groundwater (9)	Trinity Over-Pumping	Woodbine 2016 Pumping	Woodbine Modeled Available Groundwater (9)	Woodbine Over-Pumping
	Values in Acre-Feet per Year[a]					
Collin	1,934	5,807	0	3,091	4,263	0
Cooke	4,095	10,544	0	191	802	0
Dallas	2,006	3,699	0	5,980	2,804	3,176
Denton	8,021	30,151	0	2,140	3,616	0
Ellis	3,323	5,539	0	1,610	2,078	0
Fannin	168	2,092	0	3,948	4,933	0
Freestone	0	0	0	0	0	0
Grayson	4,714	10,737	0	5,548	7,541	0
Henderson	0	0	0	0	0	0
Jack	4	0	4	0	0	0
Kaufman	0	0	0	0	0	0
Navarro	0	0	0	8	68	0
Parker	7,231	11,897	0	0	0	0
Rockwall	0	0	0	0	0	0
Tarrant	8,681	17,964	0	2,748	1,141	1,607
Wise	4,390	9,760	0	0	0	0
Total	**44,567**	**108,190**	**4**	**25,264**	**27,246**	**4,782**

[a]*Data are from TWDB* (8).

Figure 1.5 Priority Groundwater Management Areas (PGMAs) in Texas



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1.5 Water Providers in Region C (MWPs, RWPs, WWPs, and WUGs)

Water providers in Region C include wholesale water providers (WWPs) and water user groups (WUGs). WWPs deliver and sell wholesale (raw or treated) water to WUGs or other WWPs. Region C has designated six of the larger WWPs as major water providers (MWPs). Water user groups (WUGs) such as cities, water supply corporations, and special utility districts provide most of the retail water service in Region C, with significant contributions from WWPs.

1.5.1 Wholesale Water Providers (WWPs)

The TWDB defines the term wholesale water provider (WWP) as follows: "Any person or entity, including river authorities and irrigation districts, that delivers or sells water wholesale (treated or raw) to WUGs or other WWPs or that the RWPG expects or recommends to deliver or sell water wholesale to WUGs or other WWPs during the period covered by the plan. The RWPGs shall identify the WWPs within each region to be evaluated for plan development."

The blue box to the right lists the entities that have been designated by Region C as wholesale water providers. **Chapter 5** includes listings of each WWP's customers.

Major Water Providers

- Fort Worth
- Dallas (Dallas Water Utilities)
- North Texas Municipal Water District
- Tarrant Regional Water District
- Trinity River Authority
- Upper Trinity Regional Water District

Regional Wholesale Water Providers

- Corsicana
- Greater Texoma Utility Authority

Wholesale Water Providers

- Arlington
- Athens Municipal Water Authority
- Dallas County Park Cities MUD
- Denison
- Denton
- Ennis
- Forney
- Gainesville
- Garland
- Grand Prairie
- Mansfield
- Midlothian
- Mustang SUD
- North Richland Hills
- Princeton
- Rockett SUD
- Rockwall
- Seagoville
- Sherman
- Terrell
- Walnut Creek SUD
- Waxahachie
- Weatherford
- Wise County WSD

Major Water Providers (MWPs)

The new category of "major water providers" (MWP) was established in rules for the development of the 2022 State Water Plan in conjunction with the removal of certain reporting requirements to allow Regional Water Planning Groups (RWPGs) to establish a more consistent list of large water providers from cycle to cycle for which they are required to report information. MWPs are intended to reflect entities of particular significance to the region's water supply instead of reporting data for every WWP as previously required. The MWP designation may include public or private entities that provide water for any water use category.

Each RWPG is responsible for designating its own list of MWPs. In Region C, the RCWPG chose to designate based on top tier providers of existing and future supplies. In 2016 the following providers supplied 84 percent of Region C water and served 94 percent of Region C population: NTMWD, TRWD, DWU, UTRWD, GTUA, TRA, and the City of Fort Worth. This list of MWPs was approved by the RCWPG at its April 9, 2018 public meeting.

City of Fort Worth. The City of Fort Worth purchases all of its raw water from Tarrant Regional Water District and has water treatment plants with combined design capacity to treat 500 MGD. The City of Fort Worth sells wholesale treated water to other water suppliers, mostly located in Tarrant County.

Dallas Water Utilities (DWU). DWU currently obtains its water supplies from Lake Ray Hubbard, Lake Tawakoni, Grapevine Lake, the Lake Ray Roberts/Lewisville/Elm Fork system, and Lake Fork. Dallas Water Utilities has contracted with the Upper Neches River Municipal Water Authority to secure water from Lake Palestine, but Lake Palestine is not currently connected to DWU's system. Currently, DWU has the capacity to treat up to 900 million gallons of water per day (mgd) with another 100 mgd of treatment capacity under construction. DWU supplies treated and raw water to wholesale customers in Dallas, Collin, Denton, Ellis, and Kaufman Counties. In addition to providing treated water, DWU owns and operates two wastewater treatment plants.

North Texas Municipal Water District (NTMWD). NTMWD supplies treated water to customers in suburban communities north and east of Dallas. The district obtains raw water from water rights in Lake Lavon, Lake Texoma, and Chapman Lake, all of which are owned and operated by the U.S. Army Corps of Engineers. NTMWD also obtains water from Lake Tawakoni and Lake Fork through the Sabine River Authority (SRA). NTMWD has a permit to reuse treated wastewater effluent from its Wilson Creek Wastewater Treatment Plant and diversions from its East Fork Water Reuse Project. This supply is blended with other freshwater supplies in Lake Lavon. In addition to providing treated water, the NTMWD owns and/or operates a number of wastewater treatment plants in Region C.

Tarrant Regional Water District (TRWD). TRWD supplies raw water to customers in Tarrant County, eight other counties in Region C, and Johnson County in the Brazos G Region. TRWD owns and operates Lake Bridgeport, Eagle Mountain Lake, Cedar Creek Reservoir, and Richland-Chambers Reservoir. The district's water supply system also includes Lake Arlington (owned by Arlington), Lake Worth (owned by Fort Worth), and Benbrook Lake (owned by the U.S. Army Corps of Engineers, with TRWD holding water rights), a major reuse project, and a substantial water transmission system. The district also has commitments to supply water through TRA to users in Ellis County.

Trinity River Authority (TRA). The Trinity River Authority serves as a regional wholesale water supplier through a number of projects in Region C.

TRA holds water rights in Joe Pool Lake, Navarro Mills Lake, and Bardwell Lake, all owned and operated by the U.S. Army Corps of Engineers. TRA sells raw water from these lakes for use in Region C. TRA has contracts to sell Joe Pool Lake water to Midlothian, Duncanville, Cedar Hill, and Grand Prairie. TRA sells water from Navarro Mills Lake to the City of Corsicana and from Bardwell Lake to Ennis and Waxahachie.

TRA has a regional treated water system in northeast Tarrant County, which treats raw water delivered by the Tarrant Regional Water District system through Lake Arlington and sells treated water to cities. This system is known as the Tarrant County Water Supply Project.

TRA has a commitment to sell raw water provided by the Tarrant Regional Water District to water suppliers in Ellis County in the future and is now selling water to some Ellis County entities. This system is known as the Ellis County Water Supply Project. In addition to its raw and treated water sales, TRA operates a number of regional wastewater treatment projects in Region C.

Upper Trinity Regional Water District (UTRWD). UTRWD operates a regional treated water supply system in Denton County, which is a rapidly growing area. The UTRWD currently has a peak water treatment capacity of 90 million gallons per day. UTRWD has a contract with the City of Commerce to divert raw water from Chapman Lake in the Sulphur River Basin. UTRWD cooperates with the City of Irving to bring that water to Lewisville Lake. UTRWD also has contracts to buy raw water from Dallas and Denton and has an indirect reuse permit. UTRWD also has a Texas water right for Lake Ralph Hall, a proposed lake in Fannin County. In addition to its water supply activities, UTRWD provides regional wastewater treatment services in Denton County.

Other Wholesale Water Providers

In addition to the major water providers listed in the previous section, the RCWPG designated thirty other wholesale water providers. Twenty-six WWPs are located primarily within Region C and four are based primarily outside of Region C. Two of the WWPs, Corsicana and Greater Texoma Utility Authority, are considered Regional providers and are discussed in **Chapter 5D** of this report. The remaining WWPs located primarily inside Region C are discussed in **Chapter 5E** of this report.

The WWPs outside of Region C are discussed only briefly throughout this report and only in the context of water supply provided to Region C. They are the Sabine River Authority, the Upper Neches River Municipal Water Authority, the Sulphur River Municipal Water District, the Sulphur River Basin Authority (future provider), and the Red River Authority. Complete plans for these WWPs can be found in other Regional Plans.

Sabine River Authority (SRA). The Sabine River Authority is primarily located in Region D (the North East Texas Region) and Region I (the East Texas Region). However, SRA has contracts to supply water to several entities in Region C, the largest contracts being with Dallas Water Utilities. SRA has water supplies in Lake Fork Reservoir, Lake Tawakoni, Toledo Bend Reservoir, and the Sabine River Basin canal system. SRA has contracts with Region C entities for over 300,000 acre-feet per year.

Upper Neches River Municipal Water Authority (UNRMWA). The Upper Neches River Municipal Water Authority is located in Region I (the East Texas Region), where it owns and operates Lake Palestine. UNRMWA has contracted to supply up to 114,937 acre-feet per year to Dallas Water Utilities in Region C, but the facilities to connect the supplies have not yet been constructed.

Sulphur River Municipal Water District (SRMWD). The Sulphur River Municipal Water District is located in Region D (the North East Texas Region) and has water rights in Chapman Lake on the South Fork of the Sulphur River. The SRWD sells raw water to the UTRWD in Region C.

Sulphur River Basin Authority (SRBA). SRBA is located in Region D (the North

East Texas Region) and does not currently provide water supply to entities in Region C, but it is anticipated that SRBA will provide water from the Sulphur Basin to NTMWD, TRWD, and UTRWD and potentially supply water to DWU and Irving. At the request of SRBA, the Region C Water Planning Group voted to designate SRBA as a WWP on September 28, 2015.

Red River Authority (RRA). RRA owns and operates small water systems in 15 different counties, spanning five different regional planning areas (A, B, C, G, and O). In Region C, RRA has a system in Grayson County.

1.5.2 Water User Groups

Cities, towns, water supply corporations, and special utility districts provide most of the retail water service in Region C. The TWDB developed the term "water user group" (WUG) to identify entities that regional water planning groups must include in their plans. The TWDB states that a WUG is defined as one of the following:

- Retail public or private utilities that provide more than 100 acre-feet per year of water for municipal use
- Collective reporting units (CRUs) consisting of grouped utilities having a common association
- County-Wide WUGs
  - Includes County Other (Rural/unincorporated areas of municipal water use), Manufacturing, Steam electric power generation, Mining, Irrigation, Livestock

Table 1.9 Region C Number of Water User Groups by County

County	Municipal	Non-Municipal	Total
Collin	44	4	**48**
Cooke	10	5	**15**
Dallas	33	5	**38**
Denton	42	4	**46**
Ellis	25	5	**30**
Fannin	17	4	**21**
Freestone	9	5	**14**
Grayson	30	5	**35**
Henderson	13	5	**18**
Jack	3	4	**7**
Kaufman	26	5	**31**
Navarro	15	4	**19**
Parker	16	5	**21**
Rockwall	19	3	**22**
Tarrant	42	5	**47**
Wise	13	5	**18**
Adjustment for Multi-County WUGs[a]	-	-	***-67***
Total	**290**	**73**	**363**

[a]Multi-County WUG is a WUG with retail customers in more than one county.

1.6 Pre-Existing Plans for Water Supply Development

1.6.1 Previous Water Supply Planning in Region C

The region has a long history of successful local water supply planning and development. Significant plans for developing additional water supplies in Region C in the near future include the following:

Dallas Water Utilities plans to connect its currently unused supplies in Lake Palestine to its system by participating with Tarrant Regional Water District in the Integrated Pipeline Project.

Tarrant Regional Water District plans to expand the facilities that divert return flows of treated wastewater from the Trinity River into Cedar Creek Reservoir. TRWD also plans to complete the Integrated Pipeline Project in cooperation with Dallas Water Utilities to deliver additional water from East Texas.

North Texas Municipal Water District is constructing Bois d'Arc Lake and transmission and treatment facilities needed to develop that supply.

Several Region C water suppliers have received permits to reuse return flows of treated wastewater in Region C and are developing projects to use those supplies.

The Upper Trinity Regional Water District has received a water right permit for the proposed Lake Ralph Hall on the North Sulphur River in Fannin County and plans to continue permitting, design, and construction of facilities to develop that supply.

Region C water suppliers are considering the development of water supplies in the Sulphur Basin to the east. Alternatives include Lake Wright Patman, the proposed George Parkhouse Reservoirs (North and South), and the proposed Marvin Nichols Reservoir. The U.S. Army Corps of Engineers has ongoing studies to analyze options for water supply in the Sulphur River Basin.

Region C water suppliers are exploring obtaining water from existing sources in Oklahoma and from Toledo Bend Reservoir in East Texas.

Other Region C suppliers are planning and developing smaller water supply projects to meet local needs.

As discussed in **Section 1.4**, there has been increasing reuse of treated wastewater in Region C in recent years. There are several permits for significant indirect reuse projects in the region. Additionally, many of the reservoirs in Region C utilize indirect reuse of treated wastewater return flows in their watersheds, which increase reservoir yields. Direct reuse, often for irrigation of golf courses, is also increasing in the region. It is clear that reuse of treated wastewater will remain a significant part of future water planning for Region C.

1.6.2 Recommendations in the 2016 Region C Water Plan and the 2017 State Water Plan

The most significant recommendations for Region C in the *2016 Region C Water Plan* [10] and the 2017 State Water Plan [11] are summarized below. A more detailed discussion of the recommendations is available in the original documents.

A large part of the water supplied in Region C is provided by five water providers: Dallas Water Utilities, Tarrant Regional Water District, North Texas Municipal Water

District, Fort Worth, and the Trinity River Authority. In the *2016 Region C Water Plan* and the 2017 State Water Plan, these five entities are expected to provide the majority of the water supply for Region C through 2070.

Recommended water management strategies in the *2016 Region C Water Plan* and the 2017 State Water Plan to meet the needs of these major water providers include the following:

Dallas Water Utilities

- Conservation
- Main Stem Pump Station (Lake Ray Hubbard Indirect Reuse)
- Main Stem Balancing Reservoir (Indirect Reuse)
- Connect Lake Palestine (Integrated Pipeline, including connection to Bachman)
- Neches Run-of-River Supply
- Lake Columbia
- Infrastructure to Treat and Deliver to Customers

Alternative strategies for Dallas Water Utilities include: Lake Texoma Desalination, Toledo Bend Reservoir to the West System, Sulphur Basin Supplies, Red River Off Channel Reservoir, Sabine Conjunctive System Operation, direct reuse, and groundwater.

Tarrant Regional Water District

- Conservation
- Integrated Pipeline
- Wetlands Project at Cedar Creek Reservoir (Indirect Reuse)
- Lake Tehuacana
- Sulphur Basin Supplies
- Interim Purchase of Raw Water from DWU in 2060

Alternative Strategies for Tarrant Regional Water District include Toledo Bend Reservoir, Western Oklahoma, Marvin Nichols Reservoir.

North Texas Municipal Water District

- Conservation
- Removal of Silt Barrier to Chapman Lake Intake Station
- Dredge Lake Lavon
- Additional Measure to Access Full Yield of Lake Lavon
- Lake Chapman Booster Pump Station
- Main Stem Pump Station and Reuse
- Lower Bois d'Arc Creek Reservoir (now named Bois d'Arc Lake)
- Additional Lake Texoma Supplies (blending with new supplies)
- Sulphur Basin Supplies
- Toledo Bend Reservoir – Phase 1
- Fannin Water Supply System
- Oklahoma
- Develop additional water treatment capacity and treated water transmission system improvements as needed

Alternative strategies for North Texas Municipal Water District include accelerating Toledo Bend Reservoir Phase 2 and obtaining water from Lake O' the Pines, Lake Texoma Desalination, Groundwater in Freestone/Anderson Area (Forestar), Marvin Nichols Reservoir, George Parkhouse Reservoir North and South.

City of Fort Worth

- Conservation
- Additional supply from Tarrant Regional Water District
- Expand water treatment plants
- Direct reuse for industry, landscape irrigation, and steam electric power

Trinity River Authority

- Conservation

- Expansions of the Ellis County Water Supply Project
- Expand existing transmission facilities for the Las Colinas Reuse Project
- Develop indirect reuse for Ennis from Lake Bardwell
- Develop steam electric power supply in Dallas, Ellis, Freestone, and Kaufman Counties
- Develop reuse from Denton Creek WWTP for irrigation in Denton and Tarrant Counties
- Develop reuse from Denton Creek WWTP for municipal use in Tarrant County
- Develop indirect reuse through Joe Pool Lake
- Develop reuse from Central Regional WWTP to City of Irving
- Develop indirect reuse from Central Regional WWTP to NTMWD

In addition to the strategies recommended for the five major water providers above, the 2016 Region C plan included strategies for individual water user groups. Major types of strategies included the following:

- Conservation for all water user groups
- Continued development and expansion of existing regional water supply systems
- Connection of water user groups to larger regional systems
- Construction of additional water treatment capacity as needed
- Development of reuse projects to meet growing steam electric and other demands

The estimated capital costs for all recommended water management strategies in the *2016 Region C Water Plan* total $23.5 billion in 2013 dollars.

1.6.3 Conservation Planning in Region C

Since completion of the *2016 Region C Water Plan*, new water conservation legislation has passed, new water conservation data have become available, a new water conservation tool has been developed by TWDB, new water conservation studies have been produced, and the TWDB has updated the regional water planning rules [12]. Relevant water conservation legislation passed since the 2016 plan will influence recommended water conservation strategies in this plan. **Chapter 5B** of this plan summarizes new information, reports existing conservation and reuse in Region C, and presents recommended water conservation and reuse strategies for Region C.

During development of this plan, the Region C Water Planning Group placed strong emphasis on water conservation and reuse as a means of meeting projected water needs. Water conservation (demand reduction) appears in this plan in four ways:

Historical Water Demand Reduction. Since the first Region C Water Plan in 2001, the projected baseline 2020 per capita water demand for the region as a whole has decreased from 225 gallons per capita per day (gpcd) to 186 gpcd, largely due to water conservation efforts in the region.

Projected Passive Water Conservation Savings. The TWDB has projected municipal water savings that are expected to result from passive water conservation measures, including low-flow plumbing fixture rules, efficient new residential clothes washer standards, and efficient new residential dishwasher standards. Water savings from these measures will occur naturally and no WUG actions are needed to realize the savings. The water demand projections presented in **Chapter 2** are the baseline water demand projections minus the projected water savings from passive measures. Therefore, the projected water savings from passive measures are built into the Region C water demand projections. The projected passive water conservation savings represent 4.7 to 8.5 percent of the baseline water demand, depending on the planning decade.

Active Water Conservation Savings Since the Base Planning Year. As described in **Section 2.3**, the TWDB chose 2011 as the base planning year. Region C WUGs have continued to implement water conservation measures since 2011. The associated water savings have reduced water demand in Region C, but this demand reduction is not reflected in the Region C water demand projections.

Active Water Conservation During the Planning Period. The recommended water management strategies include active water conservation measures that are projected to save additional water during the planning period.

In addition, Region C continues to be a leader in the implementation of reuse strategies, increasing water efficiency and reducing the need to develop new water supplies. In the *2016 Region C Water Plan*, Region C accounted for one third of the State's current and recommended reuse supplies, more than any other region.

1.8 Other Water-Related Programs

In addition to the Senate Bill One regional planning efforts, there are a number of other significant water-related programs that will affect water supply efforts in Region C. Perhaps the most important are Texas Commission on Environmental Quality water rights permitting, the Clean Rivers Program, the Clean Water Act, and the Safe Drinking Water Act.

1.7 Preliminary Assessment of Current Preparations for Drought in Region C

The drought of record for most water supplies used in Region C occurred from 1950 through 1957. The drought of 2011 through early 2015 caused low inflows and low water levels for many Region C lakes. The recent dry summers in 1996, 1998, 1999, 2000, 2006, and 2011 placed considerable stress on water suppliers throughout Texas, including Region C. Many Region C water suppliers have already made or are currently making improvements to increase delivery of raw and treated water under drought conditions. Some smaller suppliers in Region C faced a shortage of supplies in the recent droughts.

Most of those entities have moved to address this problem by connecting to a larger supplier or by developing additional supplies on their own.

Most of the water conservation plans developed in response to TCEQ and TWDB requirements include a drought contingency plan. In addition to its regional planning provisions, Senate Bill One included a requirement that all public water suppliers and irrigation districts above a certain size develop and implement a drought contingency plan. Refer to **Chapter 7** for additional information on current preparations for drought in Region C.

Texas Commission on Environmental Quality (TCEQ) Water Rights Permitting. Surface water in Texas is a public resource, and the TCEQ is empowered to grant water rights that allow beneficial use of that resource. The development of any new surface water supply requires a water right permit. Among its many other provisions, Senate Bill One set out formal criteria for the permitting of interbasin transfers for water supply. Since many of the major sources of supply that have been considered for Region C involve interbasin transfers, these criteria are important in Region C planning.

Clean Rivers Program. The Clean Rivers Program is a Texas program overseen by TCEQ and funded by fees assessed on water use and wastewater discharge permit holders. The program is designed to provide information on water quality issues and to develop plans to resolve water quality problems. The Clean Rivers Program is carried out by local entities. In Region C, the program is carried out by river authorities: the Trinity River Authority in the Trinity Basin, the Red River Authority in the Red Basin, the Brazos River Authority in the Brazos Basin, the Sulphur River Basin Authority in the Sulphur Basin, and the Sabine River Authority in the Sabine Basin.

Clean Water Act. The Clean Water Act is a federal law designed to protect water quality. The parts of the act which have the greatest impact on water supplies are the National Pollutant Discharge Elimination System (NPDES) permitting process, which covers wastewater treatment plant and storm water discharges, and the Section 404 permitting program for the discharge of dredged and fill material into the waters of the United States, which affects construction for development of water resources. In Texas, the state has recently taken over the NPDES permitting system, renaming it the Texas Pollutant Discharge Elimination System (TPDES). The TPDES Program sets the discharge requirements for wastewater treatment plants and for storm water discharges associated with construction and industrial activities. The Section 404 permit program is handled by the U.S. Army Corps of Engineers. Section 404 permitting is a required step in the development of a new reservoir and is also required for pipelines, pump stations, and other facilities constructed in or through waters of the United States.

Safe Drinking Water Act (SDWA). The Safe Drinking Water Act is a federal program that regulates drinking water supplies. In recent years, new requirements introduced under the SDWA have required significant changes to water treatment. On-going SDWA initiatives will continue to impact water treatment requirements. Some of the initiatives that may have significant impacts in Region C are the reduction in allowable levels of trihalomethanes in treated water, the requirement for reduction of total organic carbon levels in raw water, and the reduction of the allowable level of arsenic in drinking water.

SDWA Groundwater Rules. The EPA has developed groundwater monitoring regulations as part of the SWDA. TCEQ is the agency responsible for implementing these rules in Texas and has developed a source sampling compliance program for groundwater systems which took effect on December 1, 2009. Requirements of this rule are meant to ensure that groundwater systems 1) conduct source water monitoring, 2) address significant deficiencies, 3) address source water fecal contamination, and 4) implement corrective actions. The Groundwater Rule has the potential to encourage entities on groundwater to consider alternative sources. Systems that utilize groundwater as a supplemental supply may find that the additional regulatory monitoring and reporting are more trouble than the supplemental supply is worth.

1.9 Water Loss Audits

TWDB water loss audit information for entities in Region C was compiled for 2015 through 2017 and is included in Appendix B.

The primary purposes of a water loss audit are to account for all of the water being used and to identify potential areas where water can be saved. Water audits track multiple sources of water loss that are commonly described as apparent loss and real loss. Apparent loss is water that was used but for which the utility did not receive compensation. Apparent losses are associated with customer meters under-registering, billing adjustment and waivers, and unauthorized consumption. Real loss is water that was physically lost from the system before it could be used, including main breaks and leaks, customer service line breaks and leaks, and storage overflows. The sum of the apparent loss and the real loss make up the total water loss for a utility (13). The water loss audits were considered in the development of water conservation recommendations. **Table 1.10** summarizes the water loss audit information from 2015 through 2017. More information on water loss audits is presented in **Chapter 5B**.

Table 1.10 Region C Water Loss Audits Summary by Gallons and Percent for 2015, 2016, and 2017

Year	System Input Volume	Authorized Consumption	Water Loss
2015	304,885,232,804	261,373,255,290 (85.7%)	43,511,977,514 (14.3%)
2016	301,957,907,957	263,797,132,009 (87.4%)	38,160,775,948 (12.6%)
2017	355,111,124,858	316,047,812,001 (89.0%)	39,063,312,857 (11.0%)

[a]*Data are from the Texas Water Development Board (14).*

1.10 Agricultural and Natural Resources in Region C

1.10.1 Springs in Region C

No springs in Region C are currently used as a significant source of water supply. Springs were important sources of water supply to Native Americans and in the initial settlement of the area and had great influence on the initial patterns of settlement. Groundwater development and the resulting water level declines have caused many springs to disappear and greatly diminished the flow from those that remain (15).

The TPWD has identified a number of small to medium-sized springs in Region C (16). **Table 1.11** shows the distribution and number of these springs as of 1980. Former springs are springs that have run dry due to groundwater pumping, sedimentation caused by surface erosion, or other causes (17).

Table 1.11 Distribution and Estimated Size of Springs and Seeps

County	Medium (2.8 – 28 cfs)	Small (0.28 – 2.8 cfs)	Very Small (0.028 – 0.28 cfs)	Seep (Less than 0.028 cfs)	Former
Collin	0	3	10	1	4
Cooke	0	3	9	3	1
Dallas	2	6	2	0	4
Denton	0	3	8	1	1
Ellis	0	0	0	0	1
Fannin	0	3	6	3	1
Grayson	0	2	12	1	1
Parker	0	8	3	2	6
Rockwall	0	0	1	0	2
Tarrant	3	6	1	3	5
Wise	0	7	4	3	2

[a]*Data are from Texas Parks and Wildlife Department* [(16)].

1.10.2 Wetlands

According to the regulatory definition of the U.S. Army Corps of Engineers [(18)], wetlands are "areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions." Areas classified as wetlands are often dependent on water from streams and reservoirs. Some of the important functions of wetlands include providing food and habitat for fish and wildlife, water quality improvement, flood protection, shoreline erosion control, and groundwater exchange, in addition to opportunities for human recreation, education, and research.

The Natural Resources Conservation Service (NRCS) has mapped and quantified areas of hydric soils for all but one of the counties in Region C. The agency makes these data available through its local county offices and, in some cases, publishes the acreages of soil series in the soil survey report for the county. Hydric soil is defined as "soil that in its undrained condition is saturated, flooded, or ponded long enough during the growing season to develop anaerobic conditions that favor the growth and regeneration of hydrophytic vegetation" [(19)]. Thus, the area of hydric soils mapped in a county provides an indication of the potential extent of wetlands in that county. However, as implied in the definition, some areas mapped as hydric soils may not occur as wetlands because the hydrology has been changed to preclude saturation or inundation. **Table 1.12** is a list of acreages of hydric soils for the counties in Region C for which the data are available.

The acreages of hydric soils listed in **Table 1.12** should be considered as an indicator of the relative abundance of wetlands in the counties and not as an absolute quantity.

Table 1.12 Hydric Soils Mapped by the Natural Resources Conservation Service

County	Total County Acreage	Hydric Soil Acreage within County [a]	Percent of County
Collin	565,760	45,125	7.98
Cooke	568,320	13,038	2.29
Dallas	577,920	111,090	19.22
Denton	611,200	21,066	3.45
Ellis	608,000	172,539	28.38
Fannin	574,080	121,458	21.16
Freestone	574,720	197,584	34.38
Grayson	627,840	24,745	3.94
Henderson [b]	604,800	150,895	24.95
Jack	588,800	96,897	16.46
Kaufman	517,760	45,125	8.72
Navarro	695,680	198,429	28.52
Parker	581,760	26,491	4.55
Rockwall	94,080	Not Available	
Tarrant	574,080	27,800	4.84
Wise	592,000	13,352	2.26

[a]*Data from U.S. Department of Agriculture* [(19)].
[b]*The values for Henderson County include all of Henderson County, not just the Region C portion.*

1.10.3 Endangered or Threatened Species

The Endangered Species Act (ESA) provides for the conservation of endangered or threatened species and their critical habitats. Recovery plans are created for each species to provide protocols, timelines, and costs for recovering endangered species. Federal agencies are required to ensure that their activities do not jeopardize listed species or their critical habitats. In addition, many federal agencies incorporate conservation of listed species into their existing authorities.

The U.S. Fish and Wildlife Service (USFWS) is the authority responsible for the federal listing of endangered and threatened species. The Texas Parks and Wildlife Department (TPWD) maintains a separate listing of species of special concern in the Texas Biological and Conservation Data System. **Table 1.13** lists federal endangered or threatened species identified by USFWS in Region C counties.

Table 1.14 lists species of special concern as identified at the state level and species that have limited range within the state. County designations indicate that a species is either known to occur or existing habitat is suitable to support a species in the particular county.

Table 1.13 Federal Endangered or Threatened Species in Region C

Species [a]	Federal Status [b]	County															
		Collin	Cooke	Dallas	Denton	Ellis	Fannin	Freestone	Grayson	Henderso	Jack	Kaufman	Navarro	Parker	Rockwall	Tarrant	Wise
Earth Fruit	T													x			
Eskimo Curlew	E		x														
Golden-Cheeked Warbler	E			x										x			
Houston Toad	E							x									
Least Tern	E	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Large Fruited Sand Verbena	E							x									
Navasota Ladies' Tresses	E							x									
Piping Plover	T	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Red Knot	T	x	x	x	x	x	x	x	x	x		x	x		x	x	x
Smalleye Shiner [c]	E																
Sharpnose Shiner [c]	E																
Texas Fawnsfoot	C													x			
Whooping Crane	E	x	x	x	x	x		x	x	x	x	x	x	x	x	x	x

[a] *Information obtained from U.S. Fish and Wildlife Service [(20)].*
[b] *E is federally listed as endangered; T is federally listed as threatened, C is federally listed as a candidate species.*
[c] *Species were updated in response to Texas Parks and Wildlife comment on 2021 Initially Prepared Plan.*
[d] *TPWD List last updated 08/25/2020*

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Table 1.14 State Species of Special Concern in Region C

Species [a]	State Status [b]	Collin [c]	Cooke [c]	Dallas [c]	Denton [c]	Ellis [c]	Fannin [c]	Freestone [c]	Grayson [c]	Henderson [c]	Jack [c]	Kaufman [c]	Navarro [c]	Parker [c]	Rockwall [c]	Tarrant [c]	Wise [c]
A cave obligate isopod	R	x		x													
A katydid	R					x											
Alligator snapping turtle	T	x		x		x		x		x		x			x	x	
American badger	R	X	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
American bumblebee	R	X	x	x	x	x	x		x		x	x	x	x	x	x	x
American eel	R			x					x								
Arethaea ambulator	R			x	x	x											
Bachman's Sparrow	T									x							
Bald eagle	R	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Big brown bat	R	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Bigflower cornsalad	R								x								
Big free-tailed bat	R				x						x			x		x	x
Black bear	T						x	x	x	x		x	x			x	
Black Rail	T	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Blackbelted crayfish	R									x							
Blackspot shiner	R							x									
Black-capped Vireo	R			x							x			x			
Black-tailed prairie dog	R		x		x						x			x		x	x
Blue sucker	T								x								
Bombus variabilis	R								x								
Brazos Heelsplitter	T													x			
Brazos water snake	T										x			x			
Cajun chorus frog	R					x			x	x							
Carrizo sands leather-flower	R									x							
Cave myotis bat	R			x		x							x			x	
Centerville Brazos-mint	R							x		x							
Chapman's yellow-eyed grass	R							x		x							
Chub shiner	T		x						x								

Species [a]	State Status [b]	Collin [c]	Cooke [c]	Dallas [c]	Denton [c]	Ellis [c]	Fannin [c]	Freestone [c]	Grayson [c]	Henderson [c]	Jack [c]	Kaufman [c]	Navarro [c]	Parker [c]	Rockwall [c]	Tarrant [c]	Wise [c]
Comanche harvester-ant	R			x				x						x		x	
Comanche Peak prairie-clover	R													x			x
Common garter snake	R	x	x	x	x	x			x					x	x	x	
Earleaf false foxglove	R													x		x	
Earth fruit	T													x			
Eastern box turtle	R	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	X
Eastern red bat	R	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	X
Eastern spotted skunk	R	x	x	x	x	x	x	x		x	x	x	x	x	x	x	x
Engelmann's bladderpod	R	x	x	x		x								x		x	x
Eskimo Curlew	E		x														
Franklin's gull	R	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Glandular gay-feather	R	x		x													
Glass Mountains coral-root	R			x													
Glen Rose yucca	R			x	x									x		x	
Golden-cheeked Warbler	E			x										x			
Goldenwave tickseed	R							x		x							
Goldeye	R		x				x		x								
Hall's baby bulrush	R													x			x
Hall's prairie clover	R		x	x		x	x		x					x		x	
Hoary bat	R	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Houston toad	E							x									
Interior Least Tern	E	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Ironcolor shiner	R									x							
Large beakrush	R							x		x							
Large-fruited sand-verbena	E							x									
Long-tailed weasel	R	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Louisiana pigtoe	T	x		x	x	x		x		x		x	x		x	x	x
Massasauga	R		x	x								x		x	x	x	x
Mexican free-tailed bat	R	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Mink	R	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x

Species [a]	State Status [b]	Collin [c]	Cooke [c]	Dallas [c]	Denton [c]	Ellis [c]	Fannin [c]	Freestone [c]	Grayson [c]	Henderson [c]	Jack [c]	Kaufman [c]	Navarro [c]	Parker [c]	Rockwall [c]	Tarrant [c]	Wise [c]
Mohlenbrock's sedge	R							x		x				x			
Mountain lion	R	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Mountain Plover	R		x		x						x			x		x	x
Navasota ladies'-tresses	E							x									
Northern scarlet snake	T									x							
Oklahoma grass pink	R									x							
Oklahoma phlox	R			x													
Orangebelly darter	R						x		x								
Osage Plains false foxglove	R		x	x										x		x	x
Paddlefish	T		x				x		x								
Panicled indigobush	R									x							
Parkhill Prairie crayfish	R	x															
Piping Plover	T	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Plains spotted skunk	R	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Plateau milkvine	R			x													
Quayle's butterweed	R													x			
Red river pupfish	T		x														
Red river shiner	R		x						x								
Red yucca	R	x															
Regal burrowing crayfish	R						x										
Reverchon's scurfpea	R		x											x		x	x
Rough-stem aster	R							x		x							
Rufa Red Knot	T	x	x	x	x	x	x	x	x	x		x	x		x	x	x
Sandbank pocketbook	T			x	x	x		x		x		x	x			x	x
Shinner's sedge	R		x									x				x	
Short-tailed shrew	R		x														x
Shovelnose sturgeon	T		x				x		x								
Shumard's morning glory	R		x														
Silver chub	R		x						x								
Slender glass lizard	R	x	x	x	x	x	x	x	x	x	x	x		x	x	x	x

Species [a]	State Status [b]	Collin [c]	Cooke [c]	Dallas [c]	Denton [c]	Ellis [c]	Fannin [c]	Freestone [c]	Grayson [c]	Henderson [c]	Jack [c]	Kaufman [c]	Navarro [c]	Parker [c]	Rockwall [c]	Tarrant [c]	Wise [c]
Small-headed pipewort	T							x		x							
Smooth softshell	R		x		x				x					x		x	
Southeastern myotis bat	R					x		x		x		x	x		x		
Southern Crawfish Frog	R	x				x	x	x	x	x		x	x		x		
Southern dusky salamander	R			x						x							
Southern hickorynut	T									x							
Southern short-tailed shrew	R	X	x		x	x	x	x	x	x		x	x		x	x	
Soxman's milkvetch	R									x							
Strecker's chorus frog	R	x	x	x	x	x	x		x	x	x	x	x	x	x	x	x
Swallow-tailed kite	T									x			x				
Swamp rabbit	R	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Texas fawnsfoot	T													x			
Texas garter snake	R	x		x	x	x					x			x	x	x	x
Texas heelsplitter	T	x	x	x	x			x	x	x		x	x		x	x	x
Texas horned lizard	T	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Texas kangaroo rat	T										x						
Texas milk vetch	R			x												x	
Texas pigtoe	T									x							
Texas sandmint	R							x		x							
Thirteen-lined ground squirrel	R	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Timber (canebrake) rattlesnake	R	x	x	x	x	x		x	x	x			x	x		x	x
Topeka purple-coneflower	R		x		x		x					x	x	x	x	x	x
Tree dodder	R			x													
Tricolored bat	R	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Trinity Pigtoe	T			x		x		x		x		x	x				
Turnip-root scurfpea	R													x			x
Warnock's coral-root	R			x													
Western box turtle	R	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Western Burrowing Owl	R	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Western hognose snake	R									x		x					x

Species [a]	State Status [b]	Collin [c]	Cooke [c]	Dallas [c]	Denton [c]	Ellis [c]	Fannin [c]	Freestone [c]	Grayson [c]	Henderson [c]	Jack [c]	Kaufman [c]	Navarro [c]	Parker [c]	Rockwall [c]	Tarrant [c]	Wise [c]
Western hog-nosed skunk	R	x		x	x	x								x	x	x	x
Western rattlesnake	R		x		x												
White-faced Ibis	T	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Whooping Crane	E	x	x	x	x	x		x	x	x	x	x	x	x	x	x	x
Wood Stork	T	x		x		x	x	x	x	x		x	x		x		
Woodhouse's toad	R	x	x	x	x	x	x	x	x		x	x	x	x	x	x	x
Woodland vole	R	X	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x

[a]*Information is obtained from TPWD [(21)] Rare, Threatened, and Endangered Species of Texas by Counties.*
[b]*E is endangered, T is threatened, R is rare.*
[c]*TPWD List last updated 08/25/2020.*

1.10.4 Stream Segments with Significant Natural Resources

In Region C, the TPWD has identified river and stream segments classified as having significant natural resources in their report *Ecologically Significant River and Stream Segments of Region C, Regional Water Planning Area* [22]. Stream segments have been placed on this list because they have been identified by TPWD as having one or more of the following: biological function, hydrologic function, riparian conservation area, high water quality/aesthetic value, or endangered species/unique communities. Out of 324 total streams identified within Region C, TPWD chose the ten as ecologically significant.

More information on streams and the consideration of Unique Stream Segments is presented in **Chapter 8**. The ten stream segments identified by TPWD as ecologically significant are:

- Bois d’Arc Creek (from the confluence with the Red River in Fannin County upstream to its headwaters in Eastern Grayson County)
- Brazos River (from a point 330 feet upstream of FM 2580 in Parker County upstream to the Parker/Palo Pinto County line)
- Buffalo/Linn Creek [from the confluence with Alligator Creek upstream to State Route 164 (Buffalo Creek) and from the confluence with Buffalo Creek upstream to County Road 691 (Linn Creek)]
- Clear Creek (from the confluence with the Elm Fork of the Trinity River northeast of Denton in Denton County upstream to the Denton/Cooke County line)
- Coffee Mill Creek (from the confluence with Bois d’Arc Creek in Fannin County upstream to its headwaters)
- Elm Fork (from a point 110 yards upstream of U.S. 380 in Denton County upstream to Ray Roberts Dam in Denton County)
- Elm Fork (from the confluence with the West Fork of the Trinity River in Dallas County upstream to California Crossing Road in Dallas County)
- Lost Creek (from the confluence with the West Fork of the Trinity River upstream to its headwaters in Jack County)
- Purtis Creek (from the Henderson County line upstream to its headwaters)
- Trinity River (from Interstate Highway 45 in Dallas County upstream to MacArthur Boulevard in Dallas County)

1.10.5 Navigation

There is very little commercial navigation in Region C. However, the U.S. Army Corps of Engineers has defined two stretches of river in Region C that qualify as “navigable”. In the Red River Basin, the segment of the Red River from Denison Dam forming Lake Texoma upstream to Warrens Bend in Cooke County is defined as navigable. In the Trinity River Basin, the Trinity River has a reach that is considered to be “navigable” from the southeastern border of Freestone County up to Riverside Drive in Fort Worth. While these rivers meet the legal definition of navigable waters, they are not currently used for this purpose.

1.10.6 Agriculture and Prime Farmland

Table 1.15 provides some basic data on agricultural production in Region C, based on the 2017 Agricultural Census from the U.S. Department of Agriculture (USDA). Region C includes over 6,054,000 acres of farmland and over 1,845,000 acres of cropland. Irrigated agriculture does not play a significant role in Region C, with only 2 percent of the harvested cropland being irrigated.

The Natural Resources Conservation Service (NRCS) defines prime farmland as "land that has the best combination of physical and chemical characteristics for producing food, feed, forage, fiber, and oilseed crops and is also available for these uses [23]." As part of the National Resources Inventory, the NRCS has identified prime farmland throughout the country. **Figure 1.6** shows the distribution of prime farmland in Region C. Each color in **Figure 1.6** represents the percentage of the total acreage that is prime farmland of any kind. (There are four categories of prime farmland in the NRCS STATSGO database for Texas: prime farmland, prime farmland if drained, prime farmland if protected from flooding or not frequently flooded during the growing season, and prime farmland if irrigated.) There are large areas of prime farmland in Cooke, Denton, Collin, Tarrant, Dallas, and Ellis Counties. There are localized areas of irrigated agriculture in Region C. **Table 1.4** shows that 49 percent of the 2016 water use for irrigation in Region C came from groundwater (compared to only 8 percent of total water use from groundwater.) TWDB Report 269 [24] studied groundwater in most of Region C (except for Jack and Henderson Counties and part of Navarro County). Most irrigation wells in the study area were scattered over the outcrop areas of the Trinity and the Woodbine aquifers with only a few areas of concentrated activity. The largest concentration of irrigation wells is located on the Woodbine outcrop in an area bounded by western Grayson County, the eastern edge of Cooke County, and the northeastern corner of Denton County. Approximately 80 irrigation wells operated in this region (as of 1982), and several produced as much as 900 gpm. Several smaller irrigation well developments were located in Parker County and Wise County in the Trinity aquifer. There were also irrigation wells in Fannin County producing from the alluvium along the Red River.

1.10.7 State and Federal Natural Resource Holdings

The TPWD operates several state parks in Region C:

- Bonham State Park in Fannin County,
- Cedar Hill State Park in Dallas County,
- Eisenhower State Park in Grayson County, Fairfield Lake State Park in Freestone County, Fort Richardson State Park & Historic Site in Jack County,
- Lake Mineral Wells State Park in Parker County,
- Lake Ray Roberts State Park in Denton and Cooke Counties, and
- Purtis Creek State Park partially located in Henderson County.

TPWD also operates:

- Caddo Wildlife Management Area in Fannin County,
- Cedar Creek Islands Wildlife Management Area in Henderson County,
- Ray Roberts Wildlife Management Area in Cooke, Denton, and Grayson Counties, and

- Richland Creek Wildlife Management Area in Freestone and Navarro Counties.

Federal government natural resource holdings in Region C include the following:

- Parks and other land around all of the U.S. Army Corps of Engineers lakes in the region (Texoma, Ray Roberts, Lewisville, Lavon, Grapevine, Benbrook, Joe Pool, Bardwell, and Navarro Mills)
- Hagerman National Wildlife Refuge on the shore of Lake Texoma in Grayson County
- Caddo National Grasslands in Fannin County
- Lyndon B. Johnson National Grasslands in Wise County.

Area reservoirs provide a variety of recreational benefits, as well as water supply. **Table 1.16** lists the reservoirs located in Region C that have national or state lands associated with them and the recreational opportunities available at these sites. Recreational activities typically found at these sites include camping, fishing, boating, hiking, swimming, and picnicking.

Eisenhower State Park, photo courtesy of TPWD

Table 1.15 2017 U.S. Department of Agriculture County Data[a]

	Collin	Cooke	Dallas	Denton	Ellis	Fannin	Freestone	Grayson	Henderson[b]
Farms	2,706	2,284	775	3,295	2,551	2,255	1,459	2,845	1,988
Land in Farms (acres)	280,790	492,329	63,949	359,442	473,413	481,997	414,112	429,933	310,355
Crop Land (acres)	140,348	135,648	26,100	143,967	221,498	212,366	55,720	207,019	86,645
Harvested Crop Land (acres)	95,768	89,881	18,080	104,555	190,064	158,613	37,376	158,001	58,826
Irrigated Crop Land (acres)	993	940	465	2,913	2,394	4,894	1,302	2,299	1,614
Market Value ($1,000)									
-Crops	29,538	12,791	25,914	24,242	53,457	43,847	4,659	40,260	11,645
-Livestock	37,291	41,039	3,867	98,967	19,689	42,445	63,472	25,911	28,538
-Total	66,829	53,830	29,781	123,209	73,146	86,292	68,131	66,171	40,183

	Jack	Kaufman	Navarro	Parker	Rockwall	Tarrant	Wise	Total
Farms	870	2,778	2,471	4,626	403	1,173	3,697	**36,176**
Land in Farms (acres)	467,575	455,021	558,947	521,702	40,384	190,682	513,946	**6,054,577**
Crop Land (acres)	34,218	133,585	178,564	95,080	20,980	43,487	110,550	**1,845,775**
Harvested Crop Land (acres)	13,301	98,770	128,554	54,874	19,461	19,632	69,072	**1,314,828**
Irrigated Crop Land (acres)	846	1,710	1,674	1,693	125	1,263	4,508	**29,633**
Market Value ($1,000)								
-Crops	1,413	15,386	33,646	12,155	6,187	17,445	11,577	**344,162**
-Livestock	21,763	41,677	39,660	52,888	1,643	11,948	34,692	**565,490**
-Total	23,176	57,063	73,306	65,043	7,830	29,393	46,269	**909,652**

[a]*Data are from the U.S. Department of Agriculture* [(25)].

[b]Data for Henderson County are for the entire county.

Figure 1.6 Percent Prime Farmland in Region C

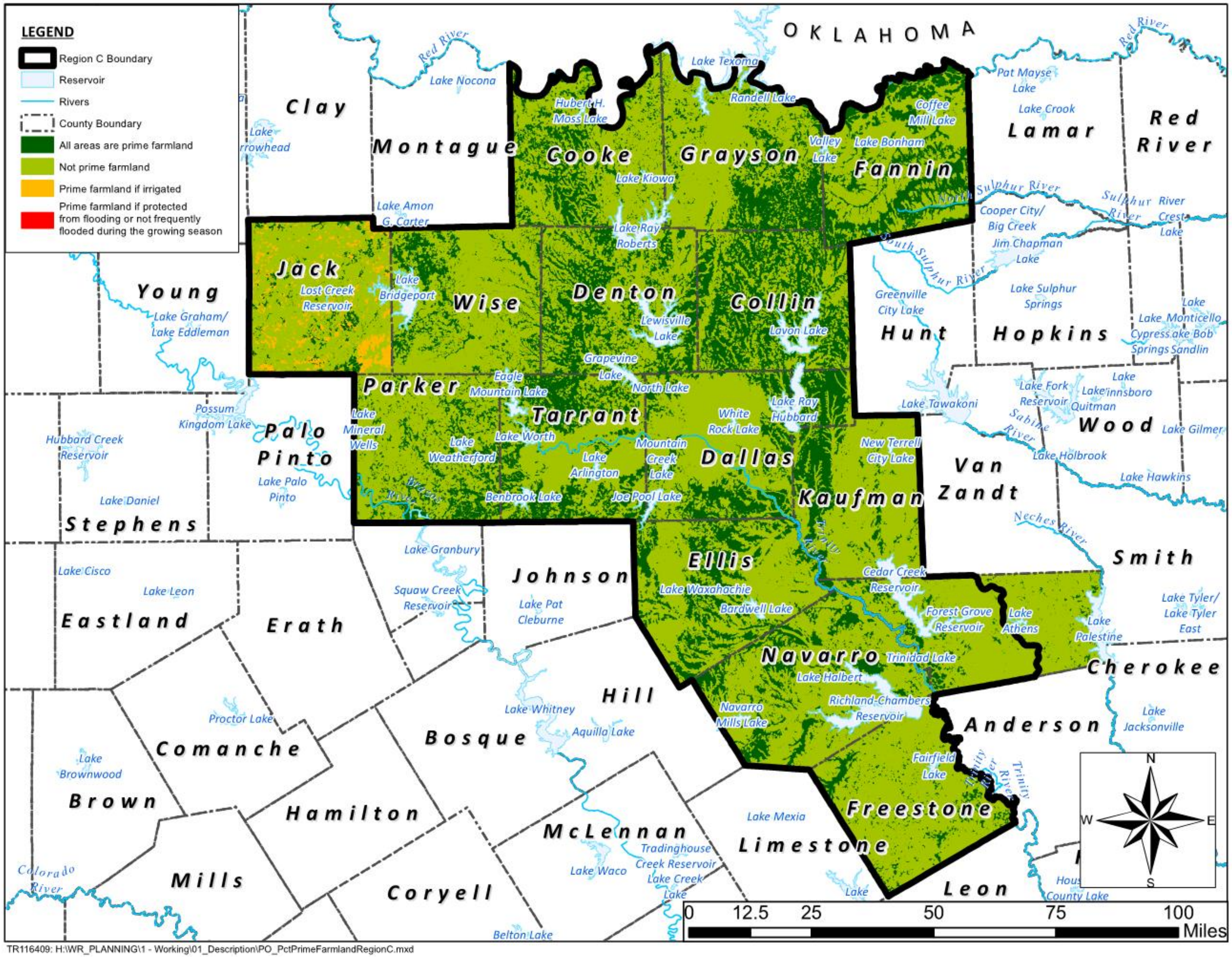


Table 1.16 Recreational Activities at Region C Reservoirs [a]

Reservoir	National Lands	State Lands	Camping	Fishing	Boating	Hiking/Nature Trails	Hunting	Swimming	Picnic Sites	Bicycling Trails	Equestrian Trails	Playgrounds
Lavon	X		X	X	X	X	X	X	X	X	X	
Texoma	X	X	X	X	X	X	X	X	X	X	X	X
Bonham		X	X	X	X	X		X	X	X		X
Ray Roberts	X	X	X	X	X	X	X	X	X	X	X	X
Lewisville	X		X	X	X	X	X	X	X	X	X	
Benbrook	X		X	X	X	X	X	X	X	X	X	
Grapevine	X		X	X	X	X	X	X	X	X	X	
Joe Pool	X	X	X	X	X	X		X	X	X	X	X
Bardwell	X		X	X	X	X	X	X	X	X	X	
Navarro Mills	X		X	X	X	X	X	X	X			
Fairfield		X	X	X	X	X		X	X	X	X	X
Mineral Wells		X	X	X	X	X		X	X	X	X	X
Lost Creek Reservoir		X	X	X	X	X		X	X	X	X	
Cedar Ck. Reservoir		X	X	X	X	X		X	X	X		

[a]*Data taken from Texas Atlas, Texas Parks and Wildlife Department, and U.S. Army Corps of Engineers [26, 26, 27].*

Lake Fairfield State Park, photo courtesy of TPWD

1.10.8 Oil and Gas Resources

Oil and natural gas fields are significant natural resources in portions of Region C.

As of February 2019, five counties within Region C had 1,500 or more regular producing gas wells (Denton, Freestone, Parker, Tarrant and Wise), with Wise County having the most at 4,213 [(28)]. As of February 2019, two counties within Region C had 1,400 or more regular producing oil wells (Cooke and Jack) and two Counties had between 500 and 1,000 regular producing oil wells (Grayson and Navarro).

1.10.9 Lignite Coal Fields

There are some lignite coal resources in Region C [(29)]. Paleozoic rocks with bituminous coal deposits underlie most of Jack County and small portions of Wise and Parker Counties. Near surface (to 200 feet in depth) lignite deposits in the Wilcox Group underlie significant portions of Freestone, Navarro, and Henderson Counties. Deposits of deep basin lignite (200 - 2,000 feet in depth) in rocks of the Wilcox Group underlie a significant portion of Freestone County. The most significant current lignite production in Region C is from the near surface Wilcox Group deposits in Freestone County [(30)].

Oil Pumpjack

1.11 Summary of Threats and Constraints to Water Supply in Region C

The most significant potential threats to existing water supplies in Region C are surface water quality concerns, climate variability, groundwater drawdown, groundwater quality, and invasive species. Constraints on the development of new supplies include the availability of sites and unappropriated water for new water supply reservoirs and the challenges imposed by environmental concerns and permitting.

1.11.1 Need to Develop Additional Supplies

Most of the water suppliers in Region C will have to develop additional supplies before 2070. The major water suppliers have supplies in excess of current needs, but they will require additional supplies to meet projected growth in the near future. Some smaller water suppliers face a more urgent need for water. Their needs can be addressed by local water supply projects or by purchasing water from a major water supplier.

1.11.2 Surface Water Quality Concerns

The Texas Commission on Environmental Quality (TCEQ) publishes the *Texas Integrated Report of Surface Water Quality* every two years in accordance with the schedule mandated under Section 303(d) and 305(b) of the Clean Water Act. The latest EPA-approved edition of the Water Quality Inventory was approved by the EPA in May 2013 [31]. The TCEQ has also established a list of stream segments for which it intends to develop total maximum daily load (TMDL) evaluations to address water quality concerns. None of the proposed TMDL studies in Region C are due to concerns related to public water supply. Most are due to general use, aquatic life, contact recreation, and fish consumption.

Many of the water supply reservoirs in Region C are experiencing increasing discharges of treated wastewater in their watersheds. To date, this has not presented a problem for public water supplies, but increased amounts of wastewater and greater nutrient loads may lead to concerns about eutrophication in some lakes. Some of the largest wastewater treatment plants are on the Trinity River in the Dallas-Fort Worth Metroplex and do not discharge into the watershed of any Region C reservoir. However, there are existing and proposed projects to withdraw water from rivers downstream of municipal wastewater treatment plants, polish the water with wetlands treatment, and convey the water to Region C water supply reservoirs. Additionally, there are significant permitted discharges upstream from many reservoirs in the region, and return flows are tending to increase with time.

In December 1998, the U.S. EPA published the *Stage 1 Disinfectants and Disinfection Byproducts (D/DBP) Rule* [32], which applies to water systems that treat surface water with a chemical disinfectant. This rule sets forth Maximum Contaminant Levels (MCLs) for a number of different contaminants including total organic carbon, trihalomethane, haloacetic acid, and dissolved solids. Under certain circumstances, the rule mandates the use of enhanced coagulation to remove total organic carbon (TOC), an indicator of potential disinfection byproduct formation. Effective January 1, 2004, all community and nontransient, noncommunity systems were required to comply with the MCLs for TTHM (0.080 milligrams per liter, or mg/l) and HAA5 (0.060 mg/l) based on the running annual average for the entire distribution system.

In January 2006, the U.S. EPA published the *Stage 2 Disinfectants and Disinfection Byproducts (D/DBP) Rule*, which requires utilities to evaluate their distribution systems to identify locations with high DBP concentrations. The utilities will then use these locations as sampling sites for DBP compliance monitoring [33]. This rule requires compliance with the MCLs for TTHM and HAA5 at each monitoring location.

The Long Term 2 Enhanced Surface Water Treatment Rule (LT2ESWTR) [34] is a companion rule to Stage 2 DBPR. This rule requires additional Cryptosporidium treatment techniques for higher-risk systems as well as provisions to reduce risks from uncovered finished water reservoirs and provisions to ensure that microbial protection is maintained when DBP concentrations are decreased.

Dissolved solids in the Red River and Lake Texoma along the northern boundary of Region C are generally high in comparison to other current Region C supplies. The use of Lake Texoma water for public supply requires desalination (Sherman, Red River Authority Preston Shores) or blending with higher quality water (NTMWD, Denison). This requirement has limited the use of water from the Red River and Lake Texoma for public water supply. The Red River Authority is serving as a local sponsor for the Red River Chloride Control Project, which may serve to improve the quality of Lake Texoma water for public water supply by diverting saline water before it reaches the lake. Before any of the chloride control efforts were initiated, about 3,450 tons per day of chlorides entered the Red River. Although portions of the project have been online since 1987, construction efforts were temporarily placed on hold while a cost-sharing partner for the operation and maintenance responsibilities was identified. The Water Resources Development Act of 2007 reaffirmed that operation and maintenance responsibilities would be federally funded. In 2008, funding for efforts in Texas was used to complete contract plans and specifications and continue environmental monitoring activities.

The Texas Commission on Environmental Quality (TCEQ) has the primary responsibility for enforcing state laws regarding water pollution. **Chapter 7** of the Texas Water Code also establishes laws to allow local governments to combat environmental crime, including water pollution. Local enforcement of these laws can supplement the enforcement activities of TCEQ and help protect Texas' water resources.

1.11.3 Invasive Species

The appearance of several invasive and/or harmful species (including zebra mussels, giant salvinia, and golden algae) poses a potential threat to water supplies throughout the state of Texas. Continued monitoring and management by water suppliers in Region C will be necessary in the coming decades. Invasive species will likely be an ongoing area of interest to Region C, as the appearance of additional invasive species in the future remains a possibility.

Zebra mussel (*Dreissena polymorpha*) is an invasive species that is native to Eurasia and is believed to have first entered the United States in 1988 through the ballast water in ships entering the Great Lakes. Zebra mussels multiply rapidly, can be easily transported on boats, and can clog intakes, pumps, pipes and other water supply infrastructure. Additionally, zebra mussels can impact fish populations, native mussels, and birds.

TPWD has four classifications of lakes relating to zebra mussels: Infested, Positive, Suspect, and Inconclusive. Infested Lakes are those where the water body has an established, reproducing zebra mussel population. Positive Lakes are those where zebra mussels or their larvae have been detected on more than one occasion. Suspect Lakes are those where zebra mussels or their larvae have been found once in recent years. Inconclusive Lakes are those where zebra mussel DNA or an unverified suspect organism has been found. As of October 24, 2019 TPWD [35] has identified the following reservoirs used for Region C water supply in relation to zebra mussels:

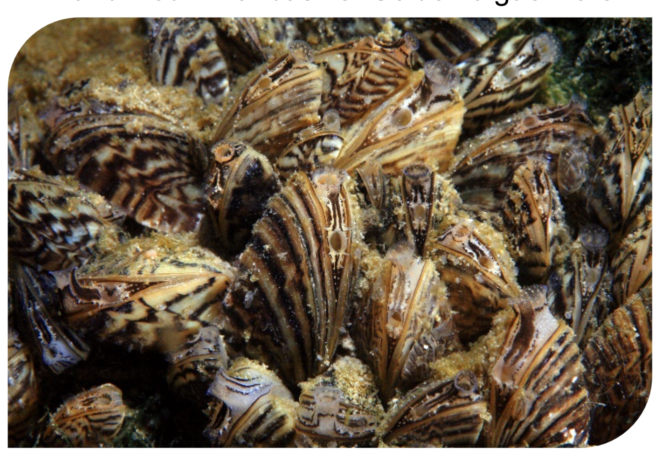
- **Infested:** Bridgeport, Eagle Mountain, Randell, Ray Roberts, and Texoma
- **Positive:** Grapevine, Lavon, Richland-Chambers, Worth
- **Suspect:** Fork, Ray Hubbard.

Due to the number of water transfers in Region C and other potential pathways of transferring zebra mussels into a reservoir (boats, birds), reservoirs should continue to be monitored for the appearance of zebra mussels. As zebra mussels spread into Region C water supply reservoirs, the operation and maintenance cost of control and removal from water supply infrastructure could be significant. To avoid further spread of this invasive species, strategies in this plan that involve transfer of water from basins or reservoirs with known presence of zebra mussels have been modified to transfer water directly to water treatment plants.

Giant salvinia (*salvinia molesta*) is a floating plant that is native to South America. Colonies of giant salvinia can develop, covering the water surface. Under certain environmental conditions (light, temperature, and available nutrients), oxygen depletion and fish kills can occur. In addition, colonies of giant salvinia can block sunlight penetration to submerged plants. Lower water levels typically experienced during the summer months help prevent the spread of giant salvinia.

Giant salvinia was first discovered in Texas in the Houston area in 1998, and has spread to over a dozen Texas lakes, including Toledo Bend and Sam Rayburn. Due to the number of water transfers in Region C and other potential pathways of transferring, reservoirs should continue to be monitored for the appearance of giant salvinia. If giant salvinia appears in Region C water supply reservoirs, mechanical techniques and herbicide can be applied during the summer months to control the population.

Golden algae (*prymnesium parvum*) is a type of aquatic plant that produces toxins that can be lethal to fish, mussels, clams, and certain amphibians. Under certain environmental conditions, an explosive increase in the algal population can occur, which can result in fish kills. Golden algae typically occur in waters with a high TDS concentration, and appears to have a competitive advantage over beneficial algae during the winter and spring months. Golden alga blooms have occurred in the Rio Grande, Brazos, Canadian, Colorado, and Red River basins. Golden algae were



Zebra Mussels

first identified in Texas in the 1980s; it remains unclear whether the species is native or invasive. Research is ongoing to better understand, detect, and manage golden alga blooms.

1.11.4 Groundwater Drawdown

Overdevelopment of aquifers and the resulting decline in water levels poses a threat to small water suppliers and to household water use in rural areas. As water levels decline, the cost of pumping water grows and water quality generally suffers. Wells that go dry must be redrilled to reach deeper portions of the aquifer. Water level declines have been reported in localized areas in each of the major and minor aquifers in Region C. In particular, the annual pumpage from the Trinity aquifer in some counties is estimated to be greater than the annual recharge (24). Concern about groundwater drawdown is likely to prevent any substantial increase in groundwater use in Region C and may require conversion to surface water in some areas.

1.11.5 Groundwater Quality

Figure 1.3 shows the major and minor aquifers in Region C. Major aquifers are the Trinity aquifer and the Carrizo-Wilcox aquifer. Minor aquifers are the Woodbine aquifer, the Nacatoch aquifer, the Cross Timbers aquifer and the Queen City aquifer. Water quality in the Trinity aquifer is acceptable for most municipal and industrial purposes (36). However, in some areas, natural concentrations of arsenic, fluoride, nitrate, chloride, iron, manganese, sulfate, and total dissolved solids in excess of either primary or secondary drinking water standards can be found. Water on the outcrop tends to be harder with relatively high iron concentration. Downdip, water tends to be softer, with concentrations of TDS, chlorides, and sulfates higher than on the outcrop. Groundwater contamination from man-made sources is found in localized areas. TWDB Report 269 reported contaminated water in wells located between Springtown in Parker County and Decatur in Wise County (24). The apparent source of the contamination was improperly completed oil and gas wells. Other potential contaminant sources (agricultural practices, abandoned wells, septic systems, etc.) are known to exist on the Trinity outcrop, but existing data are insufficient to quantify their impact on the aquifer.

Water from the Carrizo-Wilcox aquifer is fresh to slightly saline. In the outcrop, the water is hard and low in TDS (37). In the downdip, the water is softer, with a higher temperature and higher TDS concentrations. Hydrogen sulfide and methane may be found in localized areas. In much of the northeastern part of the aquifer, water is excessively corrosive and has high iron content. In this area, the groundwater may also have high concentrations of TDS, sulfate, and chloride. Some of these sites may be mineralized due to waters passing through lignite deposits, especially in the case of high sulfate. Another cause may be the historic practice of storing oil field brines in unlined surface storage pits. In Freestone County, excessive iron concentration may be a problem; a well completed in recent years by the City of Fairfield contained water with a high iron concentration (38). Excessive iron concentrations can be removed by treatment. In Tarrant County, arsenic has been detected in the public water supply for one city (39).

Water quality in the layers of the Woodbine aquifer used for public water supply is good along the outcrop. Water quality decreases downdip (southeast), with increasing concentrations of sodium, chloride, TDS, and bicarbonate. High sulfate and boron concentrations may be found in Tarrant, Dallas, Ellis, and Navarro Counties. Excessive iron concentrations also occur in parts of the Woodbine formation.

TWDB designated the Cross Timbers as a new minor aquifer. The groundwater occurs under mostly unconfined conditions and is typically discontinuous with isolated sandstone layers. The groundwater occurs in a shallow flow system that is susceptible to water level changes due to variable recharge and discharge. The groundwater quality ranges from fresh to brackish. The geometry and aquifer properties of water-bearing strata vary widely and contribute to variability in well yields [40].

The Nacatoch and Queen City aquifers provide very little water in Region C. Available data indicate that the quality of the Nacatoch in this area is acceptable for most uses. Water quality data on the Queen City aquifer in Region C are very limited.

As stated at the end of **Section 1.8**, the new SDWA Groundwater Rule will affect water user groups currently on groundwater. This rule has the potential to encourage entities on groundwater to consider alternative sources. Systems that utilize groundwater as a supplemental supply may find that the additional regulatory monitoring and reporting does not warrant the supplemental coverage.

1.12 Water-Related Threats to Agricultural and Natural Resources in Region C

Water-related threats to agricultural and natural resources in Region C include changes to natural flow conditions, water quality concerns, and inundation of land due to reservoir development. In general, there are few significant water-related threats to agricultural resources in Region C due to the limited use of water for agricultural purposes. Water-related threats to natural resources are more significant. Further information on how this plan is consistent with the long-term protection of the State's agricultural and natural resources is presented in **Section 6.4** of this report.

1.12.1 Changes to Natural Flow Conditions

Reservoir development, groundwater drawdown, and return flows of treated wastewater have greatly altered natural flow patterns in Region C. Spring flows in Region C have diminished, and many springs have dried up because of groundwater development and the resulting drawdown. This has reduced reliable flows for many tributary streams. Reservoir development also changes natural hydrology, diminishing flood flows and capturing low flows. (Some reservoirs provide steady flows in downstream reaches due to releases to empty flood control storage or meet permit requirements.) Downstream from the Dallas-Fort Worth Metroplex, base flows on the Trinity River have been greatly increased due to return flows of treated wastewater. It is unlikely that future changes to flow conditions in Region C will be as dramatic as those that have already occurred. If additional reservoirs are developed, they will likely be required to release some inflow to maintain downstream stream conditions, which was often not required in the past. It is likely that return flows from the Dallas-Fort Worth area will continue to increase over the long term, thus increasing flows in the Trinity River. On balance, this will probably enhance habitat in this reach.

1.12.2 Water Quality Concerns

There are a number of reaches in which the TCEQ has documented concerns over water quality impacts to aquatic life or fish consumption. In general, these concerns are due to low dissolved oxygen levels or to levels of lead, pesticides, or other pollutants that can harm aquatic life or present a threat to humans eating fish in which these compounds tend to accumulate. Baseline water quality conditions used to evaluate water management strategies are included in **Appendix I**.

1.12.3 Inundation Due to Reservoir Development

At various times, a number of new reservoirs have been considered for development in Region C, including:

- Tehuacana Reservoir on Tehuacana Creek in Freestone County.
- Tennessee Colony Reservoir on the main stem of the Trinity River in Freestone, Navarro, Henderson, and Anderson Counties.
- Roanoke Reservoir on Denton Creek in Denton County.
- Italy Reservoir on Chambers Creek in Ellis and Navarro Counties.
- Emhouse Reservoir at the confluence of Chambers and Waxahachie Creeks in Ellis and Navarro Counties.
- Upper Red Oak Reservoir and Lower Red Oak Reservoir on Red Oak Creek in Ellis County.
- Bear Creek Reservoir on Bear Creek in Ellis County.
- Bois d'Arc Lake (formerly Lower Bois d'Arc Reservoir) on Bois d'Arc Creek in Fannin County.
- Ralph Hall Reservoir on North Fork Sulphur River in Fannin County.
- Main Stem Balancing Reservoir, off-channel reservoir in Ellis County.

At this time, Bois d'Arc Lake is under development and Lake Ralph Hall is in the permitting process. The impacts of a new reservoir on natural resources include the inundation of habitat, often including wetlands and bottomland hardwoods, and changes to downstream flow patterns. Depending on the location, a reservoir may also inundate prime farmland. The impacts of specific projects depend on the location, the mitigation required, and the operation of the projects.

Chapter 1 List of References

(1) Texas State Data Center and Office of the State Demographer: *Texas Population Estimates Program, July 1, 2016,* [ONLINE], Available URL: http://osd.texas.gov/Data/TPEPP/ Estimates/, January 2019.

(2) United States Department of Labor - Bureau of Labor Statistics: *May 2017 Metropolitan and Nonmetropolitan Area Occupational Employment and Wage Estimates – Dallas-Fort Worth-Arlington, TX*, [ONLINE], Available URL: https://www.bls.gov/oes/2017/may/oes_19100.htm January 2019.

(3) Dallas Morning News, *The 2019 List of Dallas-Fort Worth's 150 Largest Public Companies,* May 30, 2019. https://www.dallasnews.com/business/2019/05/30/the-2019-list-of-dallas-fort-worth-s-150-largest-public-companies/.

(4) World Atlas, *The Busiest Airports In the US,* 2017. https://www.worldatlas.com/articles/busiest-airports-in-united-states.html.

(5) United States Department of Agriculture - Natural Resource Conservation Service: Geospatial Data Gateway: *Average Annual* and *Average Monthly Rainfall Data by State*, [ONLINE], Available URL: http://datagateway.nrcs.usda.gov/GDGOrder.aspx, August 2014.

(6) Texas Commission on Environmental Quality: Water Rights Database and Related Files, [Online], Available URL: https://www.tceq.texas.gov/permitting/water_rights/wr_databases.html, July 7, 2013.

(7) Texas Water Development Board: Historical Water Use Data files, Austin, [Online], Available URL: http://www.twdb.texas.gov/waterplanning/waterusesurvey/estimates/index.asp, January 2019.

(8) Texas Water Development Board: Historical Groundwater Pumpage, Austin, [Online],2016 Data, http://www2.twdb.texas.gov/ReportServerExt/Pages/ReportViewer.aspx?/wu/sumfinal_groundwater_pumpage. October 24, 2019.

(9) Texas Water Development Board: Modeled Available Groundwater files, Austin, January, 2019.

(10) Freese and Nichols, Inc., Alan Plummer Associates, Inc., CP&Y, Inc., and Cooksey Communications, Inc.: *2016 Region C Water Plan*, prepared for the Region C Water Planning Group, Fort Worth, December 2015.

(11) Texas Water Development Board: *2017 State Water Plan for Texas,* Austin, May 2016, [Online] Available URL: https://www.twdb.texas.gov/waterplanning/swp/2017/

(12) Texas Administrative Code Title 31, Part 10, Chapter 357, [Online], Available URL: http://texreg.sos.state.tx.us/public/readtac$ext.ViewTAC?tac_view=4&ti=31&pt=10&ch=357&rl=Y, accessed August 2019.

(13) Alan Plummer Associates, Inc. and Water Prospecting and Resource Consulting, LLC: *Final Report An Analysis of Water Loss As Reported by Public Water Suppliers in Texas*, prepared for the Texas Water Development Board, Fort Worth, [Online] Available

URL:
http://www.twdb.texas.gov/publications/reports/contracted_reports/doc/0600010612_WaterLossinTexas.pdf, January 24, 2007.

(14) Texas Water Development Board: Water Loss Audit Data by Region, Austin, [Online], Available URL: http://www.twdb.texas.gov/waterplanning/rwp/planningdocu/2021/current_docs.asp, January 2019.

(15) Brune, Gunnar: *Springs of Texas, Volume I*, Branch-Smith, Inc., Fort Worth, 1981.

(16) Texas Parks and Wildlife Department: *Evaluation of Selected Natural Resources in Part of the North-Central Texas Area*, Austin, 1999.

(17) United States Department of the Interior - U.S. Geological Survey (Franklin T. Heitmuller and Brian D. Reece): *Open File Report 03-315, Database of Historically Documented Springs and Spring Flow Measurements in Texas*, Austin, 2003.

(18) Wetland Training Institute, Inc.: *Field Guide for Wetland Delineation*, 1987 U.S. Army Corps of Engineers Manual, Glenwood, NM, WTI91-2, 1991.

(19) United States Department of Agriculture, Natural Resources Conservation Service Texas, Hydric Soils, NRCS Soils, [Online], Available URL: https://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/use/hydric/, February, 2019.

(20) U.S. Fish and Wildlife Service: *Endangered Species*, [Online], Available URL: http://www.fws.gov/endangered, October 2014.

(21) Texas Parks and Wildlife Department, Wildlife Division, Diversity and Habitat Assessment Programs: *County Lists of Texas' Special Species. Region C Counties*, March 2015.

(22) Texas Parks and Wildlife Department: *Ecologically Significant River and Stream Segments of Region C, Regional Water Planning Areas*, Austin, 2000.

(23) U.S. Department of Agriculture and Natural Resources Conservation Service: *National Soil Survey Handbook, title 430-VI.* [Online] Available URL: http://soils.usda.gov/technical/handbook/, 2003.

(24) Texas Department of Water Resources: *Report 269: Occurrence, Availability, and Chemical Quality of Groundwater in the Cretaceous Aquifers of North-Central Texas*, Austin, 1982.

(25) U.S. Department of Agriculture: 2017 Census of Agriculture, Volume 1, Chapter 2: Texas County Level Data, Table 1, [Online], Available URL: https://www.nass.usda.gov/Publications/AgCensus/2017/Full_Report/Volume_1,_Chapter_2_County_Level/Texas/st48_2_0001_0001.pdf, May 2019.

(26) Texas Parks and Wildlife Department: Information on State Parks and Reservoirs, Austin, [Online], Available URL: http://www.tpwd.state.tx.us/spdest/findadest/prairies_and_lakes/, November 2005.

(27) U.S. Army Corps of Engineers, Fort Worth District: Information on Federal Parks and Reservoirs, Fort Worth, [Online], Available URL: http://www.swf-wc.usace.army.mil/index.htm, November 2005.

(28) Texas Railroad Commission: *Well Distribution by County – Well Counts,* Austin, [Online], Available URL: http://www.rrc.state.tx.us/oil-gas/research-and-statistics/well-information/well-distribution-by-county-well-counts/, February 2019.

(29) Texas Center for Policy Studies: *Texas Environmental Almanac*, Austin, [Online], Available URL: http://www.texascenter.org/almanac/index.html, 1995.

(30) Texas Railroad Commission: Coal, Lignite, and Uranium Surface Mines, Austin, [Online], Available URL: http://www.rrc.state.tx.us/programs/mining/index.php, 2005.

(31) U.S. Environmental Protection Agency: 2008 Texas Water Quality Inventory and 303(d) List, [Online], Available URL: http://www.tceq.state.tx.us/assets/public/waterquality/swqm/assess/12twqi/2012_303d.pdf, May 9, 2013.

(32) U.S. Environmental Protection Agency: *Stage 1 Disinfectants and Disinfection Byproducts Rule*, EPA 815-F-98-010, December 1998.

(33) U.S. Environmental Protection Agency: *Stage 2 Disinfectants and Disinfection Byproducts Rule*, [Online] Available URL: http://www.epa.gov/safewater/disinfection/stage2/regulations.html, January 2006.

(34) U.S. Environmental Protection Agency: *Long Term 2 Enhanced Surface Water Treatment Rule*, [Online], Available URL: http://www.epa.gov/OGWDW/disinfection/lt2/index.html, January 5, 2006.

(35) Texas Parks and Wildlife Department: *Zebra Mussel Classification*, [Online], https://tpwd.texas.gov/huntwild/wild/species/exotic/zebramusselmap.phtml Austin, 2019.

(36) Texas Natural Resource Conservation Commission: *The State of Texas Water Quality Inventory*, Austin, 1996.

(37) Texas Water Development Board Report 345: *Aquifers of Texas*, Austin, 1996.

(38) Freese and Nichols, Inc.: *Freestone County Regional Water Supply Study*, prepared for the Trinity River Authority and the Texas Water Development Board, Fort Worth, 1997.

(39) Bureau of Economic Geology, University of Texas at Austin, prepared for Texas Commission on Environmental Quality: *Assessment of Arsenic in Groundwater and Water Supply Systems in Texas.* [Online], August 2018. http://www.beg.utexas.edu/files/content/beg/research/water/TCEQ%20Arsenic%20Report%20EPA%20Aug%2010%202018.pdf

(40) Texas Water Development Board and Water Conservation Implementation Task Force : *Amending the 2017 State Water Plan to designate the Cross Timbers Aquifer as a minor aquifer*, [Online], Available URL: https://www.twdb.texas.gov/board/2017/09/Board/Brd08.pdf, March 19, 2019.

2 Population and Water Demand Projections

This chapter summarizes the population and water demand projections for Region C as approved by the Texas Water Development Board (TWDB). The chapter includes a discussion on historical growth trends in Region C, the basis of projections, and the final population and water demand projections for Region C. Region C is the most populous of the sixteen regional planning areas, making up approximately a quarter of the State's population. Region C's total population is projected to nearly double from 7.6 million in 2020 to 14.7 million by 2070 (~92% increase). This will account for almost one-third of the State's population by 2070. Similarly, Region C's demand is projected to increase as well (~67%) from 1.7 million acre-feet per year in 2020 to 2.9 million acre-feet per year in 2070. Although Region C is densely populated, the region has historically used less than 10 percent of the State's total annual water use.

Chapter Outline

Section 2.1 – Historical Perspective

Section 2.2 – Population Projections

Section 2.3 – Water Demand Projections

Attachment 1 - Region C Population Projections by WUG, by County

Attachment 2 - Projected Population for WUGs in Multiple Counties or Regions

Attachment 3 - Region C Projected Municipal Demand by WUG, by County

Attachment 4 - Municipal Demand for WUGs in Multiple Counties or Regions

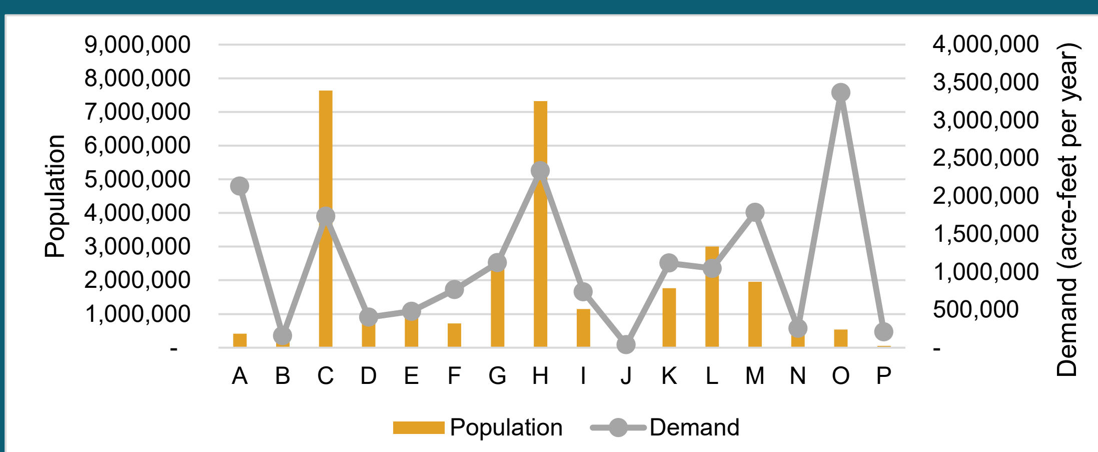
Attachment 5 - Population Served by Major Water Providers and Projected Dry-Year Water Demand on Major Water Providers by Use Category

Related Appendices

Appendix C – Adjustments to Projections

Appendix D – DB22 Reports

2020 Population and Demand Projections



2.1 Historical Perspective

The sixteen counties that comprise Region C have been among the fastest growing areas in Texas and the nation since the 1950s. The population of the region more than tripled from 1960 to 2010. The region's highest population density is centered in and around Dallas and Tarrant Counties.

For many years, the population growth in the region was concentrated in the cities of Dallas and Fort Worth. In the 1960s and 1970s, growth expanded into the suburbs in Dallas and Tarrant Counties. Then in the 1980s and more so since the 1990s, the growth extended into Collin, Denton, Rockwall and Ellis Counties.

According to the U.S. Census Bureau, the 2010 population of Region C was 6,477,835 (1). The U.S. Census Bureau estimated that the 2015 population of Region C was 7,120,408 (2). The total Region C water demand was 1,353,746 acre-feet in 2015 (3).

Figure 2.1 shows the historical population for Region C from 1960 to 2010, and

Figure 2.2 shows the historical water use for Region C from 1980 to 2010.

Aerial View of Residential Area

Figure 2.1 Historical Population in Region C

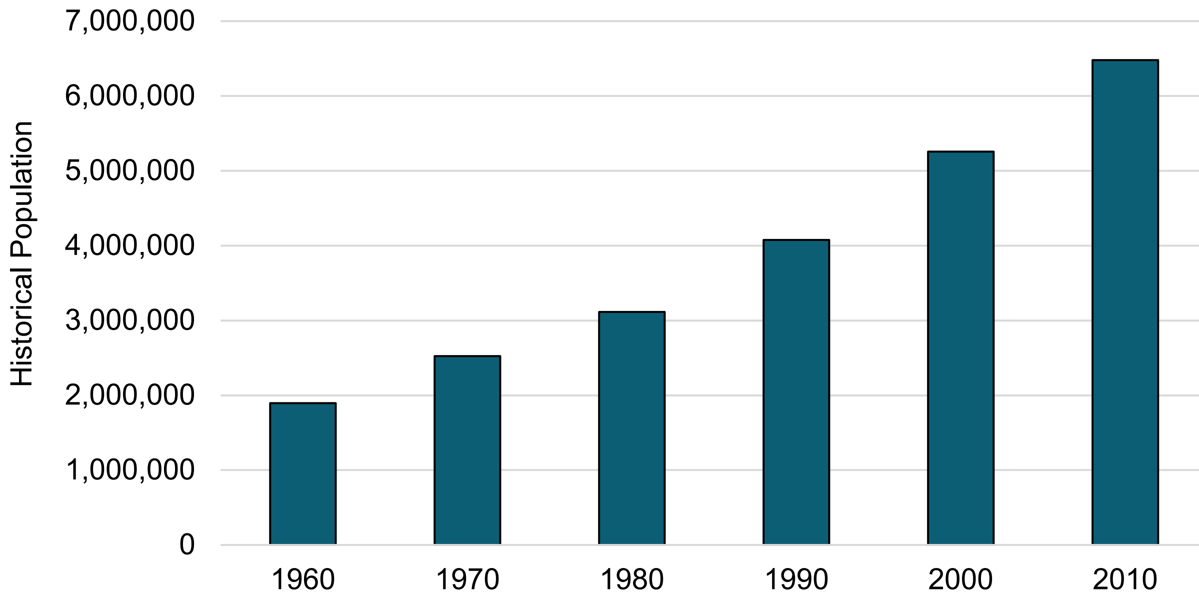
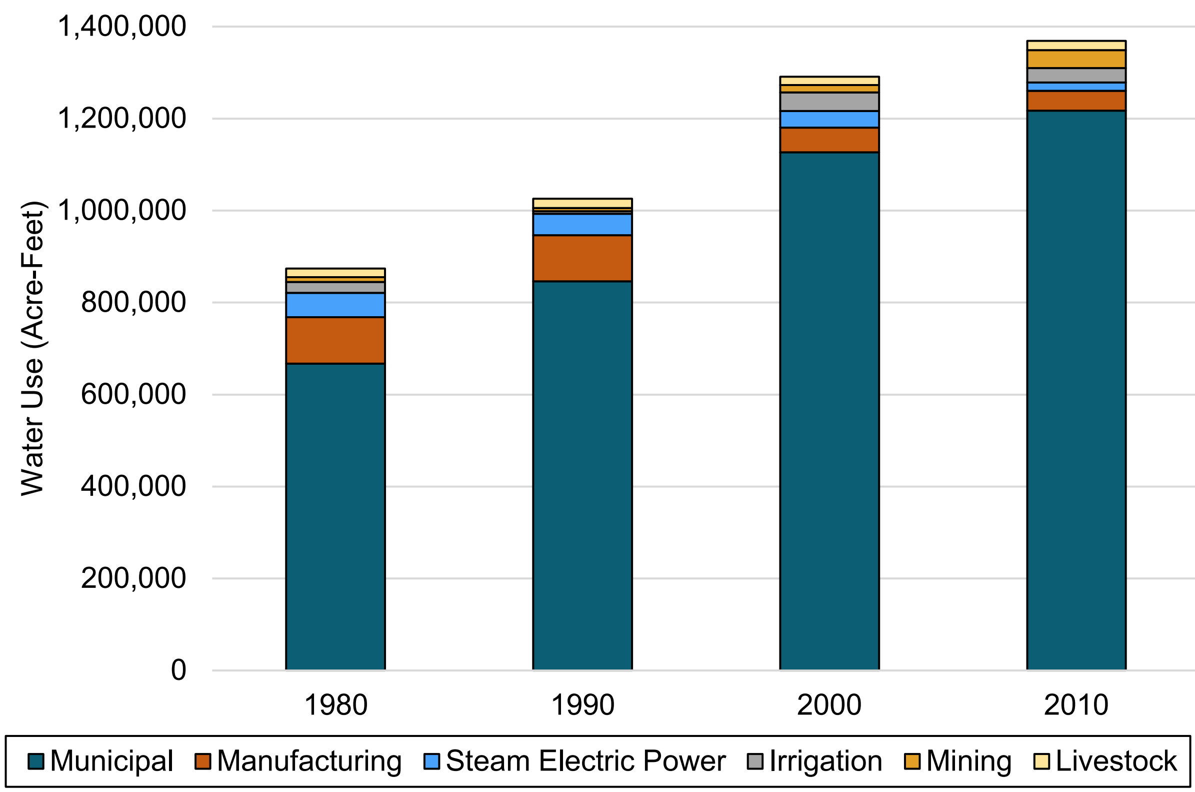


Figure 2.2 Historical Water Use in Region C



2.2 Population Projections

Population and water demand projections have been developed for all water user groups (WUGs).

2.2.1 Basis for Population Projections

For this update of the Region C Plan, 52 new water user groups have been added and 46 WUGs have been removed based on the new WUG definition. A number of WUGs were also renamed. The list of new, removed, and renamed WUGs can be found in **Appendix C**. There are over 290 municipal water user groups in Region C.

Population projections presented in this section are based on draft population projections provided by the Texas Water Development Board on December 22, 2016. Those draft projections were developed from population projections from the *2017 State Water Plan* and adjusted to match utility service area boundaries for each WUG. Region C analyzed the draft projections and made changes based on input from water user groups, wholesale water providers (WWPs) in Region C, the North Central Texas Council of Governments, and other sources. Detailed explanation of these changes is in **Appendix C**. TWDB allowed population adjustments to be made between WUGs and counties, but initially required that the total regional population remain the same as the total of their draft projections. After further consideration, TWDB allowed a slight increase (2.44%) in the overall population projections due to the under-estimation of the Region C population in the *2017 State Water Plan*, based on comparison of the 2015 U.S. Census population estimate and the interpolated 2015 Region C population from the *2017 State Water Plan*.

As stated in the previous paragraph, revisions to the projections were made based on input from water user groups and wholesale water providers in Region C. Each municipal WUG in Region C was emailed a survey regarding their population projections. An example of this survey is included in **Appendix C**. In the survey, each WUG was provided TWDB's draft population projection for the 2021 Region C Water Plan along with any revisions the consultants were suggesting based on gathered data. Each WUG was asked if they were in agreement with the projections. If the WUG was not in agreement with the projections, they were asked to provide alternative projections. Twenty-nine WUGs responded with suggestions for revisions to the population projections, and those revisions were incorporated to the extent feasible. Email notification was sent to all WUGs for which revisions were made. A summary of the justification for all changes made to population projections is included in **Appendix C**.

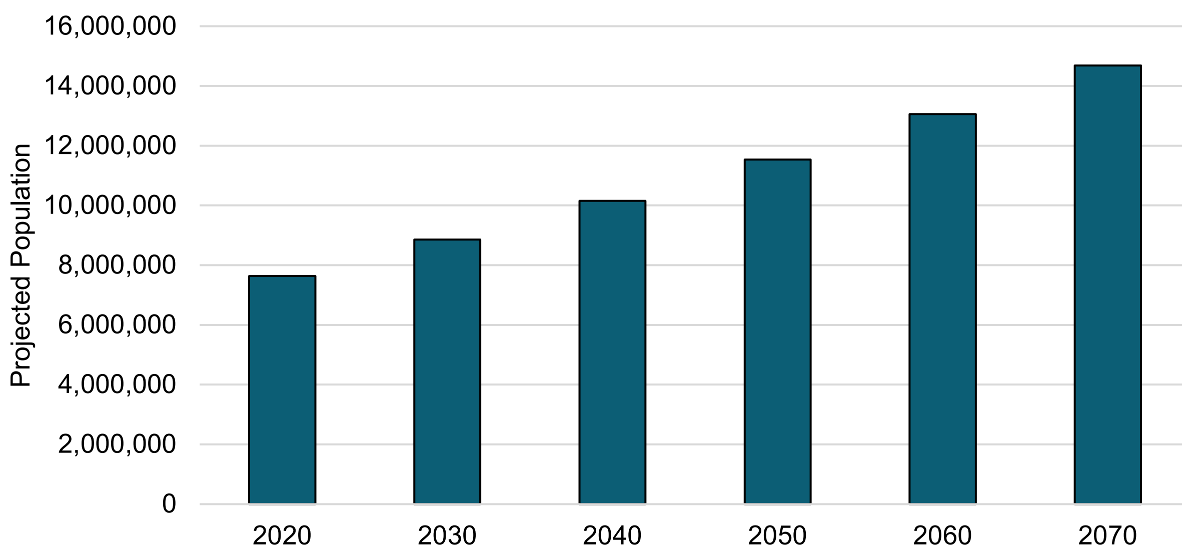
As required by TWDB regulations, these projections were posted for public review on the Region C website in advance of the Region C Planning Group meeting at which they were considered for approval. The population projections were approved by the Region C Water Planning Group at the December 18, 2017 Public Meeting and were subsequently adopted by TWDB. No public comments were received on these projection revisions.

2.2.2 Water User Group Projections

Figure 2.3 and **Table 2.1** present the projected population for the Region C counties, as adopted by TWDB. The projected 2020 population for Region C is 7,637,764. This 2020 projection is about 1.6 percent more than the projected 2020 population from the *2016 Region C Water Plan* [(4)] of 7,504,200 and about 4 percent less than the 2020 population projection from the *2011 Region C Water Plan* [(5)] of 7,971,728. The projected 2070 population for Region C is 14,684,790, which is about 2.4% more than the projected 2070 population from the 2016 Region C Water Plan of 14,347,912. Generally, the overall long-term population projections are consistent with previous plans.

Attachment 1 at the end of this chapter is a summary of the projected populations for Region C, by water user group, by county, and by basin as approved by the RCWPG and TWDB. Many of the water user groups have population that is split among multiple basins, counties, and regions. For convenience, **Attachment 2** at the end of this chapter includes the total projected populations for those water user groups in multiple basins, counties, and regions. As required for Regional Planning, this report also contains population tables generated directly from TWDB's Regional Water Planning Database (DB22). Those tables are in **Appendix D** (DB22 tables).

Figure 2.3 Adopted Population Projections for Region C



Region C's population is increasing by more than 300 people per day

Table 2.1 Adopted Population Projections for Region C by County

County	Historical 1990	Historical 2000	Historical 2010	2020	2030	2040	2050	2060	2070
Collin	264,036	491,774	782,341	1,050,506	1,239,303	1,497,921	1,807,279	2,093,720	2,373,092
Cooke	30,777	36,363	38,437	40,903	44,035	46,984	52,427	62,905	95,351
Dallas	1,852,810	2,218,774	2,368,139	2,587,960	2,871,662	3,180,529	3,429,783	3,627,334	3,770,858
Denton	273,525	432,976	662,614	891,063	1,115,119	1,329,551	1,584,015	1,866,215	2,113,136
Ellis	85,167	111,360	149,610	191,638	241,778	280,745	360,584	479,939	670,845
Fannin	24,804	31,242	33,915	38,330	43,084	52,891	69,328	101,706	137,732
Freestone	15,818	17,867	19,816	20,437	21,077	22,947	31,142	44,475	73,287
Grayson	95,021	110,595	120,877	135,311	149,527	159,610	178,907	242,865	337,120
Henderson[a]	41,309	51,984	78,532	67,579	72,592	78,504	85,901	110,493	141,881
Jack	6,981	8,763	9,044	9,751	10,409	10,817	11,033	11,190	11,291
Kaufman	52,220	71,313	103,350	146,389	195,107	242,354	306,833	423,277	566,840
Navarro	39,926	45,124	47,735	52,505	59,556	65,958	74,213	83,221	99,056
Parker	64,785	88,495	116,927	201,491	260,194	276,979	360,125	472,097	593,000
Rockwall	25,604	43,080	78,337	119,410	160,315	213,619	246,938	291,850	325,052
Tarrant	1,170,103	1,446,219	1,809,034	2,004,609	2,279,113	2,580,325	2,799,127	2,978,034	3,167,377
Wise	34,679	48,793	59,127	79,882	95,086	110,343	135,797	162,282	208,872
Region C Total	**4,077,565**	**5,254,722**	**6,477,835**	**7,637,764**	**8,857,957**	**10,150,077**	**11,533,432**	**13,051,603**	**14,684,790**

[a]*Projections for Henderson County only include the portion of Henderson County located within Region C.*

2.3 Water Demand Projections

Water demand projections are divided into two main water use categories; municipal and non-municipal. Non-municipal water use is further divided into five water use categories; irrigation, livestock, manufacturing, mining and steam electric power for the purposes of regional planning. Additionally, non-municipal demands are sometimes referred to more simply as agricultural (irrigation and livestock) and industrial (manufacturing, mining and steam electric).

Region C was given the opportunity to request adjustments to the water demand projections if needed. Region C did request a number of revisions, and those revisions are detailed in separate memoranda for each use category. **Appendix C** contains the memoranda detailing the demands for Region C.

As required by TWDB regulations, these projections were posted for public review on the Region C website in advance of the Region C Planning Group meeting at which they were considered for approval. The demand projections were approved at the December 18, 2017 Public Meeting. No public comments were received on these projection revisions.

2.3.1 Municipal Water Demand

Municipal water demand includes water used by a variety of consumers in Region C, including single-family residence, multi-family residence, and nonresidential establishments (commercial, institutional and light industrial). It includes water utilities, cities and aggregated rural areas (referred to collectively as “county other” for planning purposes). Residential and nonresidential consumers use water for purposes such as drinking, cooking, sanitation, cooling and landscape watering. Although some nonresidential establishments are included in municipal water use, water-intensive industrial customers such as large manufacturing plants, steam electric power generation facilities and mining operations are not included but instead have their own non-municipal categories. Examples of nonresidential municipal demand include hospitals, universities, offices, shopping, hotels, entertainment venues, airports, and telecom facilities.

The TWDB has defined municipal water user group (WUG) boundaries differently in this round of planning than in previous rounds. A municipal WUG is now defined based on utility service area boundaries instead of political boundaries.

Municipal water user groups include:

- Privately-owned utilities that provide an average of more than 100 acre-feet per year for municipal use for all owned water systems,
- Water systems serving institutions or facilities owned by the state or federal government that provide more than 100 acre-feet per year for municipal use;
- All other retail public utilities not covered in the first two bullets that provide more than 100 acre-feet per year for municipal use;
- Collective reporting units, or groups of retail public utilities that have a common association and are requested for inclusion by the regional water planning group;
- Municipal and domestic water use, referred to as county other, not included in any of the above.

The municipal water demand projections presented in this section are based on per capita dry-year water use and the adopted population projections from the previous section. On December 22, 2016 TWDB provided draft per capita projections for each WUG based on each WUG's per capita use from the *2016 Region C Water Plan* and the *2017 State Water Plan*. (In most cases, this per capita usage was from 2011.) These 2020 through 2070 projections included estimated water reductions due to savings from plumbing code requirements.

On June 30, 2017 TWDB provided updated 2010 through 2015 historical per capita use data based on the updated utility service area boundaries for Region C WUGs. TWDB allowed this updated per capita data to be used as supporting documentation/data to justify changes to the base per capita usage to which the plumbing code reductions are applied to determine the 2020 through 2070 per capita projections. Criteria for changing the per capita projections are outlined in Sections 2.1.1.2 and 2.1.2.1 of TWDB's General Guidelines for the Fifth Cycle of Regional Water Plan Development (referred to as Exhibit C).

Region C reviewed this 2010 through 2015 historical data to identify whether any base per capita uses should be changed. The process by which Region C reviewed this data is outlined in the memorandum "Comparison of Historical GPCDs for Region C; Requested GPCD Changes", which is included in **Appendix C**.

Using this methodology, Region C requested changes to the base per capita usage for 21 WUGs. Among the WUGs for which changes were requested are Tarrant County Other and Dallas County Other. County Other WUGs represent the area in counties that is not included in any other municipal WUG service area boundary. In Dallas and Tarrant counties, the Dallas-Fort Worth International Airport (DFWIA), a significant water user, is included in County Other. However, TWDB's historical use data and per capita calculation does not include the use for DFWIA in the Tarrant and Dallas County Other. Therefore, the per capita water use for these two WUGs was significantly revised to include DFWIA water use.

Using the final base-year per capita values for each WUG, the TWDB calculated the 2020 through 2070 per capita values incorporating the reduction in per capita values each decade expected to be caused by state and federally regulated plumbing codes (low flow plumbing fixtures, efficient residential clothes washer standards, and efficient residential dishwasher standards). TWDB then calculated the projected volume of water savings from these plumbing codes for each municipal WUG. This information (split by county and WUG) is included at the end of **Appendix C**. In total, Region C's projected water savings due to plumbing code is 74,768 acre-feet in 2020, increasing to 247,590 acre-feet in 2070.

Recent dry-year per capita demand reasonably represents demand that could be expected in a future drought. For many WUGs, 2011 was the most recent dry-year. (Exceptions to this are in Appendix C.) This most recent dry-year is defined as the "base year" because it is used as the basis for future demand projections.

2.3.2 Irrigation Water Demand

Irrigation water demand includes water used in irrigated field crops, vineyards, orchards, and self-supplied golf courses. Each planning cycle, the previous cycle's irrigation projections are adjusted by factors and trends including changes in the number of crops under irrigation, increases in irrigation application efficiency, changes in canal losses for surface water diversions and changes in cropping patterns. Irrigation demand is expected to decline as a result of more efficient irrigation systems, reduced groundwater supplies, the economic difficulty of pumping water from increasingly greater depths, and the transfer of water rights from agricultural to municipal uses.

There is some demand for crop irrigation; however this demand is mainly composed of golf courses watered by raw water or reclaimed water. The TWDB classifies the use of potable water for golf course irrigation as part of municipal use. The use of raw water or reuse of treated wastewater effluent for golf course irrigation is classified as irrigation use.

TWDB provided the draft irrigation projections on June 2, 2017. TWDB draft irrigation demands were based on an average of TWDB's 2010-2014 irrigation water use estimates. Any revisions requested by the Region C Regional Water Planning Group are summarized in **Appendix C**. **Table 2.2** summarizes the finalized, projected demands for the irrigation WUGs by county.

Table 2.2 Projected Demand for Irrigation WUGs (Acre-Feet per Year)

County	2020	2030	2040	2050	2060	2070
Collin	3,340	3,340	3,340	3,340	3,340	3,340
Cooke	1,100	1,100	1,100	1,100	1,100	1,100
Dallas	10,122	10,122	10,122	10,122	10,122	10,122
Denton	3,003	3,003	3,003	3,003	3,003	3,003
Ellis	1,367	1,367	1,367	1,367	1,367	1,367
Fannin	11,553	11,553	11,553	11,553	11,553	11,553
Freestone	569	569	569	569	569	569
Grayson	4,477	4,477	4,477	4,477	4,477	4,477
Henderson	582	582	582	582	582	582
Jack	98	98	98	98	98	98
Kaufman	285	285	285	285	285	285
Navarro	75	75	75	75	75	75
Parker	773	773	773	773	773	773
Rockwall	234	234	234	234	234	234
Tarrant	4,926	4,926	4,926	4,926	4,926	4,926
Wise	1,406	1,406	1,406	1,406	1,406	1,406
Total	**43,910**	**43,910**	**43,910**	**43,910**	**43,910**	**43,910**

2.3.3 Livestock Water Demand

Livestock water demand consists of water used in the production of various types of livestock, including cattle (beef and dairy), hogs, poultry, horses, sheep, and goats. In most cases, it was predicted that livestock use would remain fairly constant.

TWDB provided the draft livestock projections on June 2, 2017. TWDB draft livestock demands were based on an average of TWDB's 2010-2014 livestock water use estimates. Any revisions requested by the Region C Regional Water Planning Group are summarized in **Appendix C**.

Table 2.3 summarizes the finalized, projected demands for the livestock water user groups by county.

Table 2.3 Projected Demand for Livestock WUGs (Acre-Feet per Year)

County	2020	2030	2040	2050	2060	2070
Collin	912	912	912	912	912	912
Cooke	1,330	1,330	1,330	1,330	1,330	1,330
Dallas	758	758	758	758	758	758
Denton	769	769	769	769	769	769
Ellis	1,140	1,140	1,140	1,140	1,140	1,140
Fannin	1,411	1,411	1,411	1,411	1,411	1,411
Freestone	1,207	1,207	1,207	1,207	1,207	1,207
Grayson	1,143	1,143	1,143	1,143	1,143	1,143
Henderson	1,261	1,261	1,261	1,261	1,261	1,261
Jack	785	785	785	785	785	785
Kaufman	1,570	1,570	1,570	1,570	1,570	1,570
Navarro	1,691	1,691	1,691	1,691	1,691	1,691
Parker	1,634	1,634	1,634	1,634	1,634	1,634
Rockwall	111	111	111	111	111	111
Tarrant	627	627	627	627	627	627
Wise	1,198	1,198	1,198	1,198	1,198	1,198
Total	**17,547**	**17,547**	**17,547**	**17,547**	**17,547**	**17,547**

2.3.4 Manufacturing Water Demand

Manufacturing water demand consists of the water necessary for large facilities including those that process chemicals, oil and gas, food, paper, and other materials. Demands take into consideration economic projections for the manufacturing industry as well as incorporated efficiency improvements from new technology. Growth in manufacturing water demand was generally predicted to be located in the same counties in which the facilities currently exist. Manufacturing demands in Region C includes larger manufacturing facilities, food processing operations, defense industry operations and others. TWDB provided the draft manufacturing projections on June 2, 2017. TWDB draft manufacturing demands were based on 2010-2014 data from TWDB's Water Use Survey.

For the current round of regional water planning, the TWDB adopted a new policy for projecting water demands for manufacturing WUGs. This policy allows for a small increase in demands from 2020 to 2030, based on documented, planned new facilities. However, the policy holds demands constant at the 2030 level throughout the rest of the planning period (2040-2070). TWDB did not approve Region C's request to increase these demands after 2030. Since the Region C population is projected to increase by 66 percent from 2030 to 2070, it is unlikely that there would be no increase in manufacturing demands after 2030. For this reason, Region C has concerns regarding the manufacturing projections for 2040 through 2070. However, several water suppliers have a management supply factor included that helps mitigate this concern. **Table 2.4** summarizes the finalized, projected demands for the manufacturing WUGs by county.

Table 2.4 Projected Demand for Manufacturing WUGs (Acre-Feet per Year)

County	2020	2030	2040	2050	2060	2070
Collin	2,246	2,602	2,602	2,602	2,602	2,602
Cooke	116	128	128	128	128	128
Dallas	21,834	23,073	23,073	23,073	23,073	23,073
Denton	374	440	440	440	440	440
Ellis	5,414	6,549	6,549	6,549	6,549	6,549
Fannin	12	12	12	12	12	12
Freestone	19	19	19	19	19	19
Grayson	2,951	3,009	3,009	3,009	3,009	3,009
Henderson	806	985	985	985	985	985
Jack	1	1	1	1	1	1
Kaufman	946	1,109	1,109	1,109	1,109	1,109
Navarro	894	1,062	1,062	1,062	1,062	1,062
Parker	87	103	103	103	103	103
Rockwall	31	36	36	36	36	36
Tarrant	12,197	13,301	13,301	13,301	13,301	13,301
Wise	454	501	501	501	501	501
Total	**48,382**	**52,930**	**52,930**	**52,930**	**52,930**	**52,930**

2.3.5 Mining Water Demand

Mining water demand consists of water used in the exploration, development and extraction of oil, gas, coal, aggregates and other materials.

TWDB provided the draft mining projections on December 22, 2016. TWDB draft mining demands were based on a study by the University of Texas' Bureau of Economic Geology (BEG) [6] and a September 2012 update to the BEG study [7].

Any revisions requested by the Region C Regional Water Planning Group are summarized in **Appendix C**. **Table 2.5** summarizes the finalized, projected demands for the mining water user groups by county.

Table 2.5 Projected Demand for Mining WUGs

County	Values in Acre-Feet per Year					
	2020	2030	2040	2050	2060	2070
Collin	0	0	0	0	0	0
Cooke	1,583	900	378	446	511	586
Dallas	3,038	2,656	2,279	1,930	1,922	1,916
Denton	4,326	2,729	3,345	4,306	5,204	6,291
Ellis	931	547	164	123	82	55
Fannin	574	351	128	128	128	128
Freestone	5,347	5,115	5,251	5,286	5,356	5,582
Grayson	312	210	107	123	142	163
Henderson	434	506	481	484	479	469
Jack	3,396	1,821	1,698	1,731	1,768	1,862
Kaufman	296	386	491	646	783	951
Navarro	1,193	1,238	1,282	1,572	1,806	2,076
Parker	3,182	4,029	4,006	4,073	4,124	4,364
Rockwall	0	0	0	0	0	0
Tarrant	11,535	6,562	1,589	1,537	1,497	1,464
Wise	10,320	11,159	12,337	13,975	15,378	17,694
Total	**46,467**	**38,209**	**33,536**	**36,360**	**39,180**	**43,601**

2.3.6 Steam Electric Water Demand

Steam Electric Power Plants

- Calpine Plant (Freestone)
- Garland Power and Light Spencer Plant
- Forney Energy Center
- Exelon Mountain Creek Station
- Panda Power Company
- Luminant Trinidad Plant
- Ennis Power Plant
- Midlothian Energy LLC
- Handley Power Plant
- Others

Steam Electric water demand consists of water used for the purpose of generating power. A generation facility usually diverts surface waters, uses it for cooling purposes, and then returns a large portion of the water to a body of water. The water use for the facility is only the volume consumed in the cooling process and not returned. Most future water demand growth is expected to take place in the same counties in which current facilities exist. TWDB provided the draft steam electric projections on June 2, 2017. TWDB draft steam electric power generation demands were based on 2010-2014 historical use data.

For the current round of regional water planning, the TWDB adopted a new policy for projecting water demands for steam electric power WUGs. This policy allows for a small increase in water demands from 2020 to 2030, based on documented, planned new facilities. However, the policy holds projected steam electric power water demands constant at the 2030 level throughout the rest of the planning period (2040-2070). TWDB did not approve Region C's request to increase these demands after 2030. Since the Region C population is projected to increase by 66 percent from 2030 to 2070, it is unlikely that there would be no increase in steam electric power water demands after 2030. For this reason, Region C has serious concerns regarding the steam electric power projections for 2040 through 2070. However, several water suppliers have a management supply factor included that helps mitigate this concern. **Table 2.6** summarizes the finalized, projected demands for the steam electric power water user groups by county.

Table 2.6 Projected Demand for Steam Electric Power WUGs

County	Values in Acre-Feet per Year					
	2020	2030	2040	2050	2060	2070
Collin	40	40	40	40	40	40
Cooke	5	5	5	5	5	5
Dallas	1,065	1,065	1,065	1,065	1,065	1,065
Denton	173	173	173	173	173	173
Ellis	901	901	901	901	901	901
Fannin	0	0	0	0	0	0
Freestone	34,432	34,432	34,432	34,432	34,432	34,432
Grayson	4,387	4,387	4,387	4,387	4,387	4,387
Henderson	3,709	3,709	3,709	3,709	3,709	3,709
Jack	3,772	3,772	3,772	3,772	3,772	3,772
Kaufman	9,793	9,793	9,793	9,793	9,793	9,793
Navarro	0	0	0	0	0	0
Parker	604	604	604	604	604	604
Rockwall	0	0	0	0	0	0
Tarrant	1,157	4,948	4,948	4,948	4,948	4,948
Wise	2,894	2,894	2,894	2,894	2,894	2,894
Total	**62,932**	**66,723**	**66,723**	**66,723**	**66,723**	**66,723**

2.3.7 Water User Group Projections

Figure 2.4 summarizes the adopted projections for total dry-year water use by category in Region C. As can be seen in the figure, Region C's total water demand is heavily municipal (over 90 percent).

Table 2.7 presents the projected total dry-year water demand for the Region C counties, as adopted by TWDB.

Table 2.8 and **Table 2.9** show the projected dry-year water demand for the region by type of use.

Table 2.9 summarizes the projected dry-year water demand for each Region C county by type of use.

For more detail, the municipal water demand projections are listed by water user group by county as well as by basin in **Attachment 3** at the end of this chapter.

Attachment 4 lists the total projected municipal water demand for those water user groups that are split among multiple basins, counties, and regions.

As required for Regional Planning, this report also contains demand tables generated directly from TWDB's Regional Water Planning Database (DB22). Those tables are in **Appendix D**.

Figure 2.4 Adopted Projections for Total Dry-Year Water Use by Category in Region C

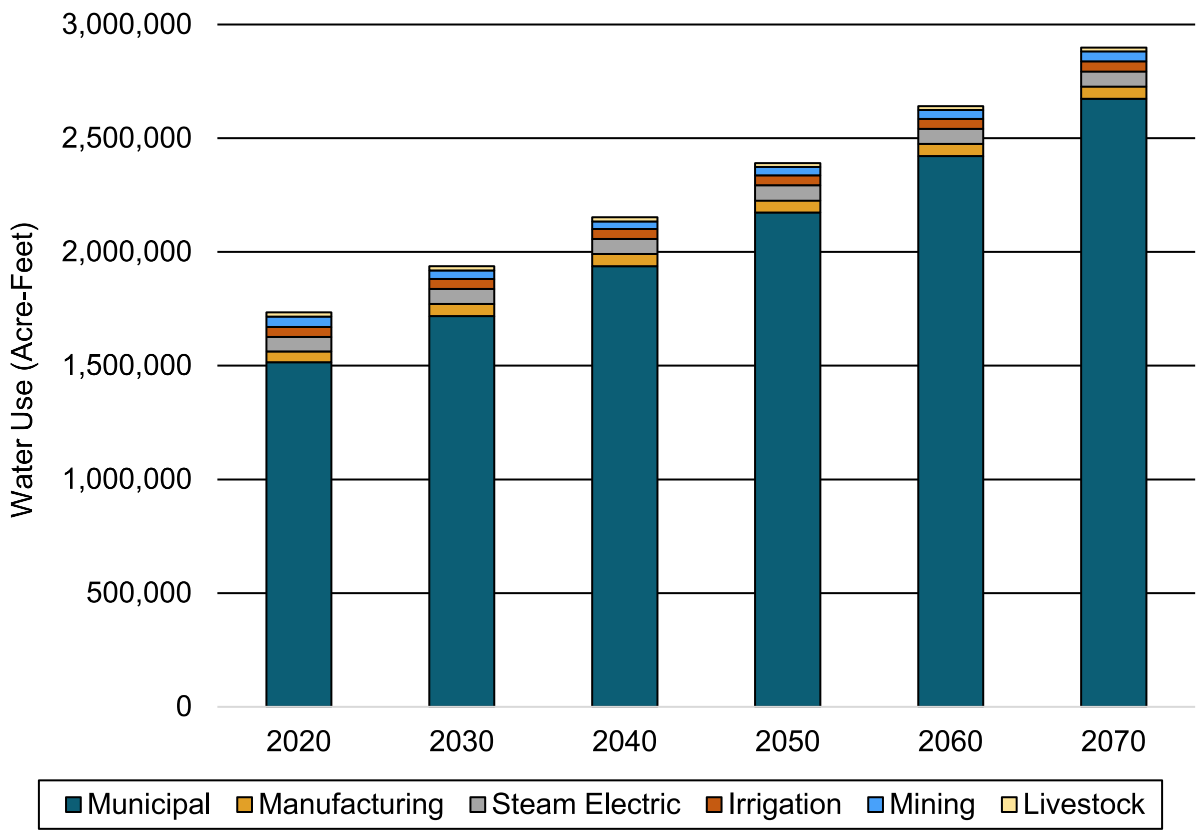


Table 2.7 Adopted Total Dry-Year Water Demand Projections for Region C by County

County	Projected Dy Year Water Demand (Acre-Feet per Year)					
	2020	2030	2040	2050	2060	2070
Collin	242,505	273,778	316,053	373,126	424,158	468,710
Cooke	10,226	9,797	9,515	10,180	11,610	15,837
Dallas	563,223	606,936	657,666	701,225	737,409	761,162
Denton	183,755	222,033	260,976	305,248	353,543	393,966
Ellis	45,341	54,859	60,713	73,196	90,964	119,473
Fannin	18,709	19,045	20,125	22,330	26,203	30,487
Freestone	44,552	44,322	44,683	45,961	47,574	50,948
Grayson	39,192	41,009	41,881	44,867	55,068	72,258
Henderson	14,326	15,058	15,595	16,488	20,224	24,847
Jack	9,279	7,744	7,640	7,681	7,733	7,839
Kaufman	32,432	39,103	45,389	53,921	68,234	85,866
Navarro	13,027	14,103	14,987	16,436	18,002	20,374
Parker	38,281	48,850	51,306	62,835	78,038	94,520
Rockwall	23,030	30,792	40,797	45,577	52,291	57,606
Tarrant	427,050	476,807	528,442	569,340	602,456	637,649
Wise	28,966	32,369	36,157	42,212	47,969	56,998
Region C Total	**1,733,893**	**1,936,605**	**2,151,925**	**2,390,623**	**2,641,476**	**2,898,540**

Table 2.8 Adopted Dry-Year Water Demand Projections for Region C by Type of Use

Use	Projected Dry Year Water Demand (Acre-Feet per Year)					
	2020	2030	2040	2050	2060	2070
Municipal	1,514,655	1,717,286	1,937,280	2,173,153	2,421,186	2,673,829
Manufacturing	48,382	52,930	52,930	52,930	52,930	52,930
Steam Electric	62,932	66,723	66,723	66,723	66,723	66,723
Irrigation	43,910	43,910	43,910	43,910	43,910	43,910
Mining	46,467	38,209	33,536	36,360	39,180	43,601
Livestock	17,547	17,547	17,547	17,547	17,547	17,547
Region C Total	**1,733,893**	**1,936,605**	**2,151,925**	**2,390,623**	**2,641,476**	**2,898,540**

Table 2.9 Adopted Dry-Year Water Demand Projections by County and Type of Use

Type of Use	Projected Dry Year Water Demand (Acre-Feet per Year)					
	2020	2030	2040	2050	2060	2070
Collin County						
Municipal	235,967	266,884	309,159	366,232	417,264	461,816
Manufacturing	2,246	2,602	2,602	2,602	2,602	2,602
Steam Electric Power	40	40	40	40	40	40
Irrigation	3,340	3,340	3,340	3,340	3,340	3,340
Mining	0	0	0	0	0	0
Livestock	912	912	912	912	912	912
Collin County Total	**242,505**	**273,778**	**316,053**	**373,126**	**424,158**	**468,710**
Cooke County						
Municipal	6,092	6,334	6,574	7,171	8,536	12,688
Manufacturing	116	128	128	128	128	128
Steam Electric Power	5	5	5	5	5	5
Irrigation	1,100	1,100	1,100	1,100	1,100	1,100
Mining	1,583	900	378	446	511	586
Livestock	1,330	1,330	1,330	1,330	1,330	1,330
Cooke County Total	**10,226**	**9,797**	**9,515**	**10,180**	**11,610**	**15,837**
Dallas County						
Municipal	526,406	569,262	620,369	664,277	700,469	724,228
Manufacturing	21,834	23,073	23,073	23,073	23,073	23,073
Steam Electric Power	1,065	1,065	1,065	1,065	1,065	1,065
Irrigation	10,122	10,122	10,122	10,122	10,122	10,122
Mining	3,038	2,656	2,279	1,930	1,922	1,916
Livestock	758	758	758	758	758	758
Dallas County Total	**563,223**	**606,936**	**657,663**	**701,225**	**737,409**	**761,162**
Denton County						
Municipal	175,110	214,919	253,246	296,557	343,954	383,290
Manufacturing	374	440	440	440	440	440
Steam Electric Power	173	173	173	173	173	173
Irrigation	3,003	3,003	3,003	3,003	3,003	3,003
Mining	4,326	2,729	3,345	4,306	5,204	6,291
Livestock	769	769	769	769	769	769
Denton County Total	**183,755**	**222,033**	**260,976**	**305,248**	**353,543**	**393,966**
Ellis County						
Municipal	35,588	44,355	50,592	63,116	80,925	109,461
Manufacturing	5,414	6,549	6,549	6,549	6,549	6,549
Steam Electric Power	901	901	901	901	901	901
Irrigation	1,367	1,367	1,367	1,367	1,367	1,367
Mining	931	547	164	123	82	55
Livestock	1,140	1,140	1,140	1,140	1,140	1,140
Ellis County Total	**45,341**	**54,859**	**60,713**	**73,196**	**90,964**	**119,473**

Type of Use	Projected Dry Year Water Demand (Acre-Feet per Year)					
	2020	2030	2040	2050	2060	2070
Fannin County						
Municipal	5,158	5,718	7,021	9,226	13,099	17,383
Manufacturing	12	12	12	12	12	12
Steam Electric Power	0	0	0	0	0	0
Irrigation	11,553	11,553	11,553	11,553	11,553	11,553
Mining	574	351	128	128	128	128
Livestock	1,411	1,411	1,411	1,411	1,411	1,411
Fannin County Total	**18,708**	**19,045**	**20,125**	**22,330**	**26,203**	**30,487**
Freestone County						
Municipal	2,978	2,980	3,205	4,448	5,991	9,139
Manufacturing	19	19	19	19	19	19
Steam Electric Power	34,432	34,432	34,432	34,432	34,432	34,432
Irrigation	569	569	569	569	569	569
Mining	5,347	5,115	5,251	5,286	5,356	5,582
Livestock	1,207	1,207	1,207	1,207	1,207	1,207
Freestone County Total	**44,552**	**44,322**	**44,683**	**45,961**	**47,574**	**50,948**
Grayson County						
Municipal	25,922	27,783	28,758	31,728	41,910	59,079
Manufacturing	2,951	3,009	3,009	3,009	3,009	3,009
Steam Electric Power	4,387	4,387	4,387	4,387	4,387	4,387
Irrigation	4,477	4,477	4,477	4,477	4,477	4,477
Mining	312	210	107	123	142	163
Livestock	1,143	1,143	1,143	1,143	1,143	1,143
Grayson County Total	**39,192**	**41,009**	**41,881**	**44,867**	**55,068**	**72,258**
Henderson County (Region C Portion Only)						
Municipal	7,534	8,015	8,577	9,467	13,208	17,841
Manufacturing	806	985	985	985	985	985
Steam Electric Power	3,709	3,709	3,709	3,709	3,709	3,709
Irrigation	582	582	582	582	582	582
Mining	434	506	481	484	479	469
Livestock	1,261	1,261	1,261	1,261	1,261	1,261
Henderson County Total	**14,326**	**15,058**	**15,595**	**16,488**	**20,224**	**24,847**
Jack County						
Municipal	1,227	1,267	1,286	1,294	1,309	1,321
Manufacturing	1	1	1	1	1	1
Steam Electric Power	3,772	3,772	3,772	3,772	3,772	3,772
Irrigation	98	98	98	98	98	98
Mining	3,396	1,821	1,698	1,731	1,768	1,862
Livestock	785	785	785	785	785	785
Jack County Total	**9,279**	**7,744**	**7,640**	**7,681**	**7,733**	**7,839**
Kaufman County						
Municipal	19,542	25,960	32,141	40,518	54,694	72,158
Manufacturing	946	1,109	1,109	1,109	1,109	1,109
Steam Electric Power	9,793	9,793	9,793	9,793	9,793	9,793
Irrigation	285	285	285	285	285	285
Mining	296	386	491	646	783	951
Livestock	1,570	1,570	1,570	1,570	1,570	1,570
Kaufman County Total	**32,432**	**39,103**	**45,389**	**53,921**	**68,234**	**85,866**

Type of Use	Projected Dry Year Water Demand (Acre-Feet per Year)					
	2020	2030	2040	2050	2060	2070
Navarro County						
Municipal	9,174	10,037	10,877	12,036	13,368	15,470
Manufacturing	894	1,062	1,062	1,062	1,062	1,062
Steam Electric Power	0	0	0	0	0	0
Irrigation	75	75	75	75	75	75
Mining	1,193	1,238	1,282	1,572	1,806	2,076
Livestock	1,691	1,691	1,691	1,691	1,691	1,691
Navarro County Total	**13,027**	**14,103**	**14,987**	**16,436**	**18,002**	**20,374**
Parker County						
Municipal	32,001	41,707	44,186	55,648	70,800	87,042
Manufacturing	87	103	103	103	103	103
Steam Electric Power	604	604	604	604	604	604
Irrigation	773	773	773	773	773	773
Mining	3,182	4,029	4,006	4,073	4,124	4,364
Livestock	1,634	1,634	1,634	1,634	1,634	1,634
Parker County Total	**38,281**	**48,850**	**51,306**	**62,835**	**78,038**	**94,520**
Rockwall County						
Municipal	22,654	30,411	40,416	45,196	51,910	57,225
Manufacturing	31	36	36	36	36	36
Steam Electric Power	0	0	0	0	0	0
Irrigation	234	234	234	234	234	234
Mining	0	0	0	0	0	0
Livestock	111	111	111	111	111	111
Rockwall County Total	**23,030**	**30,792**	**40,797**	**45,577**	**52,291**	**57,606**
Tarrant County						
Municipal	396,608	446,443	503,051	544,001	577,157	612,383
Manufacturing	12,197	13,301	13,301	13,301	13,301	13,301
Steam Electric Power	1,157	4,948	4,948	4,948	4,948	4,948
Irrigation	4,926	4,926	4,926	4,926	4,926	4,926
Mining	11,535	6,562	1,589	1,537	1,497	1,464
Livestock	627	627	627	627	627	627
Tarrant County Total	**427,050**	**476,807**	**528,442**	**569,340**	**602,456**	**637,649**
Wise County						
Municipal	12,694	15,211	17,821	22,238	26,592	33,305
Manufacturing	454	501	501	501	501	501
Steam Electric Power	2,894	2,894	2,894	2,894	2,894	2,894
Irrigation	1,406	1,406	1,406	1,406	1,406	1,406
Mining	10,320	11,159	12,337	13,975	15,378	17,694
Livestock	1,198	1,198	1,198	1,198	1,198	1,198
Wise County Total	**28,966**	**32,369**	**36,157**	**42,212**	**47,969**	**56,998**

2.3.8 Water Provider Projections

Table 2.10 shows the projected dry-year demand in Region C by major, regional and wholesale water provider. **Appendix D** also contains DB22 reports for all wholesale water providers. **Attachment 5** shows the population served by each major water provider and the demand for each major water provider by demand category.

Table 2.10 Projected Dry-Year Water Demand by Wholesale Water Provider

Wholesale Water Provider	2020	2030	2040	2050	2060	2070
Major Water Providers						
North Texas Municipal Water District	408,705	467,843	540,864	618,977	696,551	769,233
Tarrant Regional Water District	495,119	582,072	662,746	747,498	827,523	926,855
Dallas Water Utilities	528,510	553,336	608,020	671,724	738,730	781,975
Upper Trinity Regional Water District	50,334	75,852	97,651	121,641	141,150	162,360
Trinity River Authority	173,016	232,520	251,393	266,928	283,677	308,701
Fort Worth	289,575	347,010	408,324	453,667	493,064	533,882
Regional Wholesale Water Providers						
Corsicana	11,314	12,474	13,510	14,856	16,431	18,798
Greater Texoma Utility Authority	17,745	43,356	59,623	67,798	80,672	96,832
Other Region C Wholesale Water Providers						
Arlington	70,793	75,076	75,561	76,753	76,933	77,260
Athens Municipal Water Authority	5,271	5,649	5,877	6,211	8,878	11,972
Dallas County Park Cities MUD	14,962	15,304	15,221	15,143	15,128	15,127
Denison	8,696	9,491	9,631	10,616	12,690	16,290
Denton	26,889	33,776	41,635	56,978	81,307	99,893
Ennis	5,492	6,273	6,983	9,400	14,408	23,742
Forney	16,851	18,081	19,736	22,529	27,775	33,688
Gainesville	4,277	4,015	4,121	4,604	5,912	9,971
Garland	53,312	56,245	57,723	57,821	58,021	58,021
Grand Prairie	37,813	44,562	47,910	47,657	47,598	47,593
Mansfield	24,828	37,140	43,301	53,296	59,860	66,379
Midlothian	13,958	19,027	21,241	20,660	21,299	22,301
Mustang SUD	8,211	14,120	18,365	22,211	26,064	29,920
North Richland Hills	15,656	16,197	15,909	15,748	15,716	15,714
Princeton	1,781	4,560	8,852	10,414	10,540	10,844
Rockett SUD	6,590	8,156	9,070	11,591	15,521	22,101
Rockwall	16,045	22,702	31,129	32,424	35,236	38,275
Seagoville	2,416	2,824	3,253	3,732	4,247	4,361
Sherman	18,672	38,284	46,780	48,226	53,574	64,793
Terrell	5,469	9,239	12,120	14,233	16,920	20,756
Walnut Creek SUD	2,827	3,321	3,800	5,215	7,279	9,635
Waxahachie	10,366	11,712	13,594	16,837	22,321	28,903
Weatherford	6,849	8,336	8,759	14,421	22,662	30,906
Wise County WSD	2,364	3,199	4,110	5,290	6,207	7,206
Wholesale Water Providers based in Other Regions [a]						
Sabine River Authority	275,401	234,855	234,765	234,675	234,595	234,493
Upper Neches River MWA	0	105,370	104,564	103,704	102,791	101,555
Sulphur River Municipal Water District	11,795	11,729	11,662	11,594	11,528	11,460
Sulphur River Basin Authority	0	0	0	361,200	361,200	361,200
Red River Authority of Texas	358	392	421	454	487	467

[a]*Only the demand from Region C customers*

2.4 Chapter 2 List of References

(1) United States Bureau of the Census: Census 2010 Data for the State of Texas; Population by County, Population by Place, [Online], Available URL: http://quickfacts.census.gov/, March 2014.

(2) Texas Water Development Board: 2010-2015 Population Estimate Comparison (U.S. Census vs. State Water Plan Projections), http://www.twdb.texas.gov/waterplanning/rwp/planningdocu/2021/current_docs.asp December 22, 2016.

(3) Texas Water Development Board: 2015 Texas Water Use Summary Estimates for Region C, Austin, [Online], Available URL http://www2.twdb.texas.gov/ReportServerExt/Pages/ReportViewer.aspx?%2fWU%2fSumFinal_RegionReportWithReuse&rs:Command=Render, downloaded December 27, 2017.

(4) Freese and Nichols, Inc., Alan Plummer Associates, Inc., CP&Y, Inc., and Cooksey Communications, Inc.: *2016 Region C Water Plan*, prepared for the Region C Water Planning Group, Fort Worth, December 2015.

(5) Freese and Nichols, Inc., Alan Plummer Associates, Inc., CP&Y, Inc., and Cooksey Communications, Inc.: *2011 Region C Water Plan*, prepared for the Region C Water Planning Group, Fort Worth, October 2010.

(6) Bureau of Economic Geology in conjunction with Texas Water Development Board: *Current and Projected Water Use in the Texas Mining and Oil and Gas Industry*. June 2011.

(7) Bureau of Economic Geology, *Oil and Gas Water Use in Texas: Update to the 2011 Mining Water Use Report*, prepared for Texas Water Development Board, September 2012.

Attachment One

Region C Population Projections by WUG, by County

Attachment 1 - Region C Population Projections by WUG, by County

In Multiple Counties or Regions?	County	Water User Group (WUG)	Final Region C Population Projections 2020	2030	2040	2050	2060	2070
	COLLIN	ALLEN	105,000	114,000	116,000	118,000	120,000	122,000
	COLLIN	ANNA	15,037	25,747	41,195	53,553	69,619	90,505
Yes	COLLIN	BEAR CREEK SUD	5,179	8,287	11,920	16,695	20,961	26,474
Yes	COLLIN	B H P WSC	510	778	1,001	1,011	1,032	1,032
	COLLIN	BLUE RIDGE	2,425	4,190	39,507	81,703	116,583	161,591
Yes	COLLIN	CADDO BASIN SUD	2,315	2,922	4,004	5,337	6,868	8,517
Yes	COLLIN	CARROLLTON	4	6	9	12	15	19
Yes	COLLIN	CELINA	21,257	51,038	77,710	105,998	134,286	162,573
	COLLIN	COPEVILLE SUD	3,959	4,945	6,148	8,574	15,171	26,007
	COLLIN	COUNTY OTHER	4,000	4,000	4,000	4,000	7,944	12,350
	COLLIN	CULLEOKA WSC	5,500	5,787	8,739	10,615	12,000	15,000
Yes	COLLIN	DALLAS	71,320	73,220	74,169	74,169	74,169	74,169
Yes	COLLIN	DESERT WSC	400	451	531	675	917	1,198
Yes	COLLIN	EAST FORK SUD	10,735	12,040	13,826	13,963	14,492	14,997
	COLLIN	FAIRVIEW	12,592	14,529	19,397	20,193	20,418	20,418
	COLLIN	FARMERSVILLE	8,660	21,680	49,295	75,393	107,169	154,965
Yes	COLLIN	FRISCO	112,747	116,865	137,833	199,910	234,514	251,443
Yes	COLLIN	FROGNOT WSC	1,630	1,904	2,326	2,928	3,344	3,720
Yes	COLLIN	GARLAND	317	396	492	619	755	900
Yes	COLLIN	HICKORY CREEK SUD	104	149	209	305	433	614
Yes	COLLIN	JOSEPHINE	1,434	2,300	3,226	4,175	4,352	4,352
	COLLIN	LUCAS	7,822	8,908	11,794	13,720	15,330	15,330
Yes	COLLIN	MARILEE SUD	4,580	4,580	4,663	4,663	4,663	4,663
	COLLIN	MCKINNEY	186,565	205,000	227,522	275,828	330,324	357,967
	COLLIN	MELISSA	17,938	57,000	80,000	100,000	115,072	119,072
	COLLIN	MILLIGAN WSC	3,728	4,352	5,312	6,680	7,604	8,423

In Multiple Counties or Regions?	County	Water User Group (WUG)	Final Region C Population Projections 2020	2030	2040	2050	2060	2070
	COLLIN	MURPHY	19,330	19,330	19,330	19,330	19,330	19,330
Yes	COLLIN	NEVADA SUD	2,418	2,983	3,512	11,407	27,028	48,652
	COLLIN	NORTH COLLIN SUD	5,566	6,442	7,509	9,006	10,529	12,143
	COLLIN	NORTH FARMERSVILLE WSC	417	486	594	747	850	942
	COLLIN	PARKER	7,316	7,316	7,811	9,117	10,035	11,465
Yes	COLLIN	PLANO	279,151	283,397	287,717	288,601	289,054	292,054
	COLLIN	PRINCETON	11,047	38,120	77,633	91,943	91,943	91,943
Yes	COLLIN	PROSPER	19,003	22,000	25,000	28,000	35,056	35,056
Yes	COLLIN	RICHARDSON	35,700	35,700	35,700	36,536	38,207	41,690
Yes	COLLIN	ROYSE CITY	2,225	10,604	19,182	30,063	40,153	52,844
Yes	COLLIN	SACHSE	8,108	8,108	8,108	8,441	8,535	8,535
	COLLIN	SEIS LAGOS UD	2,041	2,041	2,041	2,124	2,148	2,148
Yes	COLLIN	SOUTH GRAYSON SUD	1,232	1,538	2,057	2,501	2,920	3,324
	COLLIN	VERONA SUD	2,648	3,091	3,772	4,744	5,400	5,983
Yes	COLLIN	WEST LEONARD WSC	318	362	441	596	857	1,142
Yes	COLLIN	WESTMINSTER WSC	1,889	2,204	2,687	3,377	3,851	4,277
Yes	COLLIN	WYLIE	41,381	44,531	46,984	50,563	52,636	57,986
	COLLIN	WYLIE NORTHEAST SUD	4,958	5,976	7,015	11,464	17,153	25,279
	COLLIN TOTAL		**1,050,506**	**1,239,303**	**1,497,921**	**1,807,279**	**2,093,720**	**2,373,092**
Yes	COOKE	BOLIVAR WSC	1,169	1,255	1,320	1,386	1,441	1,488
	COOKE	CALLISBURG WSC	1,656	1,696	1,726	1,744	1,756	1,767
	COOKE	COUNTY OTHER	5,627	6,063	6,714	9,849	12,444	29,307
	COOKE	GAINESVILLE	18,477	19,832	20,870	21,904	26,645	37,302
	COOKE	LAKE KIOWA SUD	2,200	2,300	2,350	2,400	2,420	2,450

In Multiple Counties or Regions?	County	Water User Group (WUG)	Final Region C Population Projections 2020	2030	2040	2050	2060	2070
	COOKE	LINDSAY	1,325	1,423	1,517	1,688	2,020	3,042
Yes	COOKE	MOUNTAIN SPRING WSC	2,654	2,848	2,998	3,146	5,000	7,999
	COOKE	MUENSTER	1,564	1,564	1,614	1,614	1,665	1,665
Yes	COOKE	TWO WAY SUD	100	108	113	119	124	128
Yes	COOKE	WOODBINE WSC	6,131	6,946	7,762	8,577	9,390	10,203
	COOKE TOTAL		**40,903**	**44,035**	**46,984**	**52,427**	**62,905**	**95,351**
	DALLAS	ADDISON	14,869	15,895	16,921	17,947	18,973	20,000
	DALLAS	BALCH SPRINGS	26,418	28,974	31,600	34,449	37,226	40,010
Yes	DALLAS	CARROLLTON	51,277	51,277	51,277	51,277	51,277	51,277
Yes	DALLAS	CEDAR HILL	53,244	65,133	76,989	83,579	83,579	83,579
	DALLAS	COCKRELL HILL	4,787	5,250	5,250	5,250	6,999	14,997
Yes	DALLAS	COMBINE WSC	810	986	1,185	1,412	1,669	1,956
Yes	DALLAS	COPPELL	40,848	41,747	41,809	41,809	41,809	41,809
	DALLAS	COUNTY OTHER	1,092	798	862	917	1,318	1,617
Yes	DALLAS	DALLAS	1,141,059	1,242,191	1,420,781	1,591,937	1,722,709	1,785,569
	DALLAS	DESOTO	54,505	58,941	64,281	70,078	75,727	78,033
	DALLAS	DUNCANVILLE	43,110	47,307	47,307	47,307	47,307	47,307
Yes	DALLAS	EAST FORK SUD	3,725	3,725	3,376	4,169	4,942	5,717
	DALLAS	FARMERS BRANCH	30,582	32,477	34,420	36,531	38,586	40,648
Yes	DALLAS	FERRIS	6	10	14	19	23	27
Yes	DALLAS	GARLAND	254,381	278,659	293,920	297,792	299,655	299,509
Yes	DALLAS	GLENN HEIGHTS	13,822	18,831	23,973	29,555	34,995	45,991
Yes	DALLAS	GRAND PRAIRIE	166,208	206,781	231,491	231,491	231,491	231,491
	DALLAS	HIGHLAND PARK	9,023	9,311	9,311	9,311	9,311	9,311
	DALLAS	HUTCHINS	9,901	13,919	17,937	21,956	25,974	29,994
	DALLAS	IRVING	259,186	294,623	301,541	301,541	301,541	301,541

In Multiple Counties or Regions?	County	Water User Group (WUG)	Final Region C Population Projections 2020	2030	2040	2050	2060	2070
	DALLAS	LANCASTER	45,097	58,781	69,582	77,498	85,417	93,333
Yes	DALLAS	LEWISVILLE	841	841	841	841	841	841
Yes	DALLAS	MESQUITE	149,800	164,758	186,045	202,822	219,171	235,561
Yes	DALLAS	OVILLA	485	624	768	924	1,076	1,862
Yes	DALLAS	RICHARDSON	73,816	76,839	79,892	82,378	82,378	82,378
Yes	DALLAS	ROCKETT SUD	1,000	2,000	2,999	3,999	4,999	5,999
Yes	DALLAS	ROWLETT	59,891	65,397	70,903	75,409	78,784	83,228
Yes	DALLAS	SACHSE	20,596	20,596	20,596	20,596	20,596	20,596
Yes	DALLAS	SEAGOVILLE	18,853	22,871	26,888	30,904	34,987	34,974
	DALLAS	SUNNYVALE	6,637	9,481	12,326	14,222	14,222	14,222
	DALLAS	UNIVERSITY PARK	25,656	25,656	25,656	25,656	25,656	25,656
	DALLAS	WILMER	4,111	4,595	7,336	13,692	21,517	39,121
Yes	DALLAS	WYLIE	2,324	2,388	2,452	2,515	2,579	2,704
	DALLAS TOTAL		**2,587,960**	**2,871,662**	**3,180,529**	**3,429,783**	**3,627,334**	**3,770,858**
	DENTON	ARGYLE WSC	13,466	17,126	22,005	22,005	22,005	22,005
	DENTON	AUBREY	4,597	6,112	7,148	8,475	10,173	12,346
	DENTON	BLACK ROCK WSC	1,570	1,977	2,347	2,745	3,215	3,639
Yes	DENTON	BOLIVAR WSC	9,904	12,050	14,614	17,479	20,832	24,660
Yes	DENTON	CARROLLTON	79,200	81,682	81,682	81,682	81,682	81,682
Yes	DENTON	CELINA	743	5,248	17,514	37,427	37,427	37,427
Yes	DENTON	COPPELL	1,134	1,134	1,134	1,134	1,134	1,134
	DENTON	CORINTH	24,928	29,520	29,520	29,520	29,520	29,520
	DENTON	COUNTY OTHER	9,573	12,431	15,289	33,673	59,607	112,763
	DENTON	CROSS TIMBERS WSC	7,500	9,523	9,647	9,785	9,947	10,131
Yes	DENTON	DALLAS	29,680	32,203	36,598	40,789	43,991	45,531
	DENTON	DENTON	145,000	186,773	233,749	322,996	463,472	570,694

In Multiple Counties or Regions?	County	Water User Group (WUG)	Final Region C Population Projections 2020	2030	2040	2050	2060	2070
	DENTON	DENTON COUNTY FWSD 10	7,884	16,750	19,770	19,770	19,770	19,770
	DENTON	DENTON COUNTY FWSD 1-A	14,000	25,021	30,000	30,000	30,000	30,000
	DENTON	DENTON COUNTY FWSD 7	13,500	13,500	13,500	13,500	13,500	13,500
Yes	DENTON	FLOWER MOUND	75,315	84,200	86,000	88,000	90,000	92,730
Yes	DENTON	FORT WORTH	36,529	56,185	81,471	114,851	147,198	179,544
Yes	DENTON	FRISCO	75,596	95,300	120,040	121,546	123,051	123,557
	DENTON	HACKBERRY	1,870	2,415	3,065	3,792	4,642	5,612
	DENTON	HIGHLAND VILLAGE	17,119	18,020	18,020	18,020	18,020	18,020
	DENTON	JUSTIN	4,766	8,532	12,298	12,298	12,298	12,298
	DENTON	KRUM	5,110	6,347	7,827	9,479	11,413	13,621
	DENTON	LAKE CITIES MUA	15,312	17,649	20,200	21,810	21,810	21,810
Yes	DENTON	LEWISVILLE	106,485	121,082	138,526	158,014	176,513	176,513
	DENTON	LITTLE ELM	29,627	33,557	33,557	33,557	33,557	33,557
Yes	DENTON	MOUNTAIN SPRING WSC	55	61	68	74	84	94
Yes	DENTON	MUSTANG SUD	30,336	56,772	83,209	109,647	136,080	162,519
	DENTON	NORTHLAKE	9,500	22,000	31,010	43,005	55,000	55,000
	DENTON	PALOMA CREEK NORTH CRU	8,194	11,174	11,174	11,174	11,174	11,174
	DENTON	PALOMA CREEK SOUTH CRU	4,154	5,665	5,665	5,665	5,665	5,665
	DENTON	PILOT POINT	6,500	8,000	11,000	15,000	20,000	27,000
Yes	DENTON	PLANO	7,449	7,747	7,946	7,946	7,946	7,946
	DENTON	PONDER	3,117	4,305	5,725	7,311	9,169	11,289
Yes	DENTON	PROSPER	1,157	5,609	10,058	15,029	15,944	15,944
	DENTON	PROVIDENCE VILLAGE WCID	7,235	7,235	7,235	7,235	7,235	7,235

In Multiple Counties or Regions?	County	Water User Group (WUG)	Final Region C Population Projections 2020	2030	2040	2050	2060	2070
	DENTON	ROANOKE	7,949	9,956	11,961	11,961	11,961	11,961
	DENTON	SANGER	8,190	10,164	12,522	15,158	18,243	21,765
Yes	DENTON	SOUTHLAKE	1,014	1,310	1,662	2,057	2,518	3,045
	DENTON	THE COLONY	53,029	58,000	62,000	67,600	67,600	67,600
	DENTON	TROPHY CLUB	12,750	12,750	12,750	12,750	12,750	12,750
Yes	DENTON	WESTLAKE	26	34	45	56	69	85
	DENTON TOTAL		**891,063**	**1,115,119**	**1,329,551**	**1,584,015**	**1,866,215**	**2,113,136**
	ELLIS	AVALON WATER SUPPLY AND SEWER SERVICE	1,182	1,435	1,764	2,405	3,242	4,537
Yes	ELLIS	BRANDON IRENE WSC	70	90	112	145	177	215
	ELLIS	BUENA VISTA-BETHEL SUD	4,619	5,617	6,605	8,465	12,169	16,217
Yes	ELLIS	CEDAR HILL	694	884	1,103	1,421	1,421	1,421
	ELLIS	COUNTY OTHER	3,392	2,819	4,119	13,317	42,127	86,838
	ELLIS	EAST GARRETT WSC	1,490	1,896	2,368	3,051	3,743	8,933
	ELLIS	ENNIS	21,354	25,111	28,828	41,086	66,145	110,073
Yes	ELLIS	FERRIS	2,944	5,190	7,186	8,181	9,177	10,173
Yes	ELLIS	FILES VALLEY WSC	755	961	1,199	1,545	1,896	2,302
Yes	ELLIS	GLENN HEIGHTS	3,874	4,929	6,153	7,930	9,728	14,843
Yes	ELLIS	GRAND PRAIRIE	55	71	88	114	140	170
Yes	ELLIS	HILCO UNITED SERVICES	149	160	167	183	192	202
	ELLIS	ITALY	2,365	3,011	3,757	4,842	6,132	8,176
Yes	ELLIS	MANSFIELD	110	130	162	236	293	361
	ELLIS	MIDLOTHIAN	20,660	30,895	32,500	34,500	36,836	40,689
Yes	ELLIS	MOUNTAIN PEAK SUD	9,467	12,047	12,800	18,377	21,269	23,861

In Multiple Counties or Regions?	County	Water User Group (WUG)	Final Region C Population Projections 2020	2030	2040	2050	2060	2070
Yes	ELLIS	OVILLA	4,000	5,089	6,352	8,186	10,042	18,505
	ELLIS	PALMER	2,440	3,104	3,875	4,994	6,383	11,784
	ELLIS	RED OAK	7,667	8,635	11,660	16,615	20,449	31,952
Yes	ELLIS	RICE WATER SUPPLY AND SEWER SERVICE	5,861	7,190	8,710	10,758	12,925	15,421
Yes	ELLIS	ROCKETT SUD	39,447	51,008	56,000	75,000	100,000	130,000
	ELLIS	SARDIS LONE ELM WSC	19,699	26,433	30,524	31,524	32,524	32,524
Yes	ELLIS	SOUTH ELLIS COUNTY WSC	1,563	1,887	2,313	3,144	4,227	5,902
Yes	ELLIS	VENUS	81	102	128	165	202	246
	ELLIS	WAXAHACHIE	37,700	43,084	52,272	64,400	78,500	95,500
	ELLIS TOTAL		**191,638**	**241,778**	**280,745**	**360,584**	**479,939**	**670,845**
	FANNIN	ARLEDGE RIDGE WSC	1,332	1,508	1,833	2,406	3,542	4,813
	FANNIN	BOIS D ARC MUD	2,319	2,625	3,190	4,187	6,164	8,376
	FANNIN	BONHAM	12,603	16,000	22,000	30,000	37,000	45,000
	FANNIN	COUNTY OTHER	5,959	4,936	5,331	7,867	22,271	38,645
Yes	FANNIN	DELTA COUNTY MUD	45	45	46	46	47	49
Yes	FANNIN	DESERT WSC	682	770	817	997	1,442	2,135
Yes	FANNIN	HICKORY CREEK SUD	297	327	348	369	402	438
	FANNIN	HONEY GROVE	1,817	1,828	1,828	1,828	1,828	1,828
	FANNIN	LADONIA	1,600	2,000	2,200	2,500	3,000	3,000
	FANNIN	LEONARD	2,200	2,400	2,500	2,600	2,700	2,800
Yes	FANNIN	NORTH HUNT SUD	525	577	617	653	709	769
Yes	FANNIN	SOUTHWEST FANNIN COUNTY SUD	4,108	4,516	4,806	5,090	6,114	7,269
	FANNIN	TRENTON	736	934	2,102	4,203	7,248	10,271

In Multiple Counties or Regions?	County	Water User Group (WUG)	Final Region C Population Projections 2020	2030	2040	2050	2060	2070
Yes	FANNIN	WEST LEONARD WSC	1,238	1,362	1,310	1,388	1,623	1,996
	FANNIN	WHITE SHED WSC	2,769	3,133	3,809	4,998	7,360	10,001
Yes	FANNIN	WHITEWRIGHT	10	11	12	13	14	15
Yes	FANNIN	WOLFE CITY	90	112	142	183	242	327
	FANNIN TOTAL		**38,330**	**43,084**	**52,891**	**69,328**	**101,706**	**137,732**
	FREESTONE	BUTLER WSC	1,450	1,465	1,475	1,490	1,497	1,506
	FREESTONE	COUNTY OTHER	4,101	4,078	3,751	4,673	11,270	29,241
	FREESTONE	FAIRFIELD	4,593	4,670	4,951	8,749	10,498	14,116
Yes	FREESTONE	FLO COMMUNITY WSC	454	489	513	532	545	555
Yes	FREESTONE	PLEASANT GROVE WSC	1,243	1,288	1,402	1,877	2,649	4,292
Yes	FREESTONE	POINT ENTERPRISE WSC	817	865	905	948	983	1,013
	FREESTONE	SOUTH FREESTONE COUNTY WSC	2,565	2,646	2,880	3,908	5,582	9,198
	FREESTONE	TEAGUE	4,029	4,298	5,728	7,575	9,132	10,744
	FREESTONE	WORTHAM	1,185	1,278	1,342	1,390	2,319	2,622
	FREESTONE TOTAL		**20,437**	**21,077**	**22,947**	**31,142**	**44,475**	**73,287**
	GRAYSON	BELLS	1,713	2,020	2,322	2,536	5,925	8,000
	GRAYSON	COLLINSVILLE	2,567	3,139	3,798	4,596	4,850	6,370
	GRAYSON	COUNTY OTHER	5,882	4,929	3,073	3,631	12,314	20,310
	GRAYSON	DENISON	27,340	30,410	30,768	33,805	39,346	52,403
Yes	GRAYSON	DESERT WSC	618	676	732	792	875	947
	GRAYSON	DORCHESTER	1,622	1,762	1,907	2,000	2,183	2,436
	GRAYSON	GUNTER	1,841	2,538	3,384	4,230	5,182	6,046
	GRAYSON	HOWE	2,868	3,372	3,854	4,275	4,823	5,379

In Multiple Counties or Regions?	County	Water User Group (WUG)	Final Region C Population Projections					
			2020	2030	2040	2050	2060	2070
	GRAYSON	KENTUCKY TOWN WSC	2,856	3,443	4,008	4,537	5,761	7,387
	GRAYSON	LUELLA SUD	3,680	4,248	4,803	5,203	5,865	6,861
Yes	GRAYSON	MARILEE SUD	3,106	3,375	3,570	3,570	3,570	3,570
Yes	GRAYSON	MUSTANG SUD	264	268	271	273	280	281
	GRAYSON	NORTHWEST GRAYSON COUNTY WCID 1	1,906	1,990	2,095	2,362	3,194	4,479
	GRAYSON	OAK RIDGE SOUTH GALE WSC	2,551	2,522	2,802	3,161	4,273	5,861
	GRAYSON	PINK HILL WSC	1,992	2,187	2,187	2,467	3,335	4,576
	GRAYSON	POTTSBORO	3,056	3,951	4,834	6,331	10,000	18,000
Yes	GRAYSON	RED RIVER AUTHORITY OF TEXAS	1,457	1,625	1,773	1,921	2,062	1,976
	GRAYSON	SHERMAN	43,522	45,675	46,749	50,692	66,937	102,574
Yes	GRAYSON	SOUTH GRAYSON SUD	2,902	3,118	3,565	3,717	3,928	4,052
	GRAYSON	SOUTHMAYD	1,281	1,426	1,569	1,731	2,334	3,151
Yes	GRAYSON	SOUTHWEST FANNIN COUNTY SUD	1,727	2,308	3,072	3,947	5,382	7,061
	GRAYSON	STARR WSC	2,355	2,588	2,556	2,882	3,897	5,347
	GRAYSON	TIOGA	1,209	1,322	1,421	1,535	3,395	4,656
	GRAYSON	TOM BEAN	1,256	1,432	1,593	1,779	2,196	3,294
Yes	GRAYSON	TWO WAY SUD	6,156	7,963	9,411	11,368	15,200	19,653
	GRAYSON	VAN ALSTYNE	3,750	5,300	7,470	9,640	18,644	23,494
Yes	GRAYSON	WESTMINSTER WSC	20	24	29	35	40	44
	GRAYSON	WHITESBORO	3,839	3,908	3,956	3,917	4,975	6,582
Yes	GRAYSON	WHITEWRIGHT	1,896	1,919	1,941	1,867	1,978	2,199
Yes	GRAYSON	WOODBINE WSC	79	89	97	107	121	131

In Multiple Counties or Regions?	County	Water User Group (WUG)	Final Region C Population Projections 2020	2030	2040	2050	2060	2070
	GRAYSON TOTAL		**135,311**	**149,527**	**159,610**	**178,907**	**242,865**	**337,120**
Yes	HENDERSON	ATHENS	14,241	15,906	17,294	19,125	32,895	48,841
Yes	HENDERSON	B B S WSC	29	30	30	30	30	30
Yes	HENDERSON	BETHEL ASH WSC	2,115	2,385	2,609	2,907	3,163	3,411
Yes	HENDERSON	COUNTY OTHER	3,314	2,557	2,770	1,706	656	1,398
	HENDERSON	CRESCENT HEIGHTS WSC	1,885	2,012	2,172	2,361	2,968	3,770
	HENDERSON	DOGWOOD ESTATES WATER	1,205	1,286	1,388	1,509	1,897	2,409
	HENDERSON	EAST CEDAR CREEK FWSD	20,100	22,320	24,840	27,570	30,630	34,050
	HENDERSON	EUSTACE	1,170	1,277	1,383	2,041	2,659	3,191
Yes	HENDERSON	MABANK	3,715	4,141	4,568	5,975	8,339	11,619
	HENDERSON	MALAKOFF	2,432	2,512	2,580	2,668	2,824	3,026
	HENDERSON	TRINIDAD	1,026	1,026	1,026	1,026	1,158	1,390
Yes	HENDERSON	VIRGINIA HILL WSC	2,384	2,734	3,027	3,413	3,774	4,246
Yes	HENDERSON	WEST CEDAR CREEK MUD	13,963	14,406	14,817	15,570	19,500	24,500
	HENDERSON TOTAL		**67,579**	**72,592**	**78,504**	**85,901**	**110,493**	**141,881**
	JACK	COUNTY OTHER	4,878	5,207	5,411	5,519	5,597	5,648
	JACK	JACKSBORO	4,873	5,202	5,406	5,514	5,593	5,643
	JACK TOTAL		**9,751**	**10,409**	**10,817**	**11,033**	**11,190**	**11,291**
Yes	KAUFMAN	ABLES SPRINGS WSC	4,502	5,582	6,730	8,443	10,293	12,308
	KAUFMAN	BECKER JIBA WSC	3,547	4,590	5,626	7,933	11,093	14,800
	KAUFMAN	COLLEGE MOUND WSC	11,510	14,270	17,206	21,584	31,717	40,174
Yes	KAUFMAN	COMBINE WSC	2,904	3,503	4,122	5,066	6,047	7,089

In Multiple Counties or Regions?	County	Water User Group (WUG)	Final Region C Population Projections 2020	2030	2040	2050	2060	2070
	KAUFMAN	COUNTY OTHER	1,559	2,889	3,241	3,293	13,587	31,127
	KAUFMAN	CRANDALL	4,209	5,218	6,292	7,840	7,920	7,920
	KAUFMAN	ELMO WSC	2,566	3,320	4,071	5,418	7,576	10,110
	KAUFMAN	FORNEY	21,341	24,927	31,904	40,020	59,400	79,200
Yes	KAUFMAN	FORNEY LAKE WSC	7,012	8,694	10,482	13,149	22,474	32,306
	KAUFMAN	GASTONIA SCURRY SUD	10,568	13,088	15,739	20,150	33,704	52,565
Yes	KAUFMAN	HIGH POINT WSC	4,314	5,356	6,462	8,057	12,155	15,724
	KAUFMAN	KAUFMAN	7,754	9,593	11,744	18,512	24,201	29,700
	KAUFMAN	KAUFMAN COUNTY DEVELOPMENT DISTRICT 1	3,687	4,771	5,849	7,786	10,887	14,527
	KAUFMAN	KAUFMAN COUNTY MUD 11	3,702	4,540	5,568	6,828	8,374	10,269
	KAUFMAN	KEMP	1,699	2,107	2,540	3,187	4,950	6,930
Yes	KAUFMAN	MABANK	6,048	6,673	7,208	9,726	13,712	19,106
Yes	KAUFMAN	MACBEE SUD	267	331	399	501	611	730
	KAUFMAN	MARKOUT WSC	2,391	3,094	3,793	5,050	7,062	9,422
Yes	KAUFMAN	MESQUITE	136	170	204	257	313	374
	KAUFMAN	NORTH KAUFMAN WSC	2,818	3,647	4,471	5,952	8,322	11,103
Yes	KAUFMAN	POETRY WSC	909	1,136	1,402	1,866	2,527	3,402
	KAUFMAN	ROSE HILL SUD	5,106	6,329	7,606	9,699	12,870	19,800
Yes	KAUFMAN	SEAGOVILLE	29	36	44	55	67	80
	KAUFMAN	TALTY SUD	10,985	12,710	14,642	20,600	28,710	39,600
	KAUFMAN	TERRELL	22,723	43,973	60,000	70,000	78,000	90,869
Yes	KAUFMAN	WEST CEDAR CREEK MUD	4,103	4,560	5,009	5,861	6,705	7,605
	KAUFMAN TOTAL		**146,389**	**195,107**	**242,354**	**306,833**	**423,277**	**566,840**

In Multiple Counties or Regions?	County	Water User Group (WUG)	Final Region C Population Projections					
			2020	2030	2040	2050	2060	2070
	NAVARRO	B AND B WSC	1,752	1,809	1,954	2,265	2,755	3,416
	NAVARRO	BLOOMING GROVE	973	1,073	1,175	1,293	1,416	1,547
Yes	NAVARRO	BRANDON IRENE WSC	193	213	234	257	281	307
	NAVARRO	CHATFIELD WSC	3,933	4,414	4,894	5,374	5,854	6,334
	NAVARRO	CORBET WSC	2,785	3,071	3,366	3,702	4,054	4,429
	NAVARRO	CORSICANA	26,739	29,484	32,318	35,546	38,921	42,525
	NAVARRO	COUNTY OTHER	2,298	3,838	4,379	5,919	7,460	15,000
	NAVARRO	DAWSON	893	934	975	1,016	1,057	1,100
	NAVARRO	KERENS	1,824	2,011	2,204	2,424	2,655	2,900
	NAVARRO	M E N WSC	3,451	3,805	4,171	4,588	5,023	5,488
	NAVARRO	NAVARRO MILLS WSC	3,128	3,450	3,782	4,159	4,554	4,975
Yes	NAVARRO	PLEASANT GROVE WSC	111	115	125	167	236	383
Yes	NAVARRO	POST OAK SUD	706	757	801	874	973	1,099
Yes	NAVARRO	RICE WATER SUPPLY AND SEWER SERVICE	3,660	4,511	5,492	6,514	7,828	9,338
Yes	NAVARRO	SOUTH ELLIS COUNTY WSC	59	71	88	115	154	215
	NAVARRO TOTAL		**52,505**	**59,556**	**65,958**	**74,213**	**83,221**	**99,056**
	PARKER	ALEDO	5,579	8,724	10,000	11,500	12,000	13,500
	PARKER	ANNETTA	3,720	4,422	5,123	5,825	6,526	7,228
Yes	PARKER	AZLE	2,467	2,676	2,887	3,100	3,746	4,806
	PARKER	COUNTY OTHER	50,936	49,541	40,513	64,100	100,000	146,554
Yes	PARKER	FORT WORTH	63,316	99,884	113,006	126,940	135,422	143,903
	PARKER	HORSESHOE BEND WATER SYSTEM	1,655	2,112	2,409	3,035	3,978	5,210

In Multiple Counties or Regions?	County	Water User Group (WUG)	Final Region C Population Projections					
			2020	2030	2040	2050	2060	2070
	PARKER	HUDSON OAKS	4,000	5,513	5,679	5,679	5,679	5,679
Yes	PARKER	MINERAL WELLS	2,107	2,078	2,044	2,004	1,958	1,905
Yes	PARKER	NORTH RURAL WSC	770	826	864	899	926	947
Yes	PARKER	PARKER COUNTY SUD	6,762	10,732	14,702	18,672	22,642	26,612
Yes	PARKER	RENO	2,522	2,566	2,613	2,670	2,734	2,809
	PARKER	SANTO SUD	94	102	108	114	121	128
	PARKER	SPRINGTOWN	4,068	5,484	5,484	5,484	5,484	5,484
Yes	PARKER	WALNUT CREEK SUD	17,811	21,176	22,589	32,601	48,379	63,430
	PARKER	WEATHERFORD	30,184	36,158	38,858	65,002	106,502	146,805
	PARKER	WILLOW PARK	5,500	8,200	10,100	12,500	16,000	18,000
	PARKER TOTAL		**201,491**	**260,194**	**276,979**	**360,125**	**472,097**	**593,000**
Yes	ROCKWALL	BEAR CREEK SUD	670	843	1,159	1,514	3,020	6,383
Yes	ROCKWALL	B H P WSC	302	375	475	612	808	1,092
Yes	ROCKWALL	BLACKLAND WSC	4,237	4,804	5,163	5,312	5,986	6,448
Yes	ROCKWALL	CASH SUD	1,220	1,580	1,989	2,403	2,864	3,354
	ROCKWALL	COUNTY OTHER	2,491	3,516	3,602	3,367	3,768	5,843
Yes	ROCKWALL	DALLAS	77	103	132	162	195	230
Yes	ROCKWALL	EAST FORK SUD	1,240	1,735	2,298	2,868	3,566	4,286
	ROCKWALL	FATE	15,994	20,789	28,000	37,000	45,000	50,000
Yes	ROCKWALL	FORNEY LAKE WSC	763	959	1,183	1,409	1,690	1,978
Yes	ROCKWALL	GARLAND	3	4	4	5	6	7
	ROCKWALL	HEATH	12,109	17,246	21,713	22,000	23,000	24,000
Yes	ROCKWALL	HIGH POINT WSC	565	709	873	1,056	1,604	2,091
	ROCKWALL	MOUNT ZION WSC	2,521	3,171	3,869	4,660	5,590	6,542
Yes	ROCKWALL	NEVADA SUD	75	91	111	449	1,122	2,019
	ROCKWALL	R C H WSC	4,266	5,946	6,969	8,487	10,994	13,407

In Multiple Counties or Regions?	County	Water User Group (WUG)	Final Region C Population Projections					
			2020	2030	2040	2050	2060	2070
	ROCKWALL	ROCKWALL	52,740	77,560	114,807	120,268	130,268	140,268
Yes	ROCKWALL	ROWLETT	7,632	7,632	7,632	7,632	7,763	7,825
Yes	ROCKWALL	ROYSE CITY	9,054	9,706	10,000	24,000	40,712	45,160
Yes	ROCKWALL	WYLIE	3,451	3,546	3,640	3,734	3,894	4,119
	ROCKWALL TOTAL		**119,410**	**160,315**	**213,619**	**246,938**	**291,850**	**325,052**
	TARRANT	ARLINGTON	387,000	404,225	413,655	423,084	423,084	423,084
Yes	TARRANT	AZLE	9,872	10,701	11,545	12,403	14,985	19,223
	TARRANT	BEDFORD	48,435	52,345	56,255	60,166	60,166	60,166
	TARRANT	BENBROOK	22,323	24,803	27,284	30,749	34,213	34,213
Yes	TARRANT	BETHESDA WSC	10,614	11,933	13,238	14,507	15,778	17,023
Yes	TARRANT	BURLESON	8,434	8,791	9,768	13,675	16,606	18,559
	TARRANT	COLLEYVILLE	23,719	25,201	27,000	28,000	28,000	28,000
	TARRANT	COMMUNITY WSC	3,419	3,845	4,265	4,673	5,083	5,484
	TARRANT	COUNTY OTHER	31,254	29,358	27,021	49,948	69,001	97,840
Yes	TARRANT	CROWLEY	16,250	18,986	22,679	27,268	34,890	39,874
	TARRANT	DALWORTHINGTON GARDENS	2,298	2,350	2,401	2,451	2,501	2,549
	TARRANT	EDGECLIFF	2,924	2,924	2,924	2,924	2,924	2,924
	TARRANT	EULESS	54,725	57,689	57,689	57,689	57,689	57,689
	TARRANT	EVERMAN	6,153	6,477	6,600	6,600	6,600	6,600
Yes	TARRANT	FLOWER MOUND	240	270	270	270	270	270
	TARRANT	FOREST HILL	12,975	13,761	14,971	17,965	22,955	29,942
Yes	TARRANT	FORT WORTH	848,803	1,042,039	1,282,178	1,395,762	1,493,447	1,592,141
Yes	TARRANT	GRAND PRAIRIE	51,864	51,864	51,864	51,864	51,864	51,864
	TARRANT	GRAPEVINE	52,243	54,037	54,037	54,037	54,037	54,037
	TARRANT	HALTOM CITY	43,611	44,602	46,585	50,550	54,514	59,470
	TARRANT	HASLET	1,750	5,380	7,870	14,000	14,000	14,000

In Multiple Counties or Regions?	County	Water User Group (WUG)	Final Region C Population Projections 2020	2030	2040	2050	2060	2070
	TARRANT	HURST	39,229	40,209	40,209	40,209	40,209	40,209
Yes	TARRANT	JOHNSON COUNTY SUD	2,649	2,897	3,233	3,568	3,904	4,240
	TARRANT	KELLER	48,279	51,974	51,974	51,974	51,974	51,974
	TARRANT	KENNEDALE	8,044	9,250	10,883	12,632	14,381	16,130
	TARRANT	LAKE WORTH	5,157	5,798	6,431	7,457	8,750	11,932
	TARRANT	LAKESIDE	1,350	1,400	1,450	1,500	1,500	1,500
Yes	TARRANT	MANSFIELD	67,501	85,935	102,678	127,297	146,050	164,697
	TARRANT	NORTH RICHLAND HILLS	72,102	77,480	77,480	77,480	77,480	77,480
	TARRANT	PANTEGO	2,653	2,653	2,653	2,653	2,653	2,653
	TARRANT	PELICAN BAY	1,684	1,716	1,748	1,779	1,810	1,841
Yes	TARRANT	RENO	15	22	29	36	44	49
	TARRANT	RICHLAND HILLS	8,401	9,001	9,601	10,850	12,000	13,500
	TARRANT	RIVER OAKS	7,559	7,559	7,559	7,559	7,559	7,559
	TARRANT	SAGINAW	23,166	26,386	29,607	31,218	31,218	31,218
	TARRANT	SANSOM PARK	4,799	5,099	5,722	6,063	6,405	6,739
Yes	TARRANT	SOUTHLAKE	26,695	29,882	34,862	39,843	44,823	49,803
	TARRANT	WATAUGA	24,525	24,525	24,525	24,525	24,525	24,525
Yes	TARRANT	WESTLAKE	1,515	4,200	6,882	7,694	7,681	7,665
	TARRANT	WESTOVER HILLS	682	699	715	732	749	764
	TARRANT	WESTWORTH VILLAGE	2,741	2,989	3,235	3,473	3,712	3,947
	TARRANT	WHITE SETTLEMENT	16,957	17,858	18,750	22,000	28,000	34,000
	TARRANT TOTAL		**2,004,609**	**2,279,113**	**2,580,325**	**2,799,127**	**2,978,034**	**3,167,377**
	WISE	ALVORD	1,625	1,957	2,297	2,800	3,200	3,600
Yes	WISE	BOLIVAR WSC	883	1,018	1,157	1,309	1,472	1,644
	WISE	BOYD	1,304	1,414	2,001	2,501	3,502	3,802

In Multiple Counties or Regions?	County	Water User Group (WUG)	Final Region C Population Projections					
			2020	2030	2040	2050	2060	2070
	WISE	BRIDGEPORT	7,337	8,999	10,702	14,762	19,682	24,603
	WISE	CHICO	1,412	1,487	1,565	2,955	3,761	4,702
	WISE	COUNTY OTHER	33,674	34,939	35,204	37,470	38,735	60,000
	WISE	DECATUR	8,509	11,740	15,254	19,752	23,227	27,002
Yes	WISE	FORT WORTH	12,176	17,481	22,561	29,015	35,327	41,639
	WISE	NEWARK	1,772	2,339	3,302	4,458	6,216	8,300
	WISE	RHOME	2,304	3,255	4,230	6,765	9,085	11,598
	WISE	RUNAWAY BAY	1,447	1,631	1,821	2,200	2,500	3,000
Yes	WISE	WALNUT CREEK SUD	3,540	4,790	6,072	7,487	11,101	14,351
	WISE	WEST WISE SUD	3,899	4,036	4,177	4,323	4,474	4,631
	WISE TOTAL		**79,882**	**95,086**	**110,343**	**135,797**	**162,282**	**208,872**
	REGIONAL TOTAL		**7,637,764**	**8,857,957**	**10,150,077**	**11,533,432**	**13,051,603**	**14,684,790**

Attachment Two

Projected Population for WUGs in Multiple Counties or Regions

Attachment 2 - Projected Population for WUGs in Multiple Counties or Regions

County	Water User Group (WUG)	Final Region C Population					
		2020	2030	2040	2050	2060	2070
KAUFMAN	ABLES SPRINGS WSC	4,502	5,582	6,730	8,443	10,293	12,308
HUNT (D)	ABLES SPRINGS WSC	866	1,327	1,952	2,816	4,046	5,834
VAN ZANDT (D)	ABLES SPRINGS WSC	33	36	39	41	44	45
	ABLES SPRINGS WSC TOTAL	**5,401**	**6,945**	**8,721**	**11,300**	**14,383**	**18,187**
HENDERSON	ATHENS	14,241	15,906	17,294	19,125	32,895	48,841
HENDERSON (I)	ATHENS	274	294	311	333	352	371
	ATHENS TOTAL	14,515	16,200	17,605	19,458	33,247	49,212
PARKER	AZLE	2,467	2,676	2,887	3,100	3,746	4,806
TARRANT	AZLE	9,872	10,701	11,545	12,403	14,985	19,223
	AZLE TOTAL	**12,339**	**13,377**	**14,432**	**15,503**	**18,731**	**24,029**
HENDERSON	B B S WSC	29	30	30	30	30	30
HENDERSON (I)	B B S WSC	1,345	1,388	1,405	1,405	1,405	1,405
	B B S WSC TOTAL	**1,374**	**1,418**	**1,435**	**1,435**	**1,435**	**1,435**
COLLIN	B H P WSC	510	778	1,001	1,011	1,032	1,032
ROCKWALL	B H P WSC	302	375	475	612	808	1,092
HUNT (D)	B H P WSC	4,421	5,494	6,950	8,960	11,824	15,986
	B H P WSC TOTAL	**5,233**	**6,647**	**8,426**	**10,583**	**13,664**	**18,110**
COLLIN	BEAR CREEK SUD	5,179	8,287	11,920	16,695	20,961	26,474
ROCKWALL	BEAR CREEK SUD	670	843	1,159	1,514	3,020	6,383
	BEAR CREEK SUD TOTAL	**5,849**	**9,130**	**13,079**	**18,209**	**23,981**	**32,857**
HENDERSON	BETHEL ASH WSC	2,115	2,385	2,609	2,907	3,163	3,411
HENDERSON (I)	BETHEL ASH WSC	3,154	3,565	3,908	4,362	4,753	5,133
VAN ZANDT (D)	BETHEL ASH WSC	905	1,185	1,399	1,613	1,788	1,938
	BETHEL ASH WSC TOTAL	**6,174**	**7,135**	**7,916**	**8,882**	**9,704**	**10,482**
TARRANT	BETHESDA WSC	10,614	11,933	13,238	14,507	15,778	17,023
JOHNSON (G)	BETHESDA WSC	18,180	20,976	23,861	27,024	30,437	34,090

County	Water User Group (WUG)	Final Region C Population					
		2020	2030	2040	2050	2060	2070
	BETHESDA WSC TOTAL	**28,794**	**32,909**	**37,099**	**41,531**	**46,215**	**51,113**
ROCKWALL	BLACKLAND WSC	4,237	4,804	5,163	5,312	5,986	6,448
HUNT (D)	BLACKLAND WSC	43	43	43	43	43	43
	BLACKLAND WSC TOTAL	**4,280**	**4,847**	**5,206**	**5,355**	**6,029**	**6,491**
COOKE	BOLIVAR WSC	1,169	1,255	1,320	1,386	1,441	1,488
DENTON	BOLIVAR WSC	9,904	12,050	14,614	17,479	20,832	24,660
WISE	BOLIVAR WSC	883	1,018	1,157	1,309	1,472	1,644
	BOLIVAR WSC TOTAL	**11,956**	**14,323**	**17,091**	**20,174**	**23,745**	**27,792**
ELLIS	BRANDON IRENE WSC	70	90	112	145	177	215
NAVARRO	BRANDON IRENE WSC	193	213	234	257	281	307
HILL (G)	BRANDON IRENE WSC	1,750	1,863	1,940	2,018	2,080	2,126
	BRANDON IRENE WSC TOTAL	**2,013**	**2,166**	**2,286**	**2,420**	**2,538**	**2,648**
TARRANT	BURLESON	8,434	8,791	9,768	13,675	16,606	18,559
JOHNSON (G)	BURLESON	34,351	41,851	48,862	53,368	59,303	66,588
	BURLESON TOTAL	**42,785**	**50,642**	**58,630**	**67,043**	**75,909**	**85,147**
COLLIN	CADDO BASIN SUD	2,315	2,922	4,004	5,337	6,868	8,517
HUNT (D)	CADDO BASIN SUD	7,800	10,341	13,788	18,546	25,327	35,181
	CADDO BASIN SUD TOTAL	**10,115**	**13,263**	**17,792**	**23,883**	**32,195**	**43,698**
COLLIN	CARROLLTON	4	6	9	12	15	19
DALLAS	CARROLLTON	51,277	51,277	51,277	51,277	51,277	51,277
DENTON	CARROLLTON	79,200	81,682	81,682	81,682	81,682	81,682
	CARROLLTON TOTAL	**130,481**	**132,965**	**132,968**	**132,971**	**132,974**	**132,978**
ROCKWALL	CASH SUD	1,220	1,580	1,989	2,403	2,864	3,354
HOPKINS (D)	CASH SUD	104	112	119	123	131	138
HUNT (D)	CASH SUD	18,458	22,148	26,579	31,894	38,273	45,925
RAINS (D)	CASH SUD	709	752	764	772	776	778
	CASH SUD TOTAL	**20,491**	**24,592**	**29,451**	**35,192**	**42,044**	**50,195**

County	Water User Group (WUG)	Final Region C Population					
		2020	2030	2040	2050	2060	2070
DALLAS	CEDAR HILL	53,244	65,133	76,989	83,579	83,579	83,579
ELLIS	CEDAR HILL	694	884	1,103	1,421	1,421	1,421
	CEDAR HILL TOTAL	**53,938**	**66,017**	**78,092**	**85,000**	**85,000**	**85,000**
COLLIN	CELINA	21,257	51,038	77,710	105,998	134,286	162,573
DENTON	CELINA	743	5,248	17,514	37,427	37,427	37,427
	CELINA TOTAL	**22,000**	**56,286**	**95,224**	**143,425**	**171,713**	**200,000**
DALLAS	COMBINE WSC	810	986	1,185	1,412	1,669	1,956
KAUFMAN	COMBINE WSC	2,904	3,503	4,122	5,066	6,047	7,089
	COMBINE WSC TOTAL	**3,714**	**4,489**	**5,307**	**6,478**	**7,716**	**9,045**
DALLAS	COPPELL	40,848	41,747	41,809	41,809	41,809	41,809
DENTON	COPPELL	1,134	1,134	1,134	1,134	1,134	1,134
	COPPELL TOTAL	**41,982**	**42,881**	**42,943**	**42,943**	**42,943**	**42,943**
TARRANT	CROWLEY	16,250	18,986	22,679	27,268	34,890	39,874
JOHNSON (G)	CROWLEY	61	96	132	170	212	257
	CROWLEY TOTAL	**16,311**	**19,082**	**22,811**	**27,438**	**35,102**	**40,131**
COLLIN	DALLAS	71,320	73,220	74,169	74,169	74,169	74,169
DALLAS	DALLAS	1,141,059	1,242,191	1,420,781	1,591,937	1,722,709	1,785,569
DENTON	DALLAS	29,680	32,203	36,598	40,789	43,991	45,531
ROCKWALL	DALLAS	77	103	132	162	195	230
	DALLAS TOTAL	**1,242,136**	**1,347,717**	**1,531,680**	**1,707,057**	**1,841,064**	**1,905,499**
FANNIN	DELTA COUNTY MUD	45	45	46	46	47	49
DELTA (D)	DELTA COUNTY MUD	1,794	1,819	1,834	1,859	1,911	1,968
	DELTA COUNTY MUD TOTAL	**1,839**	**1,864**	**1,880**	**1,905**	**1,958**	**2,017**
COLLIN	DESERT WSC	400	451	531	675	917	1,198
FANNIN	DESERT WSC	682	770	817	997	1,442	2,135
GRAYSON	DESERT WSC	618	676	732	792	875	947
	DESERT WSC TOTAL	**1,700**	**1,897**	**2,080**	**2,464**	**3,234**	**4,280**
COLLIN	EAST FORK SUD	10,735	12,040	13,826	13,963	14,492	14,997

County	Water User Group (WUG)	Final Region C Population					
		2020	2030	2040	2050	2060	2070
DALLAS	EAST FORK SUD	3,725	3,725	3,376	4,169	4,942	5,717
ROCKWALL	EAST FORK SUD	1,240	1,735	2,298	2,868	3,566	4,286
	EAST FORK SUD TOTAL	**15,700**	**17,500**	**19,500**	**21,000**	**23,000**	**25,000**
DALLAS	FERRIS	6	10	14	19	23	27
ELLIS	FERRIS	2,944	5,190	7,186	8,181	9,177	10,173
	FERRIS TOTAL	**2,950**	**5,200**	**7,200**	**8,200**	**9,200**	**10,200**
ELLIS	FILES VALLEY WSC	755	961	1,199	1,545	1,896	2,302
HILL (G)	FILES VALLEY WSC	2,538	2,702	2,812	2,928	3,014	3,065
	FILES VALLEY WSC TOTAL	**3,293**	**3,663**	**4,011**	**4,473**	**4,910**	**5,367**
FREESTONE	FLO COMMUNITY WSC	454	489	513	532	545	555
LEON (H)	FLO COMMUNITY WSC	3,858	3,919	3,969	4,036	4,095	4,152
	FLO COMMUNITY WSC TOTAL	**4,312**	**4,408**	**4,482**	**4,568**	**4,640**	**4,707**
DENTON	FLOWER MOUND	75,315	84,200	86,000	88,000	90,000	92,730
TARRANT	FLOWER MOUND	240	270	270	270	270	270
	FLOWER MOUND TOTAL	75,555	84,470	86,270	88,270	90,270	93,000
KAUFMAN	FORNEY LAKE WSC	7,012	8,694	10,482	13,149	22,474	32,306
ROCKWALL	FORNEY LAKE WSC	763	959	1,183	1,409	1,690	1,978
	FORNEY LAKE WSC TOTAL	**7,775**	**9,653**	**11,665**	**14,558**	**24,164**	**34,284**
DENTON	FORT WORTH	36,529	56,185	81,471	114,851	147,198	179,544
JOHNSON (G)	FORT WORTH	0	0	0	5,036	8,057	10,072
PARKER	FORT WORTH	63,316	99,884	113,006	126,940	135,422	143,903
TARRANT	FORT WORTH	848,803	1,042,039	1,282,178	1,395,762	1,493,447	1,592,141
WISE	FORT WORTH	12,176	17,481	22,561	29,015	35,327	41,639
	FORT WORTH TOTAL	**960,824**	**1,215,589**	**1,499,216**	**1,671,604**	**1,819,451**	**1,967,299**
COLLIN	FRISCO	112,747	116,865	137,833	199,910	234,514	251,443
DENTON	FRISCO	75,596	95,300	120,040	121,546	123,051	123,557
	FRISCO TOTAL	**188,343**	**212,165**	**257,873**	**321,456**	**357,565**	**375,000**

County	Water User Group (WUG)	Final Region C Population					
		2020	2030	2040	2050	2060	2070
COLLIN	FROGNOT WSC	1,630	1,904	2,326	2,928	3,344	3,720
HUNT (D)	FROGNOT WSC	27	32	38	47	52	59
	FROGNOT WSC TOTAL	**1,657**	**1,936**	**2,364**	**2,975**	**3,396**	**3,779**
COLLIN	GARLAND	317	396	492	619	755	900
DALLAS	GARLAND	254,381	278,659	293,920	297,792	299,655	299,509
ROCKWALL	GARLAND	3	4	4	5	6	7
	GARLAND TOTAL	**254,701**	**279,059**	**294,416**	**298,416**	**300,416**	**300,416**
DALLAS	GLENN HEIGHTS	13,822	18,831	23,973	29,555	34,995	45,991
ELLIS	GLENN HEIGHTS	3,874	4,929	6,153	7,930	9,728	14,843
	GLENN HEIGHTS TOTAL	**17,696**	**23,760**	**30,126**	**37,485**	**44,723**	**60,834**
DALLAS	GRAND PRAIRIE	166,208	206,781	231,491	231,491	231,491	231,491
ELLIS	GRAND PRAIRIE	55	71	88	114	140	170
TARRANT	GRAND PRAIRIE	51,864	51,864	51,864	51,864	51,864	51,864
	GRAND PRAIRIE TOTAL	**218,127**	**258,716**	**283,443**	**283,469**	**283,495**	**283,525**
COLLIN	HICKORY CREEK SUD	104	149	209	305	433	614
FANNIN	HICKORY CREEK SUD	297	327	348	369	402	438
HUNT (D)	HICKORY CREEK SUD	4,272	6,245	8,920	12,615	17,880	25,530
	HICKORY CREEK SUD TOTAL	**4,673**	**6,721**	**9,477**	**13,289**	**18,715**	**26,582**
KAUFMAN	HIGH POINT WSC	4,314	5,356	6,462	8,057	12,155	15,724
ROCKWALL	HIGH POINT WSC	565	709	873	1,056	1,604	2,091
	HIGH POINT WSC TOTAL	**4,879**	**6,065**	**7,335**	**9,113**	**13,759**	**17,815**
ELLIS	HILCO UNITED SERVICES	149	160	167	183	192	202
	HILCO UNITED SERVICES	5,459	5,882	6,189	6,513	6,822	7,064
	HILCO UNITED SERVICES TOTAL	**5,608**	**6,042**	**6,356**	**6,696**	**7,014**	**7,266**
TARRANT	JOHNSON COUNTY SUD	2,649	2,897	3,233	3,568	3,904	4,240
HILL (G)	JOHNSON COUNTY SUD	127	147	168	191	216	243

County	Water User Group (WUG)	Final Region C Population					
		2020	2030	2040	2050	2060	2070
JOHNSON (G)	JOHNSON COUNTY SUD	39,437	45,811	52,381	59,562	67,296	75,558
	JOHNSON COUNTY SUD TOTAL	**42,213**	**48,855**	**55,782**	**63,321**	**71,416**	**80,041**
COLLIN	JOSEPHINE	1,434	2,300	3,226	4,175	4,352	4,352
HUNT (D)	JOSEPHINE	184	325	517	783	783	783
	JOSEPHINE TOTAL	**1,618**	**2,625**	**3,743**	**4,958**	**5,135**	**5,135**
DALLAS	LEWISVILLE	841	841	841	841	841	841
DENTON	LEWISVILLE	106,485	121,082	138,526	158,014	176,513	176,513
	LEWISVILLE TOTAL	**107,326**	**121,923**	**139,367**	**158,855**	**177,354**	**177,354**
HENDERSON	MABANK	3,715	4,141	4,568	5,975	8,339	11,619
KAUFMAN	MABANK	6,048	6,673	7,208	9,726	13,712	19,106
VAN ZANDT (D)	MABANK	243	271	299	391	546	761
	MABANK TOTAL	**10,006**	**11,085**	**12,075**	**16,092**	**22,597**	**31,486**
KAUFMAN	MACBEE SUD	267	331	399	501	611	730
HUNT (D)	MACBEE SUD	346	430	544	701	925	1,250
VAN ZANDT (D)	MACBEE SUD	7,068	7,757	8,283	8,806	9,240	9,612
	MACBEE SUD TOTAL	**7,681**	**8,518**	**9,226**	**10,008**	**10,776**	**11,592**
ELLIS	MANSFIELD	110	130	162	236	293	361
TARRANT	MANSFIELD	67,501	85,935	102,678	127,297	146,050	164,697
JOHNSON (G)	MANSFIELD	2,576	3,695	4,849	6,115	7,481	8,942
	MANSFIELD TOTAL	**70,187**	**89,760**	**107,689**	**133,648**	**153,824**	**174,000**
COLLIN	MARILEE SUD	4,580	4,580	4,663	4,663	4,663	4,663
GRAYSON	MARILEE SUD	3,106	3,375	3,570	3,570	3,570	3,570
	MARILEE SUD TOTAL	**7,686**	**7,955**	**8,233**	**8,233**	**8,233**	**8,233**
DALLAS	MESQUITE	149,800	164,758	186,045	202,822	219,171	235,561
KAUFMAN	MESQUITE	136	170	204	257	313	374
	MESQUITE TOTAL	**149,936**	**164,928**	**186,249**	**203,079**	**219,484**	**235,935**
PARKER	MINERAL WELLS	2,107	2,078	2,044	2,004	1,958	1,905
PALO PINTO (G)	MINERAL WELLS	15,820	16,978	17,760	18,483	19,034	19,470

County	Water User Group (WUG)	Final Region C Population					
		2020	2030	2040	2050	2060	2070
	MINERAL WELLS TOTAL	**17,927**	**19,056**	**19,804**	**20,487**	**20,992**	**21,375**
ELLIS	MOUNTAIN PEAK SUD	9,467	12,047	12,800	18,377	21,269	23,861
JOHNSON (G)	MOUNTAIN PEAK SUD	3,579	4,362	5,170	6,056	7,012	8,035
	MOUNTAIN PEAK SUD TOTAL	**13,046**	**16,409**	**17,970**	**24,433**	**28,281**	**31,896**
COOKE	MOUNTAIN SPRING WSC	2,654	2,848	2,998	3,146	5,000	7,999
DENTON	MOUNTAIN SPRING WSC	55	61	68	74	84	94
	MOUNTAIN SPRING WSC TOTAL	**2,709**	**2,909**	**3,066**	**3,220**	**5,084**	**8,093**
DENTON	MUSTANG SUD	30,336	56,772	83,209	109,647	136,080	162,519
GRAYSON	MUSTANG SUD	264	268	271	273	280	281
	MUSTANG SUD TOTAL	**30,600**	**57,040**	**83,480**	**109,920**	**136,360**	**162,800**
COLLIN	Nevada WSC	2,418	2,983	3,512	11,407	27,028	48,652
ROCKWALL	Nevada WSC	75	91	111	449	1,122	2,019
	Nevada WSC TOTAL	**2,493**	**3,074**	**3,623**	**11,856**	**28,150**	**50,671**
FANNIN	NORTH HUNT SUD	525	577	617	653	709	769
DELTA (D)	NORTH HUNT SUD	286	290	290	290	290	290
HUNT (D)	NORTH HUNT SUD	3,522	4,602	6,069	8,092	10,974	15,163
	NORTH HUNT SUD TOTAL	**4,333**	**5,469**	**6,976**	**9,035**	**11,973**	**16,222**
PARKER	NORTH RURAL WSC	770	826	864	899	926	947
PALO PINTO (G)	NORTH RURAL WSC	1,631	1,750	1,831	1,905	1,962	2,006
	NORTH RURAL WSC TOTAL	**2,401**	**2,576**	**2,695**	**2,804**	**2,888**	**2,953**
DALLAS	OVILLA	485	624	768	924	1,076	1,862
ELLIS	OVILLA	4,000	5,089	6,352	8,186	10,042	18,505
	OVILLA TOTAL	**4,485**	**5,713**	**7,120**	**9,110**	**11,118**	**20,367**
PARKER	PARKER COUNTY SUD	6,762	10,732	14,702	18,672	22,642	26,612
PALO PINTO (G)	PARKER COUNTY SUD	60	80	102	128	158	193

County	Water User Group (WUG)	Final Region C Population					
		2020	2030	2040	2050	2060	2070
	PARKER COUNTY SUD TOTAL	**6,822**	**10,812**	**14,804**	**18,800**	**22,800**	**26,805**
COLLIN	PLANO	279,151	283,397	287,717	288,601	289,054	292,054
DENTON	PLANO	7,449	7,747	7,946	7,946	7,946	7,946
	PLANO TOTAL	**286,600**	**291,144**	**295,663**	**296,547**	**297,000**	**300,000**
FREESTONE	PLEASANT GROVE WSC	1,243	1,288	1,402	1,877	2,649	4,292
NAVARRO	PLEASANT GROVE WSC	111	115	125	167	236	383
	PLEASANT GROVE WSC TOTAL	**1,354**	**1,403**	**1,527**	**2,044**	**2,885**	**4,675**
KAUFMAN	POETRY WSC	909	1,136	1,402	1,866	2,527	3,402
HUNT (D)	POETRY WSC	2,303	2,909	3,668	4,729	6,341	8,535
	POETRY WSC TOTAL	**3,212**	**4,045**	**5,070**	**6,595**	**8,868**	**11,937**
FREESTONE	POINT ENTERPRISE WSC	817	865	905	948	983	1,013
LIMESTONE (G)	POINT ENTERPRISE WSC	782	825	858	889	916	935
	POINT ENTERPRISE WSC TOTAL	**1,599**	**1,690**	**1,763**	**1,837**	**1,899**	**1,948**
NAVARRO	POST OAK SUD	706	757	801	874	973	1,099
HILL (G)	POST OAK SUD	898	963	1,020	1,112	1,239	1,369
LIMESTONE (G)	POST OAK SUD	152	163	173	185	199	213
	POST OAK SUD TOTAL	**1,756**	**1,883**	**1,994**	**2,171**	**2,411**	**2,681**
COLLIN	PROSPER	19,003	22,000	25,000	28,000	35,056	35,056
DENTON	PROSPER	1,157	5,609	10,058	15,029	15,944	15,944
	PROSPER TOTAL	**20,160**	**27,609**	**35,058**	**43,029**	**51,000**	**51,000**
GRAYSON	RED RIVER AUTHORITY OF TEXAS	1,457	1,625	1,773	1,921	2,062	1,976
CHILDRESS (A)	RED RIVER AUTHORITY OF TEXAS	942	978	1,007	1,036	1,066	1,094
CLAY (B)	RED RIVER AUTHORITY OF TEXAS	1,542	1,542	1,542	1,542	1,542	1,542

County	Water User Group (WUG)	Final Region C Population					
		2020	2030	2040	2050	2060	2070
COLLINGSWORTH (A)	RED RIVER AUTHORITY OF TEXAS	576	642	701	759	815	860
COTTLE (B)	RED RIVER AUTHORITY OF TEXAS	49	49	49	49	49	49
DICKENS (O)	RED RIVER AUTHORITY OF TEXAS	45	50	55	59	64	68
DONLEY (A)	RED RIVER AUTHORITY OF TEXAS	950	1,059	1,156	1,252	1,345	1,432
FOARD (B)	RED RIVER AUTHORITY OF TEXAS	363	363	363	363	363	363
HALL (A)	RED RIVER AUTHORITY OF TEXAS	364	406	442	479	442	470
HARDEMAN (B)	RED RIVER AUTHORITY OF TEXAS	524	584	637	690	741	789
KING (B)	RED RIVER AUTHORITY OF TEXAS	217	217	217	217	217	217
KNOX (G)	RED RIVER AUTHORITY OF TEXAS	111	124	125	128	128	129
MONTAGUE (B)	RED RIVER AUTHORITY OF TEXAS	316	352	385	417	447	476
MOTLEY (O)	RED RIVER AUTHORITY OF TEXAS	23	26	28	31	33	35
WILBARGER (B)	RED RIVER AUTHORITY OF TEXAS	1,050	1,171	1,279	1,386	1,487	1,584
	RED RIVER AUTHORITY OF TEXAS TOTAL	**8,529**	**9,188**	**9,759**	**10,329**	**10,801**	**11,084**
PARKER	RENO	2,522	2,566	2,613	2,670	2,734	2,809
TARRANT	RENO	15	22	29	36	44	49
	RENO TOTAL	**2,537**	**2,588**	**2,642**	**2,706**	**2,778**	**2,858**
ELLIS	RICE WATER SUPPLY AND SEWER SERVICE	5,861	7,190	8,710	10,758	12,925	15,421
NAVARRO	RICE WATER SUPPLY AND SEWER SERVICE	3,660	4,511	5,492	6,514	7,828	9,338
	RICE WATER SUPPLY AND SEWER SERVICE TOTAL	**9,521**	**11,701**	**14,202**	**17,272**	**20,753**	**24,759**

County	Water User Group (WUG)	Final Region C Population					
		2020	2030	2040	2050	2060	2070
COLLIN	RICHARDSON	35,700	35,700	35,700	36,536	38,207	41,690
DALLAS	RICHARDSON	73,816	76,839	79,892	82,378	82,378	82,378
	RICHARDSON TOTAL	**109,516**	**112,539**	**115,592**	**118,914**	**120,585**	**124,068**
DALLAS	ROCKETT SUD	1,000	2,000	2,999	3,999	4,999	5,999
ELLIS	ROCKETT SUD	39,447	51,008	56,000	75,000	100,000	130,000
	ROCKETT SUD TOTAL	**40,447**	**53,008**	**58,999**	**78,999**	**104,999**	**135,999**
DALLAS	ROWLETT	59,891	65,397	70,903	75,409	78,784	83,228
ROCKWALL	ROWLETT	7,632	7,632	7,632	7,632	7,763	7,825
	ROWLETT TOTAL	**67,523**	**73,029**	**78,535**	**83,041**	**86,547**	**91,053**
COLLIN	ROYSE CITY	2,225	10,604	19,182	30,063	40,153	52,844
ROCKWALL	ROYSE CITY	9,054	9,706	10,000	24,000	40,712	45,160
HUNT (D)	ROYSE CITY	372	462	584	753	994	1,345
	ROYSE CITY TOTAL	**11,651**	**20,772**	**29,766**	**54,816**	**81,859**	**99,349**
COLLIN	SACHSE	8,108	8,108	8,108	8,441	8,535	8,535
DALLAS	SACHSE	20,596	20,596	20,596	20,596	20,596	20,596
	SACHSE TOTAL	**28,704**	**28,704**	**28,704**	**29,037**	**29,131**	**29,131**
PARKER	SANTO SUD	94	102	108	114	121	128
HOOD (G)	SANTO SUD	55	60	63	67	70	75
PALO PINTO (G)	SANTO SUD	2,028	2,208	2,330	2,470	2,614	2,768
	SANTO SUD TOTAL	**2,177**	**2,370**	**2,501**	**2,651**	**2,805**	**2,971**
DALLAS	SEAGOVILLE	18,853	22,871	26,888	30,904	34,987	34,974
KAUFMAN	SEAGOVILLE	29	36	44	55	67	80
	SEAGOVILLE TOTAL	18,882	22,907	26,932	30,959	35,054	35,054
ELLIS	SOUTH ELLIS COUNTY WSC	1,563	1,887	2,313	3,144	4,227	5,902
NAVARRO	SOUTH ELLIS COUNTY WSC	59	71	88	115	154	215
	SOUTH ELLIS COUNTY WSC TOTAL	**1,622**	**1,958**	**2,401**	**3,259**	**4,381**	**6,117**
COLLIN	SOUTH GRAYSON SUD	1,232	1,538	2,057	2,501	2,920	3,324

County	Water User Group (WUG)	Final Region C Population					
		2020	2030	2040	2050	2060	2070
GRAYSON	SOUTH GRAYSON SUD	2,902	3,118	3,565	3,717	3,928	4,052
	SOUTH GRAYSON SUD TOTAL	**4,134**	**4,656**	**5,622**	**6,218**	**6,848**	**7,376**
DENTON	SOUTHLAKE	1,014	1,310	1,662	2,057	2,518	3,045
TARRANT	SOUTHLAKE	26,695	29,882	34,862	39,843	44,823	49,803
	SOUTHLAKE TOTAL	**27,709**	**31,192**	**36,524**	**41,900**	**47,341**	**52,848**
FANNIN	SOUTHWEST FANNIN COUNTY SUD	4,108	4,516	4,806	5,090	6,114	7,269
GRAYSON	SOUTHWEST FANNIN COUNTY SUD	1,727	2,308	3,072	3,947	5,382	7,061
	SOUTHWEST FANNIN COUNTY SUD TOTAL	**5,835**	**6,824**	**7,878**	**9,037**	**11,496**	**14,330**
COOKE	TWO WAY SUD	100	108	113	119	124	128
GRAYSON	TWO WAY SUD	6,156	7,963	9,411	11,368	15,200	19,653
	TWO WAY SUD TOTAL	**6,256**	**8,071**	**9,524**	**11,487**	**15,324**	**19,781**
ELLIS	VENUS	81	102	128	165	202	246
JOHNSON (G)	VENUS	3,335	3,848	4,377	4,957	5,583	6,253
	VENUS TOTAL	**3,416**	**3,950**	**4,505**	**5,122**	**5,785**	**6,499**
HENDERSON	VIRGINIA HILL WSC	2,384	2,734	3,027	3,413	3,774	4,246
HENDERSON (I)	VIRGINIA HILL WSC	3,335	3,848	4,377	4,957	5,583	6,253
	VIRGINIA HILL WSC TOTAL	**5,719**	**6,582**	**7,404**	**8,370**	**9,357**	**10,499**
PARKER	WALNUT CREEK SUD	17,811	21,176	22,589	32,601	48,379	63,430
WISE	WALNUT CREEK SUD	3,540	4,790	6,072	7,487	11,101	14,351
	WALNUT CREEK SUD TOTAL	**21,351**	**25,966**	**28,661**	**40,088**	**59,480**	**77,781**
HENDERSON	WEST CEDAR CREEK MUD	13,963	14,406	14,817	15,570	19,500	24,500
KAUFMAN	WEST CEDAR CREEK MUD	4,103	4,560	5,009	5,861	6,705	7,605
	WEST CEDAR CREEK MUD TOTAL	**18,066**	**18,966**	**19,826**	**21,431**	**26,205**	**32,105**

County	Water User Group (WUG)	Final Region C Population					
		2020	2030	2040	2050	2060	2070
COLLIN	WEST LEONARD WSC	318	362	441	596	857	1,142
FANNIN	WEST LEONARD WSC	1,238	1,362	1,310	1,388	1,623	1,996
HUNT (D)	WEST LEONARD WSC	50	57	70	90	129	171
	WEST LEONARD WSC TOTAL	**1,606**	**1,781**	**1,821**	**2,074**	**2,609**	**3,309**
DENTON	WESTLAKE	26	34	45	56	69	85
TARRANT	WESTLAKE	1,515	4,200	6,882	7,694	7,681	7,665
	WESTLAKE TOTAL	**1,541**	**4,234**	**6,927**	**7,750**	**7,750**	**7,750**
COLLIN	WESTMINSTER WSC	1,889	2,204	2,687	3,377	3,851	4,277
GRAYSON	WESTMINSTER WSC	20	24	29	35	40	44
	WESTMINSTER WSC	**1,909**	**2,228**	**2,716**	**3,412**	**3,891**	**4,321**
FANNIN	WHITEWRIGHT	10	11	12	13	14	15
GRAYSON	WHITEWRIGHT	1,896	1,919	1,941	1,867	1,978	2,199
	WHITEWRIGHT TOTAL	**1,906**	**1,930**	**1,953**	**1,880**	**1,992**	**2,214**
FANNIN	WOLFE CITY	90	112	142	183	242	327
HUNT (D)	WOLFE CITY	1,720	2,137	2,704	3,486	4,600	6,220
	WOLFE CITY TOTAL	**1,810**	**2,249**	**2,846**	**3,669**	**4,842**	**6,547**
COOKE	WOODBINE WSC	6,131	6,946	7,762	8,577	9,390	10,203
GRAYSON	WOODBINE WSC	79	89	97	107	121	131
	WOODBINE WSC TOTAL	**6,210**	**7,035**	**7,859**	**8,684**	**9,511**	**10,334**
COLLIN	WYLIE	41,381	44,531	46,984	50,563	52,636	57,986
DALLAS	WYLIE	2,324	2,388	2,452	2,515	2,579	2,704
ROCKWALL	WYLIE	3,451	3,546	3,640	3,734	3,894	4,119
	WYLIE TOTAL	**47,156**	**50,465**	**53,076**	**56,812**	**59,109**	**64,809**

Attachment Three

Region C Projected Municipal Demand by WUG, by County

Attachment 3 - Region C Projected Municipal Demand by WUG, by County

In Multiple Counties or Regions?	County	WUG	Region C Final Municipal Demand (Acre-Feet per Year)					
			2020	2030	2040	2050	2060	2070
	COLLIN	ALLEN	21,887	23,536	23,806	24,125	24,496	24,902
	COLLIN	ANNA	2,389	4,047	6,429	8,336	10,816	14,053
Yes	COLLIN	BEAR CREEK SUD	610	948	1,342	1,866	2,336	2,947
	COLLIN	B H P WSC	38	55	68	68	69	69
	COLLIN	BLUE RIDGE	413	687	6,403	14,735	21,025	29,142
Yes	COLLIN	CADDO BASIN SUD	258	312	417	551	707	876
	COLLIN	CARROLLTON	1	1	2	2	3	3
Yes	COLLIN	CELINA	4,420	10,515	15,980	21,784	27,596	33,405
	COLLIN	COPEVILLE SUD	327	387	465	638	1,123	1,921
	COLLIN	COUNTY OTHER	627	615	606	596	1,181	1,835
	COLLIN	CULLEOKA WSC	597	596	901	1,094	1,237	1,546
Yes	COLLIN	DALLAS	15,807	15,886	15,830	15,706	15,681	15,679
	COLLIN	DESERT WSC	51	56	64	81	110	144
Yes	COLLIN	EAST FORK SUD	1,308	1,407	1,580	1,581	1,638	1,693
	COLLIN	FAIRVIEW	4,498	5,162	6,871	7,146	7,223	7,222
	COLLIN	FARMERSVILLE	1,036	2,504	5,665	8,640	12,276	17,744
Yes	COLLIN	FRISCO	27,373	28,159	33,122	47,994	56,265	60,316
	COLLIN	FROGNOT WSC	171	193	232	289	329	366
Yes	COLLIN	GARLAND	51	62	76	94	115	137
Yes	COLLIN	HICKORY CREEK SUD	10	14	20	28	40	57
Yes	COLLIN	JOSEPHINE	307	485	676	874	910	910
	COLLIN	LUCAS	2,316	2,613	3,438	3,990	4,455	4,454
Yes	COLLIN	MARILEE SUD	675	665	669	666	665	665
	COLLIN	MCKINNEY	40,856	44,424	48,984	59,223	70,879	76,807
	COLLIN	MELISSA	3,946	12,418	17,365	21,642	24,886	25,745
	COLLIN	MILLIGAN WSC	450	511	614	766	870	963

In Multiple Counties or Regions?	County	WUG	Region C Final Municipal Demand (Acre-Feet per Year)					
			2020	2030	2040	2050	2060	2070
	COLLIN	MURPHY	4,441	4,414	4,402	4,393	4,388	4,387
	COLLIN	NEVADA SUD	242	289	334	1,074	2,537	4,563
	COLLIN	NORTH COLLIN SUD	818	921	1,055	1,254	1,463	1,685
	COLLIN	NORTH FARMERSVILLE WSC	91	104	126	158	180	199
	COLLIN	PARKER	3,123	3,096	3,302	3,852	4,239	4,843
Yes	COLLIN	PLANO	71,890	71,978	72,314	72,139	72,158	72,907
	COLLIN	PRINCETON	1,184	3,964	7,951	9,320	9,303	9,298
Yes	COLLIN	PROSPER	4,872	5,600	6,353	7,109	8,896	8,895
Yes	COLLIN	RICHARDSON	8,951	8,801	8,683	8,824	9,215	10,055
Yes	COLLIN	ROYSE CITY	258	1,197	2,137	3,328	4,437	5,838
Yes	COLLIN	SACHSE	1,473	1,457	1,448	1,502	1,516	1,516
	COLLIN	SEIS LAGOS UD	577	573	571	592	598	598
Yes	COLLIN	SOUTH GRAYSON SUD	151	184	242	293	341	388
	COLLIN	VERONA SUD	266	301	360	448	509	563
	COLLIN	WEST LEONARD WSC	42	47	56	75	107	142
Yes	COLLIN	WESTMINSTER WSC	256	291	350	437	498	552
Yes	COLLIN	WYLIE	6,236	6,614	6,926	7,421	7,710	8,491
	COLLIN	WYLIE NORTHEAST SUD	674	795	924	1,498	2,238	3,295
	COLLIN TOTAL		**235,967**	**266,884**	**309,159**	**366,232**	**417,264**	**461,816**
Yes	COOKE	BOLIVAR WSC	104	107	109	113	117	121
	COOKE	CALLISBURG WSC	150	146	144	143	144	145
	COOKE	COUNTY OTHER	743	774	834	1,204	1,517	3,561
	COOKE	GAINESVILLE	2,656	2,758	2,833	2,935	3,557	4,969

In Multiple Counties or Regions?	County	WUG	Region C Final Municipal Demand (Acre-Feet per Year)					
			2020	2030	2040	2050	2060	2070
	COOKE	LAKE KIOWA SUD	891	921	938	957	964	976
	COOKE	LINDSAY	173	180	188	206	245	368
Yes	COOKE	MOUNTAIN SPRING WSC	445	468	486	506	801	1,279
	COOKE	MUENSTER	268	261	263	260	267	267
Yes	COOKE	TWO WAY SUD	11	12	12	12	13	13
Yes	COOKE	WOODBINE WSC	651	707	767	835	911	989
	COOKE TOTAL		**6,092**	**6,334**	**6,574**	**7,171**	**8,536**	**12,688**
	DALLAS	ADDISON	6,137	6,486	6,856	7,248	7,657	8,069
	DALLAS	BALCH SPRINGS	2,749	2,894	3,066	3,293	3,546	3,808
Yes	DALLAS	CARROLLTON	9,532	9,329	9,173	9,087	9,070	9,069
Yes	DALLAS	CEDAR HILL	10,660	12,810	14,994	16,201	16,186	16,184
	DALLAS	COCKRELL HILL	417	431	415	405	536	1,140
Yes	DALLAS	COMBINE WSC	77	90	105	123	145	170
Yes	DALLAS	COPPELL	10,828	10,928	10,848	10,793	10,779	10,779
	DALLAS	COUNTY OTHER	2,229	2,168	2,180	2,191	2,274	2,335
Yes	DALLAS	DALLAS	252,895	269,507	303,240	337,114	364,227	377,458
	DALLAS	DESOTO	9,422	9,965	10,703	11,575	12,483	12,856
	DALLAS	DUNCANVILLE	6,091	6,464	6,322	6,244	6,230	6,229
Yes	DALLAS	EAST FORK SUD	454	435	386	472	558	646
	DALLAS	FARMERS BRANCH	9,031	9,448	9,901	10,446	11,020	11,606
Yes	DALLAS	FERRIS	1	2	2	3	3	4
Yes	DALLAS	GARLAND	41,055	43,805	45,269	45,349	45,528	45,506
Yes	DALLAS	GLENN HEIGHTS	1,513	2,002	2,516	3,083	3,644	4,783
Yes	DALLAS	GRAND PRAIRIE	26,811	32,615	36,061	35,851	35,799	35,792
	DALLAS	HIGHLAND PARK	4,055	4,139	4,105	4,090	4,087	4,087
	DALLAS	HUTCHINS	2,186	3,033	3,888	4,748	5,612	6,479

In Multiple Counties or Regions?	County	WUG	Region C Final Municipal Demand (Acre-Feet per Year)					
			2020	2030	2040	2050	2060	2070
	DALLAS	IRVING	55,798	62,288	63,021	62,619	62,535	62,524
	DALLAS	LANCASTER	7,670	9,755	11,407	12,634	13,905	15,186
Yes	DALLAS	LEWISVILLE	158	155	153	152	152	152
Yes	DALLAS	MESQUITE	22,314	23,822	26,318	28,392	30,609	32,880
Yes	DALLAS	OVILLA	116	146	178	213	248	429
Yes	DALLAS	RICHARDSON	18,508	18,943	19,432	19,895	19,869	19,868
Yes	DALLAS	ROCKETT SUD	114	220	323	427	532	638
Yes	DALLAS	ROWLETT	9,163	9,793	10,480	11,062	11,534	12,183
Yes	DALLAS	SACHSE	3,742	3,702	3,679	3,664	3,659	3,658
Yes	DALLAS	SEAGOVILLE	2,061	2,412	2,778	3,161	3,569	3,567
	DALLAS	SUNNYVALE	2,234	3,159	4,089	4,710	4,707	4,706
	DALLAS	UNIVERSITY PARK	7,612	7,506	7,418	7,370	7,361	7,361
	DALLAS	WILMER	423	455	702	1,293	2,027	3,680
Yes	DALLAS	WYLIE	350	355	361	369	378	396
	DALLAS TOTAL		**526,406**	**569,262**	**620,369**	**664,277**	**700,469**	**724,228**
	DENTON	ARGYLE WSC	2,659	3,365	4,322	4,319	4,317	4,314
	DENTON	AUBREY	547	711	823	972	1,164	1,412
	DENTON	BLACK ROCK WSC	296	368	433	505	590	668
Yes	DENTON	BOLIVAR WSC	885	1,028	1,212	1,429	1,697	2,007
Yes	DENTON	CARROLLTON	14,723	14,861	14,613	14,476	14,448	14,446
Yes	DENTON	CELINA	154	1,081	3,602	7,692	7,691	7,690
Yes	DENTON	COPPELL	301	297	294	293	292	292
	DENTON	CORINTH	4,269	4,986	4,959	4,942	4,935	4,934
	DENTON	COUNTY OTHER	1,199	1,537	1,878	4,108	7,241	13,671
	DENTON	CROSS TIMBERS WSC	1,642	2,060	2,073	2,096	2,128	2,166
Yes	DENTON	DALLAS	6,578	6,987	7,811	8,638	9,301	9,625

In Multiple Counties or Regions?	County	WUG	Region C Final Municipal Demand (Acre-Feet per Year)					
			2020	2030	2040	2050	2060	2070
	DENTON	DENTON	26,174	33,012	40,885	56,228	80,557	99,143
	DENTON	DENTON COUNTY FWSD 10	1,485	3,128	3,690	3,689	3,687	3,686
	DENTON	DENTON COUNTY FWSD 1-A	3,659	6,493	7,776	7,773	7,771	7,769
	DENTON	DENTON COUNTY FWSD 7	3,418	3,405	3,403	3,401	3,399	3,397
Yes	DENTON	FLOWER MOUND	18,988	20,956	21,288	21,714	22,184	22,855
Yes	DENTON	FORT WORTH	7,190	10,843	15,557	21,833	27,949	34,079
Yes	DENTON	FRISCO	18,353	22,963	28,846	29,181	29,523	29,639
	DENTON	HACKBERRY	452	578	730	902	1,103	1,332
	DENTON	HIGHLAND VILLAGE	3,835	3,972	3,927	3,902	3,897	3,897
	DENTON	JUSTIN	712	1,242	1,775	1,771	1,770	1,770
	DENTON	KRUM	1,135	1,391	1,703	2,055	2,471	2,947
	DENTON	LAKE CITIES MUA	2,153	2,435	2,758	2,962	2,956	2,955
Yes	DENTON	LEWISVILLE	19,984	22,285	25,176	28,536	31,821	31,817
	DENTON	LITTLE ELM	4,075	4,564	4,550	4,538	4,528	4,528
Yes	DENTON	MOUNTAIN SPRING WSC	9	10	11	12	13	15
Yes	DENTON	MUSTANG SUD	4,548	8,361	12,201	16,049	19,904	23,762
	DENTON	NORTHLAKE	1,923	4,402	6,197	8,591	10,986	10,985
	DENTON	PALOMA CREEK NORTH CRU	1,700	2,303	2,302	2,301	2,299	2,298
	DENTON	PALOMA CREEK SOUTH CRU	854	1,165	1,165	1,165	1,165	1,165
	DENTON	PILOT POINT	891	1,069	1,449	1,964	2,614	3,527
Yes	DENTON	PLANO	1,918	1,968	1,997	1,986	1,984	1,984
	DENTON	PONDER	388	524	690	878	1,099	1,352
Yes	DENTON	PROSPER	297	1,428	2,556	3,816	4,046	4,046

In Multiple Counties or Regions?	County	WUG	Region C Final Municipal Demand (Acre-Feet per Year)					
			2020	2030	2040	2050	2060	2070
	DENTON	PROVIDENCE VILLAGE WCID	938	930	929	927	925	925
	DENTON	ROANOKE	2,255	2,797	3,345	3,339	3,337	3,336
	DENTON	SANGER	1,140	1,377	1,672	2,010	2,414	2,878
Yes	DENTON	SOUTHLAKE	419	538	680	840	1,027	1,242
	DENTON	THE COLONY	8,071	8,631	9,105	9,857	9,844	9,841
	DENTON	TROPHY CLUB	4,863	4,829	4,811	4,802	4,798	4,797
Yes	DENTON	WESTLAKE	30	39	52	65	79	98
	DENTON TOTAL		**175,110**	**214,919**	**253,246**	**296,557**	**343,954**	**383,290**
	ELLIS	AVALON WATER SUPPLY AND SEWER SERVICE	149	175	211	286	384	538
Yes	ELLIS	BRANDON IRENE WSC	9	11	14	18	22	26
	ELLIS	BUENA VISTA-BETHEL SUD	1,282	1,541	1,800	2,299	3,300	4,395
Yes	ELLIS	CEDAR HILL	139	174	215	275	275	275
	ELLIS	COUNTY OTHER	414	330	467	1,473	4,649	9,576
	ELLIS	EAST GARRETT WSC	246	306	377	483	592	1,411
	ELLIS	ENNIS	4,026	4,625	5,234	7,401	11,887	19,761
Yes	ELLIS	FERRIS	460	787	1,069	1,206	1,348	1,492
Yes	ELLIS	FILES VALLEY WSC	116	143	175	223	273	332
Yes	ELLIS	GLENN HEIGHTS	424	524	646	827	1,013	1,544
Yes	ELLIS	GRAND PRAIRIE	9	11	14	18	22	26
Yes	ELLIS	HILCO UNITED SERVICES	21	22	22	24	25	26
	ELLIS	ITALY	311	380	464	592	749	997
Yes	ELLIS	MANSFIELD	30	35	44	64	79	97
	ELLIS	MIDLOTHIAN	4,811	7,094	7,408	7,839	8,359	9,231

In Multiple Counties or Regions?	County	WUG	Region C Final Municipal Demand (Acre-Feet per Year)					
			2020	2030	2040	2050	2060	2070
Yes	ELLIS	MOUNTAIN PEAK SUD	2,971	3,733	3,938	5,636	6,517	7,308
Yes	ELLIS	OVILLA	954	1,192	1,473	1,891	2,317	4,264
	ELLIS	PALMER	274	334	407	519	662	1,219
	ELLIS	RED OAK	1,144	1,265	1,687	2,390	2,936	4,582
Yes	ELLIS	RICE WATER SUPPLY AND SEWER SERVICE	701	833	992	1,215	1,456	1,735
Yes	ELLIS	ROCKETT SUD	4,505	5,606	6,028	8,000	10,638	13,816
	ELLIS	SARDIS LONE ELM WSC	5,304	7,037	8,079	8,324	8,583	8,581
Yes	ELLIS	SOUTH ELLIS COUNTY WSC	401	476	579	784	1,053	1,469
Yes	ELLIS	VENUS	15	19	23	30	37	45
	ELLIS	WAXAHACHIE	6,872	7,702	9,226	11,299	13,749	16,715
	ELLIS TOTAL		**35,588**	**44,355**	**50,592**	**63,116**	**80,925**	**109,461**
	FANNIN	ARLEDGE RIDGE WSC	157	171	202	263	385	523
	FANNIN	BOIS D ARC MUD	273	297	352	458	672	912
	FANNIN	BONHAM	2,024	2,505	3,393	4,598	5,662	6,882
	FANNIN	COUNTY OTHER	663	529	552	795	2,232	3,866
	FANNIN	DELTA COUNTY MUD	3	3	3	3	3	3
	FANNIN	DESERT WSC	86	95	99	120	173	256
Yes	FANNIN	HICKORY CREEK SUD	30	31	33	34	37	41
	FANNIN	HONEY GROVE	292	284	277	275	274	274
	FANNIN	LADONIA	248	304	332	376	451	451
	FANNIN	LEONARD	328	347	353	363	376	390
Yes	FANNIN	NORTH HUNT SUD	35	39	41	44	48	52

In Multiple Counties or Regions?	County	WUG	Region C Final Municipal Demand (Acre-Feet per Year)					
			2020	2030	2040	2050	2060	2070
Yes	FANNIN	SOUTHWEST FANNIN COUNTY SUD	407	433	453	475	569	675
	FANNIN	TRENTON	136	166	365	729	1,256	1,780
	FANNIN	WEST LEONARD WSC	165	176	165	174	202	249
	FANNIN	WHITE SHED WSC	301	327	386	501	735	998
Yes	FANNIN	WHITEWRIGHT	1	1	2	2	2	2
	FANNIN	WOLFE CITY	9	10	13	16	22	29
	FANNIN TOTAL		**5,158**	**5,718**	**7,021**	**9,226**	**13,099**	**17,383**
	FREESTONE	Butler WSC	223	218	214	214	215	216
	FREESTONE	COUNTY OTHER	422	405	361	439	1,051	2,716
	FREESTONE	FAIRFIELD	955	948	987	1,730	2,073	2,786
Yes	FREESTONE	FLO COMMUNITY WSC	58	60	62	63	65	66
Yes	FREESTONE	PLEASANT GROVE WSC	124	123	129	170	239	386
	FREESTONE	POINT ENTERPRISE WSC	89	91	92	95	98	101
	FREESTONE	SOUTH FREESTONE COUNTY WSC	255	251	263	352	500	824
	FREESTONE	TEAGUE	683	708	917	1,201	1,445	1,699
	FREESTONE	WORTHAM	169	176	180	184	305	345
	FREESTONE TOTAL		**2,978**	**2,980**	**3,205**	**4,448**	**5,991**	**9,139**
	GRAYSON	BELLS	182	206	232	250	580	783
	GRAYSON	COLLINSVILLE	282	333	395	473	498	653
	GRAYSON	COUNTY OTHER	747	602	363	426	1,434	2,356
	GRAYSON	DENISON	7,226	7,888	7,877	8,598	9,992	13,298
	GRAYSON	DESERT WSC	78	83	89	95	105	114

In Multiple Counties or Regions?	County	WUG	Region C Final Municipal Demand (Acre-Feet per Year)					
			2020	2030	2040	2050	2060	2070
	GRAYSON	DORCHESTER	123	126	132	136	147	164
	GRAYSON	GUNTER	297	400	527	656	803	936
	GRAYSON	HOWE	274	306	339	370	416	464
	GRAYSON	KENTUCKY TOWN WSC	355	412	469	525	665	852
	GRAYSON	LUELLA SUD	387	430	475	508	571	667
Yes	GRAYSON	MARILEE SUD	458	490	512	510	509	509
	GRAYSON	MUSTANG SUD	40	39	40	40	41	41
	GRAYSON	NORTHWEST GRAYSON COUNTY WCID 1	194	194	199	221	298	418
	GRAYSON	OAK RIDGE SOUTH GALE WSC	221	209	224	249	335	459
	GRAYSON	PINK HILL WSC	228	242	236	263	355	486
	GRAYSON	POTTSBORO	518	655	791	1,030	1,624	2,920
	GRAYSON	RED RIVER AUTHORITY OF TEXAS	358	392	421	454	487	467
	GRAYSON	SHERMAN	10,701	11,043	11,152	12,009	15,825	24,226
Yes	GRAYSON	SOUTH GRAYSON SUD	355	373	420	435	458	472
	GRAYSON	SOUTHMAYD	143	153	164	179	240	323
Yes	GRAYSON	SOUTHWEST FANNIN COUNTY SUD	171	221	289	369	501	656
	GRAYSON	STARR WSC	242	255	245	273	368	504
	GRAYSON	TIOGA	165	175	184	196	430	589
	GRAYSON	TOM BEAN	237	264	289	320	394	590
Yes	GRAYSON	TWO WAY SUD	682	855	995	1,192	1,590	2,053
	GRAYSON	VAN ALSTYNE	518	710	983	1,258	2,420	3,047

In Multiple Counties or Regions?	County	WUG	Region C Final Municipal Demand (Acre-Feet per Year)					
			2020	2030	2040	2050	2060	2070
Yes	GRAYSON	WESTMINSTER WSC	3	3	4	5	5	6
	GRAYSON	WHITESBORO	469	461	453	441	557	735
Yes	GRAYSON	WHITEWRIGHT	260	254	249	237	250	278
Yes	GRAYSON	WOODBINE WSC	8	9	10	10	12	13
	GRAYSON TOTAL		**25,922**	**27,783**	**28,758**	**31,728**	**41,910**	**59,079**
Yes	HENDERSON	ATHENS	2,906	3,174	3,400	3,730	6,394	9,484
	HENDERSON	B B S WSC	3	3	3	3	3	3
Yes	HENDERSON	BETHEL ASH WSC	215	234	251	276	300	323
	HENDERSON	COUNTY OTHER	304	220	226	139	53	113
	HENDERSON	CRESCENT HEIGHTS WSC	163	166	174	186	233	296
	HENDERSON	DOGWOOD ESTATES WATER	183	190	202	217	273	346
	HENDERSON	EAST CEDAR CREEK FWSD	1,351	1,500	1,669	1,853	2,059	2,288
	HENDERSON	EUSTACE	126	132	140	203	263	315
Yes	HENDERSON	MABANK	736	806	880	1,144	1,593	2,218
	HENDERSON	MALAKOFF	274	272	270	274	289	309
	HENDERSON	TRINIDAD	105	99	96	96	107	128
	HENDERSON	VIRGINIA HILL WSC	230	251	270	300	330	371
Yes	HENDERSON	WEST CEDAR CREEK MUD	938	968	996	1,046	1,311	1,647
	HENDERSON TOTAL		**7,534**	**8,015**	**8,577**	**9,467**	**13,208**	**17,841**
	JACK	COUNTY OTHER	545	560	566	568	574	580
	JACK	JACKSBORO	682	707	720	726	735	741
	JACK TOTAL		**1,227**	**1,267**	**1,286**	**1,294**	**1,309**	**1,321**
Yes	KAUFMAN	ABLES SPRINGS WSC	303	375	452	567	692	827
	KAUFMAN	BECKER JIBA WSC	323	401	480	669	933	1,243

In Multiple Counties or Regions?	County	WUG	Region C Final Municipal Demand (Acre-Feet per Year)					
			2020	2030	2040	2050	2060	2070
	KAUFMAN	COLLEGE MOUND WSC	774	959	1,156	1,451	2,132	2,700
Yes	KAUFMAN	COMBINE WSC	275	318	365	442	526	616
	KAUFMAN	COUNTY OTHER	172	310	340	342	1,407	3,220
	KAUFMAN	CRANDALL	763	926	1,104	1,368	1,381	1,381
	KAUFMAN	ELMO WSC	216	268	320	421	586	782
	KAUFMAN	FORNEY	3,090	3,554	4,509	5,634	8,343	11,114
Yes	KAUFMAN	FORNEY LAKE WSC	1,137	1,391	1,666	2,083	3,552	5,102
	KAUFMAN	GASTONIA SCURRY SUD	710	880	1,058	1,354	2,265	3,533
Yes	KAUFMAN	HIGH POINT WSC	391	462	542	668	1,003	1,296
	KAUFMAN	KAUFMAN	1,280	1,533	1,841	2,875	3,752	4,602
	KAUFMAN	KAUFMAN COUNTY DEVELOPMENT DISTRICT 1	879	1,120	1,361	1,804	2,520	3,361
	KAUFMAN	KAUFMAN COUNTY MUD 11	608	730	883	1,077	1,318	1,616
	KAUFMAN	KEMP	301	364	433	540	836	1,170
Yes	KAUFMAN	MABANK	1,198	1,299	1,388	1,862	2,620	3,648
Yes	KAUFMAN	MACBEE SUD	18	22	27	34	41	49
	KAUFMAN	MARKOUT WSC	415	526	637	843	1,177	1,569
Yes	KAUFMAN	MESQUITE	20	25	29	36	44	52
	KAUFMAN	NORTH KAUFMAN WSC	192	245	300	400	559	746
	KAUFMAN	POETRY WSC	100	121	146	193	260	350
	KAUFMAN	ROSE HILL SUD	441	523	613	773	1,022	1,569
Yes	KAUFMAN	SEAGOVILLE	3	4	5	6	7	8
	KAUFMAN	TALTY SUD	1,800	2,061	2,363	3,312	4,609	6,352
	KAUFMAN	TERRELL	3,857	7,237	9,786	11,370	12,658	14,741

In Multiple Counties or Regions?	County	WUG	Region C Final Municipal Demand (Acre-Feet per Year)					
			2020	2030	2040	2050	2060	2070
Yes	KAUFMAN	WEST CEDAR CREEK MUD	276	306	337	394	451	511
	KAUFMAN TOTAL		**19,542**	**25,960**	**32,141**	**40,518**	**54,694**	**72,158**
	NAVARRO	B AND B WSC	242	242	255	293	355	440
	NAVARRO	BLOOMING GROVE	163	175	187	204	223	243
Yes	NAVARRO	BRANDON IRENE WSC	25	27	29	31	34	37
	NAVARRO	CHATFIELD WSC	428	465	503	544	591	639
	NAVARRO	CORBET WSC	250	264	280	303	331	361
	NAVARRO	CORSICANA	6,104	6,582	7,101	7,750	8,472	9,253
	NAVARRO	COUNTY OTHER	261	424	474	628	787	1,579
	NAVARRO	DAWSON	149	151	155	159	165	172
	NAVARRO	KERENS	216	227	241	263	288	314
	NAVARRO	M E N WSC	487	523	564	615	672	734
	NAVARRO	NAVARRO MILLS WSC	333	352	376	407	444	485
Yes	NAVARRO	PLEASANT GROVE WSC	11	11	11	15	21	34
	NAVARRO	POST OAK SUD	52	53	54	59	65	74
Yes	NAVARRO	RICE WATER SUPPLY AND SEWER SERVICE	438	523	625	736	882	1,051
Yes	NAVARRO	SOUTH ELLIS COUNTY WSC	15	18	22	29	38	54
	NAVARRO TOTAL		**9,174**	**10,037**	**10,877**	**12,036**	**13,368**	**15,470**
	PARKER	ALEDO	862	1,322	1,505	1,727	1,802	2,026
	PARKER	ANNETTA	431	496	565	637	712	787
Yes	PARKER	AZLE	386	407	430	457	551	705
	PARKER	COUNTY OTHER	6,614	6,272	5,027	7,828	12,150	17,770
Yes	PARKER	FORT WORTH	12,462	19,277	21,579	24,131	25,713	27,314

In Multiple Counties or Regions?	County	WUG	Region C Final Municipal Demand (Acre-Feet per Year)					
			2020	2030	2040	2050	2060	2070
	PARKER	HORSESHOE BEND WATER SYSTEM	157	192	213	265	346	453
	PARKER	HUDSON OAKS	1,375	1,875	1,922	1,919	1,918	1,918
Yes	PARKER	MINERAL WELLS	343	330	318	308	300	292
Yes	PARKER	NORTH RURAL WSC	75	77	78	79	82	83
	PARKER	PARKER COUNTY SUD	718	1,106	1,495	1,886	2,282	2,679
Yes	PARKER	RENO	170	172	176	179	184	189
	PARKER	SANTO SUD	12	12	13	13	14	15
	PARKER	SPRINGTOWN	903	1,196	1,189	1,184	1,183	1,183
Yes	PARKER	WALNUT CREEK SUD	1,331	1,517	1,581	2,254	3,326	4,353
	PARKER	WEATHERFORD	5,306	6,213	6,586	10,928	17,870	24,614
	PARKER	WILLOW PARK	856	1,243	1,509	1,853	2,367	2,661
	PARKER TOTAL		**32,001**	**41,707**	**44,186**	**55,648**	**70,800**	**87,042**
Yes	ROCKWALL	BEAR CREEK SUD	79	96	130	169	337	711
	ROCKWALL	B H P WSC	23	26	32	41	54	73
Yes	ROCKWALL	BLACKLAND WSC	856	952	1,009	1,030	1,159	1,248
Yes	ROCKWALL	CASH SUD	140	176	217	260	309	362
	ROCKWALL	COUNTY OTHER	401	562	573	534	592	917
Yes	ROCKWALL	DALLAS	17	22	28	34	41	49
Yes	ROCKWALL	EAST FORK SUD	151	203	263	325	403	484
	ROCKWALL	FATE	2,818	3,626	4,869	6,422	7,803	8,663
Yes	ROCKWALL	FORNEY LAKE WSC	124	153	188	223	267	312
Yes	ROCKWALL	GARLAND	0	1	1	1	1	1
	ROCKWALL	HEATH	3,946	5,563	6,992	7,078	7,397	7,718
Yes	ROCKWALL	HIGH POINT WSC	51	61	73	88	132	172
	ROCKWALL	MOUNT ZION WSC	501	615	740	886	1,061	1,241

In Multiple Counties or Regions?	County	WUG	Region C Final Municipal Demand (Acre-Feet per Year)					
			2020	2030	2040	2050	2060	2070
	ROCKWALL	NEVADA SUD	8	9	11	42	105	189
	ROCKWALL	R C H WSC	900	1,234	1,432	1,736	2,246	2,737
	ROCKWALL	ROCKWALL	9,902	14,346	21,079	22,002	23,798	25,611
Yes	ROCKWALL	ROWLETT	1,168	1,143	1,128	1,120	1,137	1,145
Yes	ROCKWALL	ROYSE CITY	1,049	1,096	1,114	2,657	4,498	4,989
Yes	ROCKWALL	WYLIE	520	527	537	548	570	603
	ROCKWALL TOTAL		**22,654**	**30,411**	**40,416**	**45,196**	**51,910**	**57,225**
	TARRANT	ARLINGTON	66,810	68,113	68,511	69,419	69,282	69,277
Yes	TARRANT	AZLE	1,546	1,629	1,721	1,829	2,203	2,822
	TARRANT	BEDFORD	9,202	9,679	10,191	10,785	10,768	10,768
	TARRANT	BENBROOK	5,164	5,614	6,081	6,797	7,544	7,544
Yes	TARRANT	BETHESDA WSC	2,225	2,448	2,678	2,914	3,164	3,412
Yes	TARRANT	BURLESON	1,275	1,299	1,425	1,982	2,402	2,683
	TARRANT	COLLEYVILLE	9,211	9,693	10,313	10,656	10,648	10,648
Yes	TARRANT	COMMUNITY WSC	338	360	384	419	455	490
	TARRANT	COUNTY OTHER	7,212	6,774	6,296	9,847	12,753	17,316
	TARRANT	CROWLEY	2,409	2,753	3,244	3,874	4,945	5,647
	TARRANT	DALWORTHINGTON GARDENS	908	918	929	943	962	980
	TARRANT	EDGECLIFF	503	490	480	474	473	473
	TARRANT	EULESS	9,062	9,298	9,116	9,016	8,997	8,996
	TARRANT	EVERMAN	529	527	513	501	499	499
Yes	TARRANT	FLOWER MOUND	61	67	67	67	67	67
	TARRANT	FOREST HILL	1,359	1,377	1,445	1,699	2,159	2,811
Yes	TARRANT	FORT WORTH	167,062	201,103	244,833	265,334	283,569	302,202
Yes	TARRANT	GRAND PRAIRIE	8,366	8,180	8,079	8,032	8,021	8,019
Yes	TARRANT	GRAPEVINE	18,406	18,806	18,665	18,589	18,574	18,573

In Multiple Counties or Regions?	County	WUG	Region C Final Municipal Demand (Acre-Feet per Year)					
			2020	2030	2040	2050	2060	2070
	TARRANT	HALTOM CITY	5,238	5,179	5,260	5,619	6,039	6,581
	TARRANT	HASLET	570	1,730	2,513	4,447	4,443	4,443
	TARRANT	HURST	6,696	6,687	6,551	6,476	6,463	6,462
Yes	TARRANT	JOHNSON COUNTY SUD	341	362	396	433	472	512
	TARRANT	KELLER	12,339	13,148	13,073	13,028	13,013	13,012
	TARRANT	KENNEDALE	1,420	1,596	1,850	2,133	2,425	2,720
	TARRANT	LAKE WORTH	1,130	1,241	1,354	1,558	1,825	2,486
	TARRANT	LAKESIDE	370	378	388	399	398	398
Yes	TARRANT	MANSFIELD	18,494	23,328	27,730	34,279	39,293	44,295
	TARRANT	NORTH RICHLAND HILLS	12,812	13,457	13,254	13,140	13,116	13,115
	TARRANT	PANTEGO	686	674	664	658	657	657
	TARRANT	PELICAN BAY	113	115	117	120	122	124
Yes	TARRANT	RENO	1	1	2	2	3	3
	TARRANT	RICHLAND HILLS	1,148	1,185	1,228	1,371	1,512	1,700
	TARRANT	RIVER OAKS	856	823	796	781	778	778
	TARRANT	SAGINAW	3,169	3,528	3,903	4,087	4,080	4,079
	TARRANT	SANSOM PARK	534	544	591	617	649	683
Yes	TARRANT	SOUTHLAKE	11,036	12,275	14,265	16,269	18,287	20,314
	TARRANT	WATAUGA	2,844	2,740	2,655	2,608	2,600	2,599
Yes	TARRANT	WESTLAKE	1,752	4,845	7,930	8,862	8,846	8,827
	TARRANT	WESTOVER HILLS	929	949	968	990	1,013	1,033
	TARRANT	WESTWORTH VILLAGE	401	423	447	475	506	538
	TARRANT	WHITE SETTLEMENT	2,081	2,107	2,145	2,472	3,132	3,797
	TARRANT TOTAL		**396,608**	**446,443**	**503,051**	**544,001**	**577,157**	**612,383**
	WISE	ALVORD	228	274	322	392	448	504

In Multiple Counties or Regions?	County	WUG	Region C Final Municipal Demand (Acre-Feet per Year)					
			2020	2030	2040	2050	2060	2070
Yes	WISE	BOLIVAR WSC	79	87	96	107	120	134
	WISE	BOYD	217	229	316	391	547	593
	WISE	BRIDGEPORT	1,273	1,526	1,793	2,456	3,268	4,083
	WISE	CHICO	278	286	296	551	700	875
	WISE	COUNTY OTHER	4,043	4,077	4,016	4,195	4,318	6,680
	WISE	DECATUR	2,319	3,149	4,060	5,240	6,157	7,156
Yes	WISE	FORT WORTH	2,396	3,374	4,308	5,516	6,708	7,903
	WISE	NEWARK	194	248	344	462	643	857
	WISE	RHOME	397	552	712	1,135	1,523	1,943
	WISE	RUNAWAY BAY	527	588	652	785	891	1,069
Yes	WISE	WALNUT CREEK SUD	265	343	425	518	763	985
	WISE	WEST WISE SUD	478	478	481	490	506	523
	WISE TOTAL		**12,694**	**15,211**	**17,821**	**22,238**	**26,592**	**33,305**
	Region C Total Municipal		**1,514,655**	**1,717,286**	**1,937,279**	**2,173,153**	**2,421,186**	**2,673,829**

Attachment Four

Municipal Demand for WUGs in Multiple Counties or Regions

Attachment 4 - Projected Municipal Demand for WUGs in Multiple Counties or Regions

County	Water User Group (WUG)	Region C Final Demand (Acre-Feet per Year)					
		2020	2030	2040	2050	2060	2070
KAUFMAN	ABLES SPRINGS WSC	303	375	452	567	692	827
HUNT (D)	ABLES SPRINGS WSC	58	89	131	189	272	392
VAN ZANDT (D)	ABLES SPRINGS WSC	2	2	3	3	3	3
	ABLES SPRINGS WSC TOTAL	**363**	**466**	**586**	**759**	**967**	**1,222**
HENDERSON	ATHENS	2,906	3,174	3,400	3,730	6,394	9,484
HENDERSON (I)	ATHENS	56	59	61	65	68	72
	ATHENS TOTAL	**2,962**	**3,233**	**3,461**	**3,795**	**6,462**	**9,556**
PARKER	AZLE	386	407	430	457	551	705
TARRANT	AZLE	1,546	1,629	1,721	1,829	2,203	2,822
	AZLE TOTAL	**1,932**	**2,036**	**2,151**	**2,286**	**2,754**	**3,527**
HENDERSON (C)	B B S WSC	3	3	3	3	3	3
HENDERSON (I)	B B S WSC	131	130	127	124	124	124
	B B S WSC TOTAL	**134**	**133**	**130**	**127**	**127**	**127**
COLLIN	B H P WSC	38	55	68	68	69	69
ROCKWALL	B H P WSC	23	26	32	41	54	73
HUNT (D)	B H P WSC	330	386	471	602	795	1,074
	B H P WSC TOTAL	**391**	**467**	**571**	**711**	**918**	**1,216**
HENDERSON	BETHEL ASH WSC	215	234	251	276	300	323
HENDERSON (I)	BETHEL ASH WSC	321	350	376	414	450	486
VAN ZANDT (D)	BETHEL ASH WSC	92	116	134	153	169	183
	BETHEL ASH WSC TOTAL	**628**	**700**	**761**	**843**	**919**	**992**
TARRANT	BETHESDA WSC	2,225	2,448	2,678	2,914	3,164	3,412
JOHNSON (G)	BETHESDA WSC	3,811	4,304	4,826	5,428	6,104	6,833
	BETHESDA WSC TOTAL	**6,036**	**6,752**	**7,504**	**8,342**	**9,268**	**10,245**
ROCKWALL	BLACKLAND WSC	857	952	1,009	1,030	1,159	1,248
HUNT (D)	BLACKLAND WSC	9	9	8	8	8	8

County	Water User Group (WUG)	Region C Final Demand (Acre-Feet per Year)					
		2020	2030	2040	2050	2060	2070
	BLACKLAND WSC TOTAL	**866**	**961**	**1,017**	**1,038**	**1,167**	**1,256**
COOKE	BOLIVAR WSC	104	107	109	113	117	121
DENTON	BOLIVAR WSC	885	1,028	1,212	1,429	1,697	2,007
WISE	BOLIVAR WSC	79	87	96	107	120	134
	BOLIVAR WSC TOTAL	**1,068**	**1,222**	**1,417**	**1,649**	**1,934**	**2,262**
ELLIS	BRANDON IRENE WSC	9	11	14	18	22	26
HILL (G)	BRANDON IRENE WSC	231	237	239	246	253	259
NAVARRO	BRANDON IRENE WSC	25	27	29	31	34	37
	BRANDON IRENE WSC TOTAL	**265**	**275**	**282**	**295**	**309**	**322**
TARRANT	BURLESON	1,275	1,299	1,425	1,982	2,402	2,683
JOHNSON (G)	BURLESON	5,191	6,185	7,128	7,736	8,578	9,626
	BURLESON TOTAL	**6,466**	**7,484**	**8,553**	**9,718**	**10,980**	**12,309**
COLLIN	CADDO BASIN SUD	258	312	417	551	707	876
HUNT (D)	CADDO BASIN SUD	870	1,105	1,438	1,914	2,607	3,617
	CADDO BASIN SUD TOTAL	**1,128**	**1,417**	**1,855**	**2,465**	**3,314**	**4,493**
COLLIN	CARROLLTON	1	1	2	2	3	3
DALLAS	CARROLLTON	9,532	9,329	9,173	9,087	9,070	9,069
DENTON	CARROLLTON	14,723	14,861	14,613	14,476	14,448	14,446
	CARROLLTON TOTAL	**24,256**	**24,191**	**23,788**	**23,565**	**23,521**	**23,518**
ROCKWALL	CASH SUD	140	176	217	260	309	362
HOPKINS (D)	CASH SUD	12	12	13	13	14	15
HUNT (D)	CASH SUD	2,120	2,464	2,902	3,451	4,130	4,950
RAINS (D)	CASH SUD	81	84	83	84	84	84
	CASH SUD TOTAL	**2,353**	**2,736**	**3,215**	**3,808**	**4,537**	**5,411**

County	Water User Group (WUG)	Region C Final Demand (Acre-Feet per Year)					
		2020	2030	2040	2050	2060	2070
DALLAS	CEDAR HILL	10,660	12,810	14,994	16,201	16,186	16,184
ELLIS	CEDAR HILL	139	174	215	275	275	275
	CEDAR HILL TOTAL	**10,799**	**12,984**	**15,209**	**16,476**	**16,461**	**16,459**
COLLIN	CELINA	4,419	10,515	15,980	21,784	27,596	33,405
DENTON	CELINA	154	1,081	3,602	7,691	7,691	7,690
	CELINA TOTAL	**4,573**	**11,596**	**19,582**	**29,475**	**35,287**	**41,095**
DALLAS	COMBINE WSC	77	90	105	123	145	170
KAUFMAN	COMBINE WSC	275	318	365	442	526	616
	COMBINE WSC TOTAL	**352**	**408**	**470**	**565**	**671**	**786**
DALLAS	COPPELL	10,828	10,928	10,848	10,793	10,779	10,779
DENTON	COPPELL	301	297	294	293	292	292
	COPPELL TOTAL	**11,129**	**11,225**	**11,142**	**11,086**	**11,071**	**11,071**
TARRANT	CROWLEY	2,409	2,753	3,244	3,874	4,945	5,647
JOHNSON (G)	CROWLEY	9	14	19	24	30	36
	CROWLEY TOTAL	**2,418**	**2,767**	**3,263**	**3,898**	**4,975**	**5,683**
COLLIN	DALLAS	15,806	15,886	15,830	15,706	15,681	15,679
DALLAS	DALLAS	252,895	269,507	303,241	337,113	364,228	377,457
DENTON	DALLAS	6,578	6,987	7,811	8,638	9,301	9,625
ROCKWALL	DALLAS	17	22	28	34	41	48
	DALLAS TOTAL	**275,296**	**292,402**	**326,910**	**361,491**	**389,251**	**402,810**
FANNIN	DELTA COUNTY MUD	3	3	3	3	3	3
DELTA (D)	DELTA COUNTY MUD	127	123	124	125	129	133
	DELTA COUNTY MUD TOTAL	**130**	**126**	**127**	**128**	**132**	**136**
COLLIN	DESERT WSC	51	56	64	81	110	144
FANNIN	DESERT WSC	86	95	99	120	173	256
GRAYSON	DESERT WSC	78	83	89	95	105	114
	DESERT WSC TOTAL	**215**	**234**	**252**	**296**	**388**	**514**

County	Water User Group (WUG)	Region C Final Demand (Acre-Feet per Year)					
		2020	2030	2040	2050	2060	2070
COLLIN	EAST FORK SUD	1,308	1,407	1,581	1,581	1,638	1,694
DALLAS	EAST FORK SUD	454	435	386	472	558	646
ROCKWALL	EAST FORK SUD	151	203	263	325	403	484
	EAST FORK SUD TOTAL	**1,913**	**2,045**	**2,230**	**2,378**	**2,599**	**2,824**
DALLAS	FERRIS	1	2	2	3	3	4
ELLIS	FERRIS	460	787	1,069	1,206	1,348	1,492
	FERRIS TOTAL	**461**	**789**	**1,071**	**1,209**	**1,351**	**1,496**
ELLIS	FILES VALLEY WSC	116	143	175	223	273	332
HILL (G)	FILES VALLEY WSC	389	402	410	423	434	441
	FILES VALLEY WSC TOTAL	**505**	**545**	**585**	**646**	**707**	**773**
FREESTONE	FLO COMMUNITY WSC	58	61	61	63	65	66
LEON (H)	FLO COMMUNITY WSC	334	384	436	490	550	611
	FLO COMMUNITY WSC TOTAL	**392**	**445**	**497**	**553**	**615**	**677**
DENTON	FLOWER MOUND	18,988	20,956	21,288	21,714	22,184	22,855
TARRANT	FLOWER MOUND	61	67	67	67	67	67
	FLOWER MOUND TOTAL	**19,049**	**21,023**	**21,355**	**21,781**	**22,251**	**22,922**
KAUFMAN	FORNEY LAKE WSC	1,137	1,391	1,666	2,083	3,552	5,102
ROCKWALL	FORNEY LAKE WSC	124	153	188	223	267	312
	FORNEY LAKE WSC TOTAL	**1,261**	**1,544**	**1,854**	**2,306**	**3,819**	**5,414**
DENTON	FORT WORTH	7,190	10,843	15,557	21,833	27,949	34,079
JOHNSON	FORT WORTH	0	0	0	957	1,530	1,912
PARKER	FORT WORTH	12,462	19,277	21,579	24,131	25,713	27,314
TARRANT	FORT WORTH	167,062	201,103	244,833	265,334	283,569	302,202
WISE	FORT WORTH	2,396	3,374	4,308	5,516	6,708	7,903

County	Water User Group (WUG)	Region C Final Demand (Acre-Feet per Year)					
		2020	2030	2040	2050	2060	2070
	FORT WORTH TOTAL	**189,110**	**234,597**	**286,277**	**317,771**	**345,469**	**373,410**
COLLIN	FRISCO	27,373	28,159	33,122	47,995	56,266	60,316
DENTON	FRISCO	18,354	22,963	28,846	29,181	29,522	29,638
	FRISCO TOTAL	**45,727**	**51,122**	**61,968**	**77,176**	**85,788**	**89,954**
COLLIN	FROGNOT WSC	171	193	232	289	329	366
HUNT (D)	FROGNOT WSC	3	3	4	5	5	6
	FROGNOT WSC TOTAL	**174**	**196**	**236**	**294**	**334**	**372**
COLLIN	GARLAND	51	62	76	94	115	137
DALLAS	GARLAND	41,055	43,806	45,270	45,349	45,528	45,506
ROCKWALL	GARLAND	0	1	1	1	1	1
	GARLAND TOTAL	**41,106**	**43,869**	**45,347**	**45,444**	**45,644**	**45,644**
DALLAS	GLENN HEIGHTS	1,513	2,002	2,516	3,083	3,644	4,783
ELLIS	GLENN HEIGHTS	424	524	646	827	1,013	1,544
	GLENN HEIGHTS TOTAL	**1,937**	**2,526**	**3,162**	**3,910**	**4,657**	**6,327**
DALLAS	GRAND PRAIRIE	26,811	32,615	36,061	35,851	35,799	35,792
ELLIS	GRAND PRAIRIE	9	11	14	18	22	26
TARRANT	GRAND PRAIRIE	8,366	8,180	8,079	8,032	8,021	8,019
	GRAND PRAIRIE TOTAL	**35,186**	**40,806**	**44,154**	**43,901**	**43,842**	**43,837**
COLLIN	HICKORY CREEK SUD	10	14	20	28	40	57
FANNIN	HICKORY CREEK SUD	30	31	33	34	37	41
HUNT (D)	HICKORY CREEK SUD	425	596	835	1,172	1,658	2,365
	HICKORY CREEK SUD TOTAL	**465**	**641**	**888**	**1,234**	**1,735**	**2,463**
KAUFMAN	HIGH POINT WSC	391	462	542	668	1,003	1,296
ROCKWALL	HIGH POINT WSC	51	61	73	88	132	172

County	Water User Group (WUG)	Region C Final Demand (Acre-Feet per Year)					
		2020	2030	2040	2050	2060	2070
	HIGH POINT WSC TOTAL	**442**	**523**	**615**	**756**	**1,135**	**1,468**
ELLIS	HILCO UNITED SERVICES	21	22	22	24	25	26
BOSQUE (G)	HILCO UNITED SERVICES	198	207	213	222	232	244
HILL (G)	HILCO UNITED SERVICES	565	589	607	633	661	681
	HILCO UNITED SERVICES TOTAL	**784**	**818**	**842**	**879**	**918**	**951**
TARRANT	JOHNSON COUNTY SUD	341	361	396	433	472	512
HILL (G)	JOHNSON COUNTY SUD	16	18	21	23	26	29
JOHNSON (G)	JOHNSON COUNTY SUD	5,079	5,720	6,413	7,220	8,136	9,127
	JOHNSON COUNTY SUD TOTAL	**5,436**	**6,099**	**6,830**	**7,676**	**8,634**	**9,668**
COLLIN	JOSEPHINE	307	485	676	874	910	910
HUNT (D)	JOSEPHINE	39	68	108	164	164	164
	JOSEPHINE TOTAL	**346**	**553**	**785**	**1,038**	**1,074**	**1,074**
COLLIN	BEAR CREEK SUD	611	948	1,342	1,865	2,336	2,947
ROCKWALL	BEAR CREEK SUD	79	96	130	169	337	711
	BEAR CREEK SUD TOTAL	**690**	**1,044**	**1,472**	**2,034**	**2,673**	**3,658**
DALLAS	LEWISVILLE	158	155	153	152	152	152
DENTON	LEWISVILLE	19,984	22,285	25,176	28,536	31,821	31,817
	LEWISVILLE TOTAL	**20,142**	**22,440**	**25,329**	**28,688**	**31,973**	**31,969**
HENDERSON	MABANK	736	806	880	1,144	1,593	2,218
KAUFMAN	MABANK	1,198	1,299	1,388	1,862	2,620	3,648
VAN ZANDT (D)	MABANK	48	53	58	75	104	145
	MABANK TOTAL	**1,982**	**2,158**	**2,326**	**3,081**	**4,317**	**6,011**
KAUFMAN	MACBEE SUD	18	22	27	34	41	49

County	Water User Group (WUG)	Region C Final Demand (Acre-Feet per Year)					
		2020	2030	2040	2050	2060	2070
HUNT (D)	MACBEE SUD	23	29	37	47	62	84
VAN ZANDT (D)	MACBEE SUD	475	521	557	592	621	646
	MACBEE SUD TOTAL	**516**	**572**	**621**	**673**	**724**	**779**
ELLIS	MANSFIELD	30	35	44	64	79	97
TARRANT	MANSFIELD	18,494	23,327	27,730	34,279	39,293	44,295
JOHNSON (G)	MANSFIELD	706	1,003	1,310	1,647	2,013	2,405
	MANSFIELD TOTAL	**19,230**	**24,365**	**29,084**	**35,990**	**41,385**	**46,797**
COLLIN	MARILEE SUD	675	665	668	666	665	665
GRAYSON	MARILEE SUD	458	490	513	510	510	508
	MARILEE SUD TOTAL	**1,133**	**1,155**	**1,181**	**1,176**	**1,175**	**1,173**
DALLAS	MESQUITE	22,314	23,822	26,318	28,392	30,609	32,880
KAUFMAN	MESQUITE	20	25	29	36	44	52
	MESQUITE TOTAL	**22,334**	**23,847**	**26,347**	**28,428**	**30,653**	**32,932**
PARKER	MINERAL WELLS	343	330	318	308	300	292
PALO PINTO (G)	MINERAL WELLS	2,579	2,692	2,759	2,840	2,919	2,985
	MINERAL WELLS TOTAL	**2,922**	**3,022**	**3,077**	**3,148**	**3,219**	**3,277**
ELLIS	MOUNTAIN PEAK SUD	2,971	3,733	3,937	5,635	6,517	7,309
JOHNSON (G)	MOUNTAIN PEAK SUD	1,123	1,351	1,591	1,857	2,149	2,461
	MOUNTAIN PEAK SUD TOTAL	**4,094**	**5,084**	**5,528**	**7,492**	**8,666**	**9,770**
COOKE	MOUNTAIN SPRING WSC	445	468	486	506	801	1,279
DENTON	MOUNTAIN SPRING WSC	9	10	11	12	13	15
	MOUNTAIN SPRING WSC TOTAL	**454**	**478**	**497**	**518**	**814**	**1,294**
DENTON	MUSTANG SUD	4,549	8,361	12,201	16,049	19,904	23,763
GRAYSON	MUSTANG SUD	40	39	40	40	41	41

County	Water User Group (WUG)	Region C Final Demand (Acre-Feet per Year)					
		2020	2030	2040	2050	2060	2070
	MUSTANG SUD TOTAL	**4,589**	**8,400**	**12,241**	**16,089**	**19,945**	**23,804**
COLLIN	NEVADA WSC	242	289	334	1,074	2,537	4,563
ROCKWALL	NEVADA WSC	8	9	11	42	105	189
	NEVADA WSC TOTAL	**250**	**298**	**345**	**1,116**	**2,642**	**4,752**
FANNIN	NORTH HUNT SUD	35	39	41	44	48	52
DELTA (D)	NORTH HUNT SUD	19	19	19	19	19	19
HUNT (D)	NORTH HUNT SUD	237	309	408	544	738	1,019
	NORTH HUNT SUD TOTAL	**291**	**367**	**468**	**607**	**805**	**1,090**
PARKER	NORTH RURAL WSC	75	77	78	79	82	83
	NORTH RURAL WSC	158	163	165	168	173	177
	NORTH RURAL WSC TOTAL	**233**	**240**	**243**	**247**	**255**	**260**
DALLAS	OVILLA	116	146	178	213	248	429
ELLIS	OVILLA	954	1,192	1,473	1,891	2,317	4,264
	OVILLA TOTAL	**1,070**	**1,338**	**1,651**	**2,104**	**2,565**	**4,693**
PARKER	PARKER COUNTY SUD	718	1,107	1,495	1,886	2,282	2,680
PALO PINTO (G)	PARKER COUNTY SUD	6	8	10	13	16	19
	PARKER COUNTY SUD TOTAL	**724**	**1,115**	**1,505**	**1,899**	**2,298**	**2,699**
COLLIN	PLANO	71,890	71,978	72,314	72,139	72,158	72,907
DENTON	PLANO	1,918	1,968	1,997	1,986	1,984	1,984
	PLANO TOTAL	**73,808**	**73,946**	**74,311**	**74,125**	**74,142**	**74,891**
FREESTONE	PLEASANT GROVE WSC	124	123	129	170	239	386
NAVARRO	PLEASANT GROVE WSC	11	11	11	15	21	34
	PLEASANT GROVE WSC TOTAL	**135**	**134**	**140**	**185**	**260**	**420**

County	Water User Group (WUG)	Region C Final Demand (Acre-Feet per Year)					
		2020	2030	2040	2050	2060	2070
KAUFMAN	POETRY WSC	100	121	146	193	260	350
HUNT (D)	POETRY WSC	253	309	382	488	653	878
	POETRY WSC TOTAL	**353**	**430**	**528**	**681**	**913**	**1,228**
FREESTONE	POINT ENTERPRISE WSC	89	91	92	95	98	101
LIMESTONE (G)	POINT ENTERPRISE WSC	85	87	87	89	91	93
	POINT ENTERPRISE WSC TOTAL	**174**	**178**	**179**	**184**	**189**	**194**
NAVARRO	POST OAK SUD	52	53	54	59	65	74
HILL (G)	POST OAK SUD	66	67	69	75	83	92
LIMESTONE (G)	POST OAK SUD	11	11	12	12	13	14
	POST OAK SUD TOTAL	**129**	**131**	**135**	**146**	**161**	**180**
COLLIN	PROSPER	4,872	5,600	6,352	7,108	8,896	8,895
DENTON	PROSPER	296	1,427	2,556	3,815	4,046	4,046
	PROSPER TOTAL	**5,168**	**7,028**	**8,908**	**10,924**	**12,942**	**12,941**
GRAYSON	RED RIVER AUTHORITY OF TEXAS	358	392	421	454	487	467
KNOX (G)	RED RIVER AUTHORITY OF TEXAS	27	30	30	30	30	30
MOTLEY (O)	RED RIVER AUTHORITY OF TEXAS	6	6	7	7	8	8
COTTLE (B)	RED RIVER AUTHORITY OF TEXAS	12	12	12	12	12	12
DICKENS (O)	RED RIVER AUTHORITY OF TEXAS	11	12	13	14	15	16

County	Water User Group (WUG)	Region C Final Demand (Acre-Feet per Year)					
		2020	2030	2040	2050	2060	2070
KING (B)	RED RIVER AUTHORITY OF TEXAS	53	52	52	51	51	51
FOARD (B)	RED RIVER AUTHORITY OF TEXAS	89	87	86	86	86	86
HALL (A)	RED RIVER AUTHORITY OF TEXAS	89	98	105	113	104	111
MONTAGUE (B)	RED RIVER AUTHORITY OF TEXAS	78	85	91	99	106	112
HARDEMAN (B)	RED RIVER AUTHORITY OF TEXAS	129	141	151	163	175	186
COLLINGSWORTH (A)	RED RIVER AUTHORITY OF TEXAS	142	155	167	179	192	203
CHILDRESS (A)	RED RIVER AUTHORITY OF TEXAS	232	236	239	245	252	258
DONLEY (A)	RED RIVER AUTHORITY OF TEXAS	234	255	275	296	318	338
CLAY(B)	RED RIVER AUTHORITY OF TEXAS	379	372	366	365	364	364
WILBARGER (B)	RED RIVER AUTHORITY OF TEXAS	258	282	304	328	351	374
	RED RIVER AUTHORITY OF TEXAS TOTAL	**2,097**	**2,215**	**2,319**	**2,442**	**2,551**	**2,616**
PARKER	RENO	170	172	176	179	184	189
TARRANT	RENO	1	1	2	2	3	3
	RENO TOTAL	171	173	178	181	187	192

County	Water User Group (WUG)	Region C Final Demand (Acre-Feet per Year)					
		2020	2030	2040	2050	2060	2070
ELLIS	RICE WATER SUPPLY AND SEWER SERVICE	701	833	992	1,215	1,456	1,735
NAVARRO	RICE WATER SUPPLY AND SEWER SERVICE	438	523	625	736	882	1,051
	RICE WATER SUPPLY AND SEWER SERVICE TOTAL	**1,140**	**1,356**	**1,617**	**1,950**	**2,338**	**2,786**
COLLIN	RICHARDSON	8,952	8,801	8,683	8,824	9,215	10,054
DALLAS	RICHARDSON	18,508	18,943	19,432	19,895	19,869	19,868
	RICHARDSON TOTAL	**27,460**	**27,744**	**28,115**	**28,719**	**29,084**	**29,922**
DALLAS	ROCKETT SUD	114	220	323	427	532	638
ELLIS	ROCKETT SUD	4,505	5,606	6,028	7,999	10,638	13,816
	ROCKETT SUD TOTAL	**4,619**	**5,826**	**6,351**	**8,426**	**11,170**	**14,454**
DALLAS	ROWLETT	9,164	9,794	10,481	11,062	11,535	12,183
ROCKWALL	ROWLETT	1,168	1,143	1,128	1,120	1,137	1,145
	ROWLETT TOTAL	**10,332**	**10,937**	**11,609**	**12,182**	**12,672**	**13,328**
COLLIN	ROYSE CITY	258	1,197	2,137	3,328	4,437	5,837
ROCKWALL	ROYSE CITY	1,049	1,096	1,114	2,657	4,498	4,989
HUNT (D)	ROYSE CITY	43	52	65	83	110	149
	ROYSE CITY TOTAL	**1,350**	**2,345**	**3,316**	**6,068**	**9,045**	**10,975**
COLLIN	SACHSE	1,473	1,457	1,448	1,502	1,516	1,516
DALLAS	SACHSE	3,742	3,702	3,679	3,664	3,659	3,658
	SACHSE TOTAL	**5,215**	**5,159**	**5,127**	**5,166**	**5,175**	**5,174**
PARKER	SANTO SUD	12	12	13	13	14	15
HOOD (G)	SANTO SUD	7	7	7	8	8	9
PALO PINTO (G)	SANTO SUD	254	267	275	288	304	322
	SANTO SUD TOTAL	**273**	**286**	**295**	**309**	**326**	**346**
DALLAS	SEAGOVILLE	2,061	2,412	2,778	3,161	3,569	3,567

County	Water User Group (WUG)	Region C Final Demand (Acre-Feet per Year)					
		2020	2030	2040	2050	2060	2070
KAUFMAN	SEAGOVILLE	3	4	5	6	7	8
	SEAGOVILLE TOTAL	**2,064**	**2,416**	**2,783**	**3,167**	**3,576**	**3,575**
ELLIS	SOUTH ELLIS COUNTY WSC	401	476	579	784	1,053	1,469
NAVARRO	SOUTH ELLIS COUNTY WSC	15	18	22	29	38	54
	SOUTH ELLIS COUNTY WSC TOTAL	**416**	**494**	**601**	**812**	**1,091**	**1,523**
COLLIN	SOUTH GRAYSON SUD	151	184	242	293	341	388
GRAYSON	SOUTH GRAYSON SUD	355	373	420	435	458	472
	SOUTH GRAYSON SUD TOTAL	**506**	**557**	**662**	**728**	**799**	**860**
DENTON	SOUTHLAKE	419	538	680	840	1,027	1,242
TARRANT	SOUTHLAKE	11,036	12,275	14,265	16,269	18,287	20,314
	SOUTHLAKE TOTAL	**11,455**	**12,813**	**14,945**	**17,109**	**19,314**	**21,556**
FANNIN	SOUTHWEST FANNIN COUNTY SUD	407	433	453	475	569	675
GRAYSON	SOUTHWEST FANNIN COUNTY SUD	171	221	289	369	501	656
	SOUTHWEST FANNIN COUNTY SUD TOTAL	**578**	**654**	**742**	**844**	**1,070**	**1,331**
COOKE	TWO WAY SUD	11	12	12	12	13	13
GRAYSON	TWO WAY SUD	682	855	995	1,192	1,590	2,053
	TWO WAY SUD TOTAL	**693**	**867**	**1,007**	**1,204**	**1,603**	**2,066**
ELLIS	VENUS	15	19	23	30	37	45
JOHNSON (G)	VENUS	623	709	801	903	1,015	1,137
	VENUS TOTAL	**638**	**728**	**824**	**933**	**1,052**	**1,182**
HENDERSON	VIRGINIA HILL WSC	230	251	270	300	330	371
HENDERSON (I)	VIRGINIA HILL WSC	166	182	195	217	237	257

County	Water User Group (WUG)	Region C Final Demand (Acre-Feet per Year) 2020	2030	2040	2050	2060	2070
	VIRGINIA HILL WSC TOTAL	**396**	**433**	**465**	**517**	**567**	**628**
PARKER	WALNUT CREEK SUD	1,331	1,517	1,581	2,254	3,326	4,353
WISE	WALNUT CREEK SUD	265	343	425	518	763	985
	WALNUT CREEK SUD TOTAL	**1,596**	**1,860**	**2,006**	**2,772**	**4,089**	**5,338**
HENDERSON	WEST CEDAR CREEK MUD	938	968	996	1,046	1,311	1,647
KAUFMAN	WEST CEDAR CREEK MUD	276	306	337	394	451	511
	WEST CEDAR CREEK MUD TOTAL	**1,214**	**1,274**	**1,333**	**1,440**	**1,762**	**2,158**
COLLIN	WEST LEONARD WSC	42	47	56	75	107	142
FANNIN	WEST LEONARD WSC	165	176	165	174	202	249
HUNT (D)	WEST LEONARD WSC	7	7	9	11	16	21
	WEST LEONARD WSC	**214**	**230**	**230**	**260**	**325**	**412**
DENTON	WESTLAKE	30	39	52	65	79	98
TARRANT	WESTLAKE	1,753	4,845	7,931	8,862	8,846	8,826
	WESTLAKE TOTAL	**1,783**	**4,884**	**7,983**	**8,927**	**8,925**	**8,924**
COLLIN	WESTMINSTER WSC	256	291	350	437	498	552
GRAYSON	WESTMINSTER WSC	3	3	4	5	5	6
	WESTMINSTER WSC	**259**	**294**	**354**	**442**	**503**	**558**
FANNIN	WHITEWRIGHT	1	1	2	2	2	2
GRAYSON	WHITEWRIGHT	260	254	249	237	250	278
	WHITEWRIGHT TOTAL	**261**	**255**	**251**	**239**	**252**	**280**
FANNIN	WOLFE CITY	9	10	13	16	22	29
HUNT (D)	WOLFE CITY	169	199	243	311	409	552
	WOLFE CITY TOTAL	**178**	**209**	**256**	**327**	**431**	**581**
COOKE	WOODBINE WSC	651	707	767	835	911	989

County	Water User Group (WUG)	Region C Final Demand (Acre-Feet per Year)					
		2020	2030	2040	2050	2060	2070
GRAYSON	WOODBINE WSC	8	9	10	10	12	13
	WOODBINE WSC TOTAL	**659**	**716**	**777**	**845**	**923**	**1,002**
COLLIN	WYLIE	6,236	6,614	6,926	7,421	7,710	8,491
DALLAS	WYLIE	350	355	361	369	378	396
ROCKWALL	WYLIE	520	527	537	548	570	603
	WYLIE TOTAL	**7,106**	**7,496**	**7,824**	**8,338**	**8,658**	**9,490**

Attachment Five

Population Served by Major Water Providers and Projected Dry-Year Water Demand for Major Water Providers by Use Category

Attachment 5 – Population Served by Major Water Providers and Projected Dry-Year Water Demand for Major Water Providers by Use Category

Major Water Provider/ Use Category	Population & Projected Dry-Year Demand Including Customers (Demand in Acre-Feet per Year) 2020	2030	2040	2050	2060	2070
Dallas (Dallas Water Utilities)						
Population Served	**2,417,266**	**2,602,910**	**2,920,061**	**3,278,119**	**3,669,413**	**3,965,234**
Municipal Demand	501,332	526,326	580,492	643,548	709,962	752,867
Manufacturing Demand	16,419	17,356	17,385	17,445	17,513	17,541
Irrigation Demand	1,000	1,000	1,000	1,000	1,000	1,000
Steam Electric Power Demand	8,493	8,493	8,493	8,493	8,493	8,493
Mining Demand	1,266	161	650	1,238	1,762	2,074
Livestock Demand	0	0	0	0	0	0
Total DWU Demand	**528,510**	**553,336**	**608,020**	**671,724**	**738,730**	**781,975**
Fort Worth						
Population Served	**1,394,591**	**1,694,815**	**2,017,530**	**2,262,135**	**2,478,090**	**2,702,871**
Municipal Demand	276,153	332,658	394,109	439,454	478,852	519,670
Manufacturing Demand	9,668	10,541	10,538	10,536	10,535	10,535
Irrigation Demand	0	0	0	0	0	0
Steam Electric Power Demand	2,000	2,000	2,000	2,000	2,000	2,000
Mining Demand	1,754	1,811	1,677	1,677	1,677	1,677
Livestock Demand	0	0	0	0	0	0
Total Fort Worth Demand	**289,575**	**347,010**	**408,324**	**453,667**	**493,064**	**533,882**
North Texas Municipal Water District						
Population Served	**1,909,849**	**2,260,585**	**2,687,043**	**3,125,533**	**3,603,179**	**4,089,603**
Municipal Demand	398,281	456,693	529,714	607,827	685,401	758,083
Manufacturing Demand	6,777	7,503	7,503	7,503	7,503	7,503
Irrigation Demand	1,219	1,219	1,219	1,219	1,219	1,219
Steam Electric Power Demand	2,428	2,428	2,428	2,428	2,428	2,428
Mining Demand	0	0	0	0	0	0
Livestock Demand	0	0	0	0	0	0
Total NTMWD Demand	**408,705**	**467,843**	**540,864**	**618,977**	**696,551**	**769,233**
Tarrant Regional Water District						
Population Served	**2,399,399**	**2,883,379**	**3,328,157**	**3,773,780**	**4,267,998**	**4,893,661**
Municipal Demand	459,159	546,117	627,501	710,330	788,443	884,870
Manufacturing Demand	4,615	5,616	5,720	5,974	6,452	6,953
Irrigation Demand	14,529	16,792	15,960	15,960	15,960	15,960
Steam Electric Power Demand	2,293	2,293	2,293	2,293	2,293	2,293
Mining Demand	14,523	11,254	11,272	12,941	14,375	16,779
Livestock Demand	0	0	0	0	0	0

Major Water Provider/ Use Category	Population & Projected Dry-Year Demand Including Customers (Demand in Acre-Feet per Year)					
	2020	2030	2040	2050	2060	2070
Total TRWD Demand	**495,119**	**582,072**	**662,746**	**747,498**	**827,523**	**926,855**
Trinity River Authority						
Population Served	**622,557**	**918,459**	**1,020,815**	**1,108,434**	**1,211,110**	**1,352,275**
Municipal Demand	132,529	190,908	209,784	225,277	242,055	266,915
Manufacturing Demand	5,136	5,281	5,044	4,801	4,506	4,402
Irrigation Demand	26,893	27,449	27,574	27,690	27,788	27,848
Steam Electric Power Demand	8,458	8,495	8,481	8,468	8,459	8,450
Mining Demand	0	387	510	692	869	1,086
Livestock Demand	0	0	0	0	0	0
Total TRA Demand	**173,016**	**232,520**	**251,393**	**266,928**	**283,677**	**308,701**
Upper Trinity Regional Water District						
Population Served	**225,485**	**367,666**	**478,764**	**599,947**	**708,714**	**835,971**
Municipal Demand	47,915	74,040	94,281	115,779	134,037	153,951
Manufacturing Demand	20	38	52	52	52	52
Irrigation Demand	0	0	0	0	0	0
Steam Electric Power Demand	942	1,530	2,119	3,294	3,294	3,294
Mining Demand	1,457	244	1,199	2,516	3,767	5,063
Livestock Demand	0	0	0	0	0	0
Total UTRWD Demand	**50,334**	**75,852**	**97,651**	**121,641**	**141,150**	**162,360**

3 Analysis of Water Supply Currently Available to Region C

This chapter gives an overall summary of the water supplies available to Region C. **Appendix E** includes further details on the development of this information. Under the Texas Water Development Board (TWDB) regional water planning guidelines [(1)], each region is to identify currently available water supplies to the region by source and user. The supplies available by source are based on the supply available during drought of record conditions.

For surface water reservoirs, available supply is generally the equivalent of firm yield supply or permitted amount (whichever is lower). However, several providers in Region C have chosen to use safe yields as the available supply. The safe yield is less than the firm yield and is discussed in more detail in **Section 3.2** and **Appendix E**. For run-of-the-river supplies, available supply is the minimum supply available in a month over the historical record.

Available groundwater supplies are defined by county and aquifer. Generally, groundwater supply is the supply available with acceptable long-term impacts to water levels. Modeled Available Groundwater (MAG) numbers have been developed by the TWDB to define the long-term available groundwater supply. MAG numbers were not available for "other aquifer." These supply amounts are based on historical pumping data obtained from the TWDB [(2)].

Currently available water supplies are those water supplies that have been permitted or contracted and that have infrastructure in place to transport and treat the water.

Some water supplies that are permitted or contracted for use do not yet have the infrastructure in place. Connecting such supplies is considered a water management strategy and water management strategies are discussed in **Chapter 5** of this report.

Chapter Outline

Section 3.1 – Overall Water Supply Availability

Section 3.2 – Surface Water Availability

Section 3.3 – Groundwater Availability

Section 3.3 – Currently Available Water Supplies

Section 3.5 – Water Availability by Major Water Providers (MWP)

Section 3.6 – Water Availability by Water User Group (WUG)

Section 3.7 – Summary of Current Water Supplies in Region C

Related Appendices

Appendix D – DB22 Reports

Appendix E – Water Supply Available

3.1 Overall Water Supply Availability

Table 3.1 and **Figure 3.1** summarize the overall water supply availability in Region C, including both connected and unconnected water sources. About 54 percent of the water supply available to Region C is from in-region reservoirs in 2020.

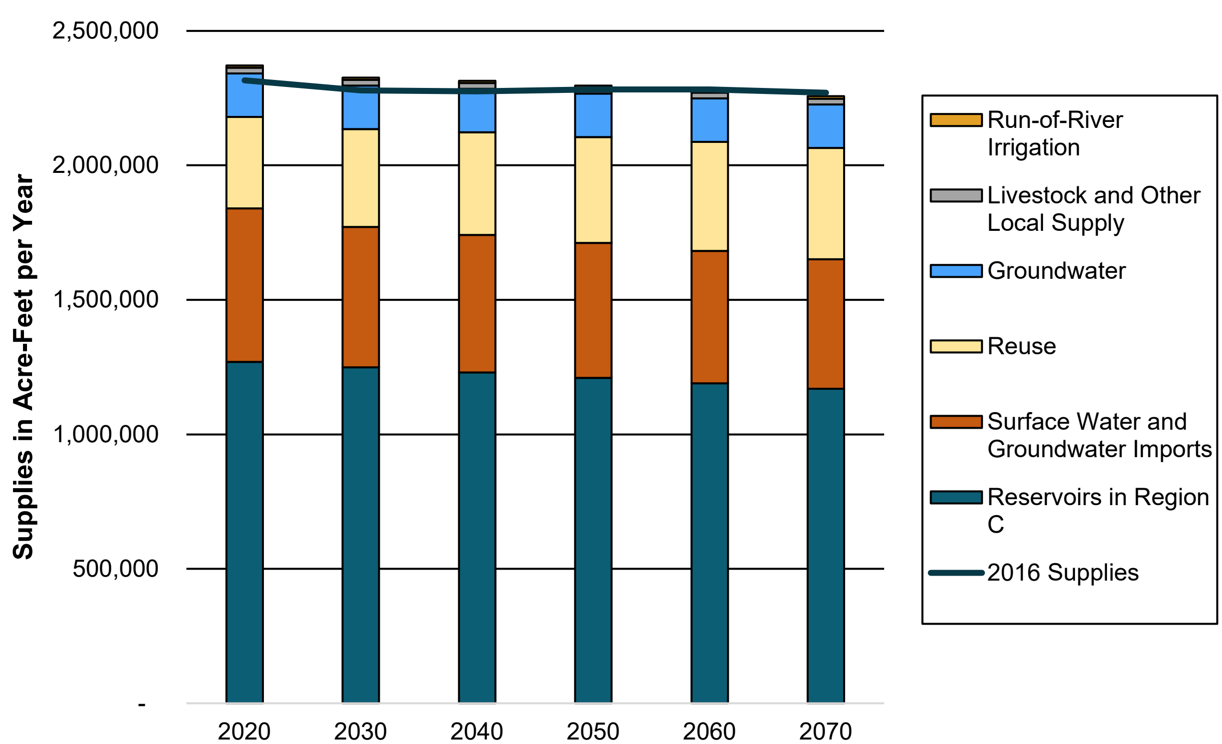
- Groundwater is approximately 7 percent of the overall supply available to Region C.
- Local supplies (limited, individual supplies that are available only to particular non-municipal WUGs) are less than 2 percent of the overall supply available to Region C.
- Authorized reuse in 2020 is about 14 percent of the overall supply available to Region C. It is worth noting that the development of reuse strategies has increased the overall reuse available from the *2016 Region C Water Plan* (3). A complete list of the recommended reuse strategies is included in **Chapter 5B**. Available reuse quantities are dependent on return flows over time, which can increase as water demands increase due to growth but can also decrease if conservation strategies reduce return flows.
- Importation of water from reservoirs in other regions is approximately 24 percent of the water available to Region C in 2020.
- Overall water supply availability is similar to the *2016 Region C Regional Water Plan*.
- Currently connected and available supplies are less than overall water supplies and are discussed in **Section 3.43.1**. The sources of the information in **Table 3.1** and **Figure 3.1** are discussed in greater detail in the following sections.

Lake Bardwell in Ennis

Table 3.1 Overall Water Supply Availability in Region C

Source	Values in Acre-Feet per Year					
	2020	2030	2040	2050	2060	2070
Run-of-River Irrigation	8,735	8,735	8,735	8,735	8,735	8,735
Livestock and Other Local Supply	21,248	21,248	21,248	21,248	21,248	21,248
Groundwater	161,948	161,800	162,386	162,100	162,548	162,150
Reuse	337,067	361,209	378,854	391,173	403,239	411,487
Surface Water and Groundwater Imports	570,746	520,778	510,783	500,854	491,718	481,582
Reservoirs in Region C	1,269,040	1,249,558	1,229,730	1,209,600	1,189,327	1,169,027
REGION C TOTAL	**2,368,784**	**2,323,328**	**2,311,736**	**2,293,710**	**2,276,815**	**2,254,229**

Figure 3.1 Overall Water Supply Availability in Region C



3.2 Surface Water Availability

3.2.1 Reservoirs

In the guidelines for Regional Water Planning [1], the TWDB requires that water availability for reservoirs be based on results of the TCEQ-approved Water Availability Models (WAMs). In Region C, most of the in-region reservoirs are located in the Trinity River Basin. Region C also uses water supplies originating in the Neches, Red, Sabine, Brazos, and Sulphur River Basins.

The WAM models were developed for the purpose of reviewing and granting new surface water right permits. The assumptions in the WAM models are based on the legal interpretation of water rights, and in some cases do not accurately reflect current operations. For planning purposes, adjustments were made to the WAMs to better reflect current and future surface water conditions in the region.

Generally, changes made to the WAM included:

- Assessment of reservoir sedimentation rates and calculation of area-capacity conditions for current and future conditions.
- Inclusion of subordination agreements.
- Inclusion of system operations where appropriate.
- Use of minimum storage elevations for U.S. Army Corps of Engineers reservoirs, where appropriate.
- Other specific corrections by river basin, as appropriate.

These adjustments were approved by the Executive Administrator (EA) of the Texas Water Development Board in a letter to the Chairman of the Region C Water Planning Group, dated June 21, 2018.

The lower surface water availability compared to the *2016 Region C Water Plan* [3] is due to the changes based on new volumetric surveys and operational changes by some of the larger providers.

Table 3.2 lists the reservoir water supplies available for use in Region C. More detail on the determination of available supplies from reservoirs is included in **Appendix E**.

Table 3.2 Surface Water Supplies Currently Available to Region C (Acre-Feet per Year)

Reservoir	Permitted Diversion	2020	2030	2040	2050	2060	2070
Systems in Region C							
Lost Creek/Jacksboro System	*1,597*	1,597	1,597	1,597	1,597	1,597	1,597
West Fork (includes Bridgeport Local)[a]	*123,459*	94,192	92,458	90,725	88,992	87,258	85,525
Elm Fork/Lewisville/Ray Roberts (Dallas)[a]	*184,166*	172,975	165,580	158,185	150,791	143,396	136,001
Grapevine - Dallas	*7,367*	7,367	7,367	7,367	7,142	6,896	6,650
Subtotal of Systems in Region C	***316,589***	**276,131**	**267,002**	**257,874**	**248,522**	**239,147**	**229,773**
Reservoirs in Region C							
Cedar Creek[a]	*175,000*	158,891	157,192	155,494	153,796	152,098	150,400
Richland-Chambers (TRWD)[a]	*210,000*	185,230	180,984	176,738	172,492	168,246	164,000
Richland-Chambers (Corsicana) and Halbert	*13,863*	13,863	13,855	13,847	13,838	13,830	13,822
Moss	*7,740*	7,410	7,410	7,410	7,410	7,410	7,410
Lake Texoma (Texas' Share - NTMWD)	*197,000*	197,000	197,000	197,000	197,000	197,000	197,000
Lake Texoma (Texas' Share - GTUA)	*83,200*	83,200	83,200	83,200	83,200	83,200	83,200
Lake Texoma (Texas' Share - Denison)	*24,400*	24,400	24,400	24,400	24,400	24,400	24,400
Lake Texoma (Texas' Share - TXU)	*16,400*	16,400	16,400	16,400	16,400	16,400	16,400
Lake Texoma (Texas' Share - RRA)	*2,250*	2,250	2,250	2,250	2,250	2,250	2,250
Randell	*1,400*	1,400	1,400	1,400	1,400	1,400	1,400
Valley	-	0	0	0	0	0	0
Bonham	*5,340*	5,340	5,340	5,340	5,340	5,340	5,340
Ray Roberts (Denton)	*18,902*	18,902	18,853	18,676	18,500	18,324	18,148
Lewisville (Denton)	*7,817*	7,817	7,817	7,817	7,817	7,698	7,550
Benbrook[a]	*6,833*	5,391	5,387	5,383	5,378	5,374	5,370
Weatherford	*2,923*	2,923	2,880	2,837	2,793	2,750	2,707
Grapevine (PCMUD)	*16,900*	16,900	16,900	16,808	16,639	16,469	16,300
Grapevine (Grapevine)	*1,983*	1,919	1,886	1,852	1,818	1,784	1,750
Arlington[a]	*9,700*	7,640	7,530	7,420	7,310	7,200	7,090
Joe Pool	*14,883*	14,883	14,575	14,267	13,958	13,650	13,342
Mountain Creek	*6,400*	6,400	6,400	6,400	6,400	6,400	6,400
North	-	0	0	0	0	0	0
Lake Ray Hubbard (Dallas)	*56,113*	55,730	54,828	53,926	53,024	52,122	51,220
White Rock	*3,200*	3,200	3,200	3,200	3,200	3,200	3,200
Terrell	*2,267*	2,267	2,250	2,233	2,217	2,200	2,183
Clark	*210*	210	210	210	210	210	210

Reservoir	Permitted Diversion	2020	2030	2040	2050	2060	2070
Bardwell	*9,600*	9,600	9,295	8,863	8,432	8,000	7,568
Waxahachie	*2,800*	2,800	2,695	2,590	2,485	2,380	2,275
Forest Grove	*8,653*	8,653	8,590	8,527	8,463	8,400	8,337
Trinidad City Lake	*450*	450	450	450	450	450	450
Trinidad	*3,050*	3,050	3,050	3,050	3,050	3,050	3,050
Navarro Mills	*18,333*	18,333	17,325	16,317	15,308	14,300	13,292
Fairfield	*870*	870	870	870	870	870	870
Bryson	-	0	0	0	0	0	0
Mineral Wells	*2,495*	2,495	2,483	2,470	2,458	2,445	2,433
Teague City Lake	*189*	189	189	189	189	189	189
Lake Lavon	*108,920*	106,603	105,163	103,722	102,281	100,841	99,400
Muenster	*300*	300	300	300	300	300	300
Subtotal of Reservoirs in Region C	***1,040,384***	**992,909**	**982,556**	**971,856**	**961,078**	**950,180**	**939,254**
Imports[b]							
Chapman (NTMWD)	*44,792*	42,768	42,525	42,282	42,039	41,796	41,553
Chapman (Irving)	*42,280*	40,369	40,140	39,911	39,681	39,452	39,223
Chapman (Upper Trinity MWD)	*12,606*	12,036	11,968	11,900	11,831	11,763	11,694
Tawakoni (Dallas)	*183,768*	174,080	169,120	164,160	159,200	154,240	149,280
Fork (Dallas)	*119,699*	119,699	116,180	112,332	108,484	104,636	100,788
Upper Sabine (NTMWD)	*50,707*	51,201	10,655	10,565	10,475	10,395	10,293
Palestine (Dallas)	*114,337*	106,230	105,370	104,564	103,704	102,791	101,555
Lake Livingston	*20,000*	20,000	20,000	20,000	20,000	20,000	20,000
Lake Aquilla	*660*	380	459	508	572	629	655
Lake Granbury	*695*	576	577	576	576	576	576
Lake Athens (Athens)	*5,983*	1,192	1,570	1,798	2,132	3,366	3,930
Vulcan Materials (from BRA System)	*1,000*	1,000	1,000	1,000	1,000	1,000	1,000
Parker County (from Lake Palo Pinto)	*1,257*	796	783	772	762	754	746
Subtotal of Imports	***597,784***	**570,327**	**520,347**	**510,368**	**500,456**	**491,398**	**481,293**
TOTAL	***1,954,757***	**1,839,367**	**1,769,905**	**1,740,098**	**1,710,056**	**1,680,725**	**1,650,320**

[a]*Amounts reported are safe yields.*

[b]*Note that for imports, the amounts are Region C supplies only, not the total from the reservoir.*

3.2.2 Other Local Supplies

Other local supplies include run-of-the-river supplies associated with water rights and used for municipal, manufacturing, mining, and power generation. They also include local surface water supplies used for mining and livestock. For livestock and mining local supplies, some of the available supplies were revised from previous plans considering the historical use over the past ten years [(4)], 2011 use [(4)], and projected demands.

More detail on the determination of available other local supplies is included in **Table 3.3** and **Appendix E**.

Table 3.3 Run-of-the-River and Other Local Water Supplies

County	Values in Acre-Feet per Year						
	Run-of-the-River Supply					Other Local Supply	
	Irrigation	Manufacturing	Mining	Municipal	Steam Electric	Livestock	Mining
Collin	408	0	0	0	0	1,002	0
Cooke	0	0	0	0	0	1,187	0
Dallas	791	0	0	0	368	198	1,525
Denton	0	0	0	0	0	622	1,366
Ellis	3	0	0	0	0	1,112	0
Fannin	4,613	0	72	49	0	1,306	0
Freestone	87	0	0	41	0	1,043	120
Grayson	1,091	30	0	0	0	1,075	0
Henderson	415	0	0	0	0	345	0
Jack	110	0	0	0	0	802	370
Kaufman	64	0	0	0	0	1,622	86
Navarro	226	0	0	252	0	1,603	0
Parker	239	0	0	0	0	1,922	20
Rockwall	0	0	0	0	0	117	0
Tarrant	549	0	0	0	959	442	342
Wise	139	0	133	0	0	1,117	0
TOTAL	**8,735**	**30**	**205**	**342**	**1,327**	**15,515**	**3,829**

3.2.3 Reuse

The reuse supply considered as available to the region is from existing projects based on current permits, authorizations, and facilities. Categories of reuse include currently permitted and operating indirect reuse projects, in which water is reused after being returned to the stream; existing reuse projects for industrial purposes (including recycled water for mining use); and authorized direct reuse projects for which facilities are already developed. The specific reuse projects included are discussed in **Appendix E**.

Indirect reuse project sponsors in Region C include the North Texas Municipal Water District (NTMWD), Trinity River Authority (TRA), Tarrant Regional Water District (TRWD), the Upper Trinity Regional Water District (UTRWD), Dallas Water Utilities (DWU), Denton, and Grapevine. In addition, there are a number of existing direct reuse projects for landscape irrigation, golf course irrigation, cooling water, park irrigation, and natural gas industry use in Region C. Many of these projects were included in the *2016 Region C Water Plan* (3).

It is anticipated that reuse will increase in Region C over the next 50 years, but proposed and potential reuse projects are not included as currently available supplies. There are a number of reuse projects considered as potentially feasible management strategies as part of this planning process. Recommended water management strategies for reuse are discussed in **Chapter 5B** of this report. **Table 3.4** summarizes the currently permitted reuse supplies by county in Region C. Note that in some cases, currently available reuse supplies are expected to increase over time with increasing return flows.

Table 3.4 Currently Permitted Reuse Supplies by County

County	Volumes in Acre-Feet per Year					
	2020	2030	2040	2050	2060	2070
Collin	52,394	62,124	73,497	76,512	76,512	76,512
Cooke	4	4	4	4	4	4
Dallas	9,732	9,732	9,732	9,732	9,732	9,732
Denton	55,296	62,771	68,128	76,774	88,824	97,054
Ellis	4,398	4,801	5,533	6,048	6,048	6,048
Fannin	0	0	0	0	0	0
Freestone	0	0	0	0	0	0
Grayson	0	0	0	0	0	0
Henderson	32	32	32	32	32	32
Jack	27	26	26	25	25	24
Kaufman	105,689	111,737	111,841	111,862	111,862	111,862
Navarro	100,465	100,465	100,465	100,465	100,465	100,465
Parker	397	463	503	641	660	680
Rockwall	672	672	672	672	672	672
Tarrant	7,961	8,382	8,421	8,406	8,403	8,402
Wise	0	0	0	0	0	0
TOTAL	**337,067**	**361,209**	**378,854**	**391,173**	**403,239**	**411,487**

3.3 Groundwater Availability

Groundwater supplies in Region C are obtained from two major aquifers (Carrizo-Wilcox and Trinity), three minor aquifers (Woodbine, Nacatoch, and Queen City), and locally undifferentiated formations, referred to as "other aquifer".

The TWDB guidelines [(1)] state that Modeled Available Groundwater (MAG) estimates provided by the TWDB are to be used to determine available groundwater supplies. MAG estimates are developed by the TWDB using Desired Future Conditions (DFCs) submitted by Groundwater Management Areas (GMAs). The TWDB created sixteen GMAs in Texas. GMA 8 covers all of Region C except for Jack County, Henderson County, and a small portion of Navarro County. The GMAs are responsible for developing DFCs for aquifers within their respective areas. The TWDB quantifies MAG estimates based on the DFCs provided by the GMAs.

3.3.1 Trinity and Woodbine Aquifers

The Woodbine aquifer overlies the Trinity aquifer. The Woodbine aquifer is in Collin, Cooke, Dallas, Denton, Ellis, Fannin, Grayson, Kaufman, Navarro, Rockwall, and Tarrant Counties in Region C. The Trinity aquifer is in Collin, Cooke, Dallas, Denton, Ellis, Fannin, Grayson, Jack, Kaufman, Navarro, Parker, Rockwall, Tarrant, and Wise Counties in Region C. Most of the pumping from the Trinity aquifer in Region C is from three layers: Paluxy, Hensel, and Hosston. MAG estimates provided by the TWDB were used to determine groundwater availability from the Trinity and Woodbine aquifers. These availability numbers are shown in **Table 3.5.**

3.3.2 Carrizo-Wilcox, Queen City, Nacatoch, and Cross Timbers Aquifers

Supplies from the Carrizo-Wilcox aquifer are available in Freestone, Henderson, and Navarro Counties in Region C. Supplies from the Queen City aquifer are available in Henderson County in Region C. The Nacatoch aquifer underlies Kaufman, Henderson, and Navarro Counties in Region C. MAG estimates provided by the TWDB were used to determine groundwater availability from the Carrizo-Wilcox and Queen City aquifers. GMA 8 and GMA 11 deemed the Nacatoch aquifer "non-relevant", and new water availability estimates for this aquifer were not included in the MAGs developed by TWDB. Therefore, availability for this aquifer was assumed to be the same as the amounts used in the *2016 Region C Water Plan.* The Cross Timbers aquifer was designated as a new minor aquifer in 2017. No desired future conditions have been established by the groundwater conservation district for this aquifer, therefore no MAG amounts are available. For this reason, the availability from this aquifer is assumed to be the "other aquifer" availability used in the *2016 Region C Water Plan* for the areas where "other aquifer" overlaps the newly designated Cross Timbers aquifer. **Table 3.5** shows the groundwater availability by county to Region C from these aquifers. As with reservoirs, this number represents the amount of water available from the aquifer, without considering limitations imposed by, or current availability due to, the capacity of wells and other facilities. The amount of groundwater currently available in Region C is discussed in **Section 3.4.**

3.3.3 Other Aquifers

There are several locally undifferentiated formations in Region C, referred to as “other aquifer.” Other aquifer supplies are used in Fannin and Navarro Counties in Region C. Available supplies from these undifferentiated formations are not included in the MAG numbers. Other aquifer available supply amounts are based on historical use. In the historical pumping data obtained from the TWDB, there are significant amounts of groundwater classified as “other aquifer” or “unknown aquifer”. In many cases, it is believed the “other aquifer” use should be classified as part of a differentiated formation but was not. In these cases, other aquifer supplies were not shown to be available despite the “availability” shown in the historical data.

3.3.4 Groundwater Conservation Districts

There are currently seven Groundwater Conservation Districts (GCDs) that include one or more Region C counties. These GCDs are listed below and shown in **Figure 3.2.**

- Upper Trinity GCD (Wise and Parker Counties)
- Northern Trinity GCD (Tarrant County)
- Neches and Trinity Valleys GCD (includes Henderson County)
- Mid-East Texas GCD (includes Freestone County)
- Prairielands GCD (includes Ellis County)
- North Texas GCD (Collin, Cooke, and Denton Counties)
- Red River GCD (Grayson and Fannin Counties)

3.3.5 Summary

In Region C, new MAG estimates for the Trinity, Woodbine, Carrizo-Wilcox, and Queen City aquifers were available for this cycle of regional water planning. New MAG estimates were not available for the Nacatoch aquifer and the availability for this aquifer was assumed to be the same as the amounts used in the *2016 Region C Water Plan.* No MAG amounts were available for the newly designated Cross Timbers aquifer and the availability was assumed to be the “other aquifer” availability used in the *2016 Region C Water Plan* for the areas where “other aquifer” overlaps the newly designated Cross Timbers aquifer. MAG estimates were not available for other aquifers, and groundwater supplies were based on historical pumping information from the TWDB [(2)]. The total available supply from groundwater in Region C is 161,948 acre-feet per year in 2020, changing to 162,150 acre-feet per year in 2070. About 67 percent of the available groundwater in Region C is from the Trinity aquifer, 17 percent from the Woodbine aquifer, 10 percent from the Carrizo-Wilcox aquifer, and 6 percent from minor and undesignated aquifers. More detail on the determination of available supplies from groundwater is included in **Appendix E**.

Figure 3.2 Groundwater Conservation Districts in Region C

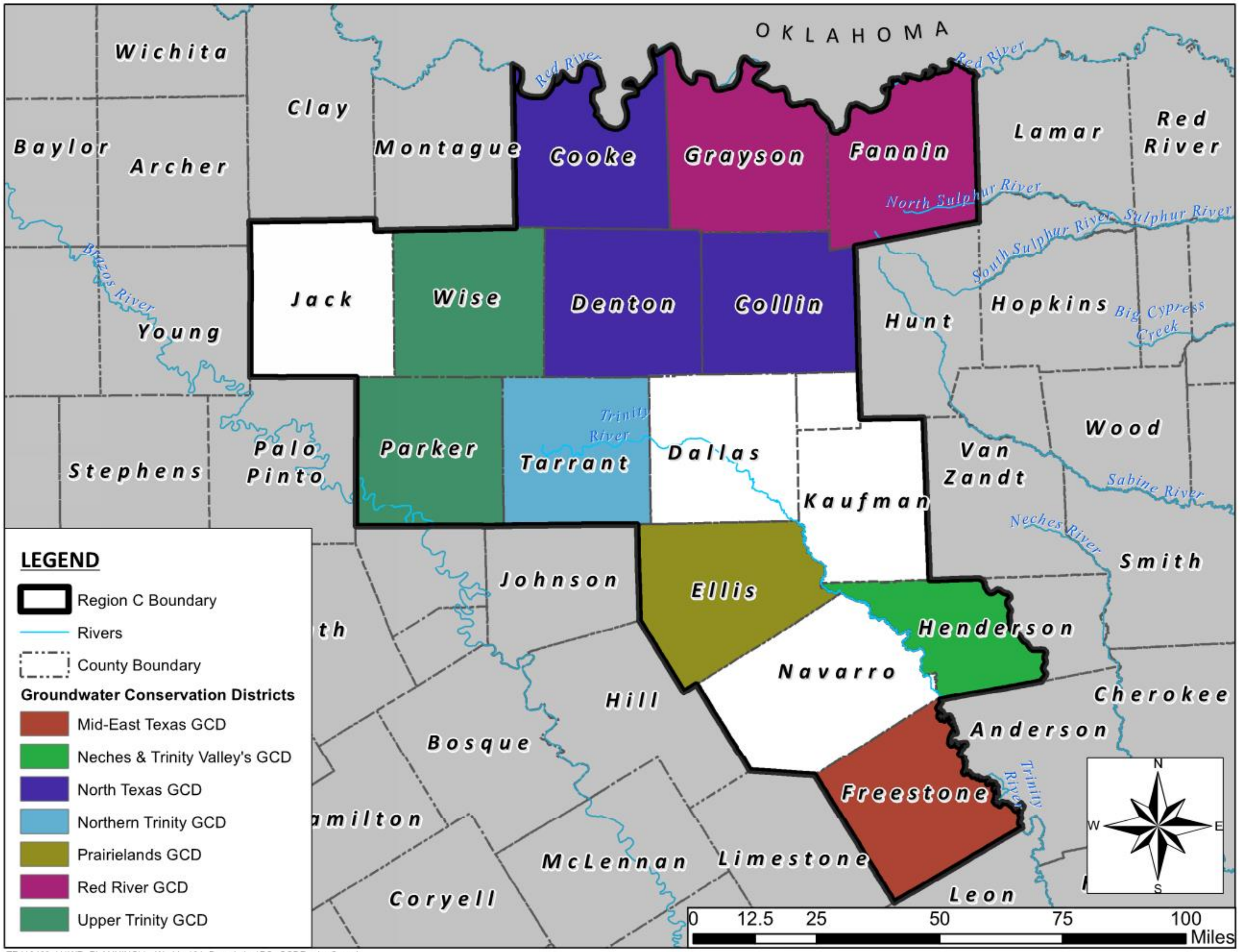


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Table 3.5 Groundwater Availability in Region C (Acre-Feet per Year)

Aquifer	County	2020	2030	2040	2050	2060	2070
Carrizo-Wilcox	Freestone	9,046	9,267	9,484	9,664	9,898	9,898
Carrizo-Wilcox	Henderson	7,829	7,829	7,829	7,732	7,577	7,548
Carrizo-Wilcox	Navarro	15	15	15	15	15	15
Carrizo-Wilcox Subtotal		**16,890**	**17,111**	**17,328**	**17,411**	**17,490**	**17,461**
Trinity	Collin	5,807	5,792	5,807	5,792	5,807	5,792
Trinity	Cooke	10,544	10,514	10,544	10,514	10,544	10,514
Trinity	Dallas	3,699	3,688	3,699	3,688	3,699	3,688
Trinity	Denton	30,151	30,068	30,151	30,068	30,151	30,068
Trinity	Ellis	5,539	5,524	5,539	5,524	5,539	5,524
Trinity	Fannin	2,092	2,087	2,092	2,087	2,092	2,087
Trinity	Grayson	10,737	10,708	10,737	10,708	10,737	10,708
Trinity	Kaufman	0	0	0	0	0	0
Trinity	Navarro	0	0	0	0	0	0
Trinity	Parker	11,897	11,863	11,897	11,863	11,897	11,863
Trinity	Rockwall	0	0	0	0	0	0
Trinity	Tarrant	17,964	17,915	17,964	17,915	17,964	17,915
Trinity	Wise	9,760	9,734	9,760	9,734	9,760	9,734
Trinity Subtotal		**108,190**	**107,893**	**108,190**	**107,893**	**108,190**	**107,893**
Woodbine	Collin	4,263	4,251	4,263	4,251	4,263	4,251
Woodbine	Cooke	802	799	802	799	802	799
Woodbine	Dallas	2,804	2,796	2,804	2,796	2,804	2,796
Woodbine	Denton	3,616	3,607	3,616	3,607	3,616	3,607
Woodbine	Ellis	2,078	2,073	2,078	2,073	2,078	2,073
Woodbine	Fannin	4,933	4,921	4,933	4,921	4,933	4,921
Woodbine	Grayson	7,541	7,521	7,541	7,521	7,541	7,521
Woodbine	Kaufman	0	0	0	0	0	0
Woodbine	Navarro	68	68	68	68	68	68
Woodbine	Rockwall	0	0	0	0	0	0
Woodbine	Tarrant	1,141	1,138	1,141	1,138	1,141	1,138
Woodbine		**27,246**	**27,174**	**27,246**	**27,174**	**27,246**	**27,174**
Cross Timbers	Jack, Parker	984	984	984	984	984	984
Nacatoch	Ellis, Kaufman, Navarro & Rockwall	1,939	1,939	1,939	1,939	1,939	1,939
Queen City	Henderson	3,345	3,345	3,345	3,345	3,345	3,345
Other	Fannin, Navarro	3,354	3,354	3,354	3,354	3,354	3,354
Minor and Other Subtotal		**9,622**	**9,622**	**9,622**	**9,622**	**9,622**	**9,622**
TOTAL		**161,948**	**161,800**	**162,386**	**162,100**	**162,548**	**162,150**

3.4 Currently Available Water Supplies

Table 3.6 and **Figure 3.3** show the currently available water supplies in Region C by different source types. **Table 3.7** shows the currently available supplies for water user groups by county. Currently available supplies are supplies that can be used with currently existing water rights, contracts, and facilities. They are less than the overall supplies available to the region because the facilities needed to use some supplies have not yet been developed. Common constraints limiting currently available supplies include the availability and capacity of transmission systems, treatment plants, and wells.

The difference between currently available supply and that which is available to users is due primarily to transmission and treatment plant capacity limitations.

The currently available supplies from in-region reservoirs, local sources, groundwater and current reuse are nearly fully allocated by 2070. Some of the amount of available supplies not allocated can be attributed to sources that are not currently used for water supply (White Rock Lake, Lake Mineral Wells and Forest Grove Reservoir).

Permitted surface water and groundwater imports to Region C are shown in **Table 3.1**. In 2070, approximately one-third of these supplies are not currently connected to water supply systems. The connection of these supplies will be considered as water management strategies and are discussed in more detail in **Chapter 5**.

Table 3.6 Currently Available Water Supplies to Water Users by Source Type

Category	Values in Acre-Feet per Year					
	2020	2030	2040	2050	2060	2070
Reservoirs in Region C	913,440	885,687	857,842	834,420	812,292	785,052
Run-of-River Irrigation	8,735	8,735	8,735	8,735	8,735	8,735
Livestock and Other Local Supply	20,996	20,996	20,996	20,996	20,996	20,996
Surface and Groundwater Imports	347,914	309,213	309,298	309,655	310,696	310,997
Groundwater	111,685	110,179	109,382	109,342	110,065	110,180
Reuse	261,924	288,516	308,785	323,565	340,358	354,480
REGION C TOTAL	**1,664,694**	**1,623,326**	**1,615,038**	**1,606,713**	**1,603,142**	**1,590,440**

Figure 3.3 Currently Available Supplies for Region C Water Users

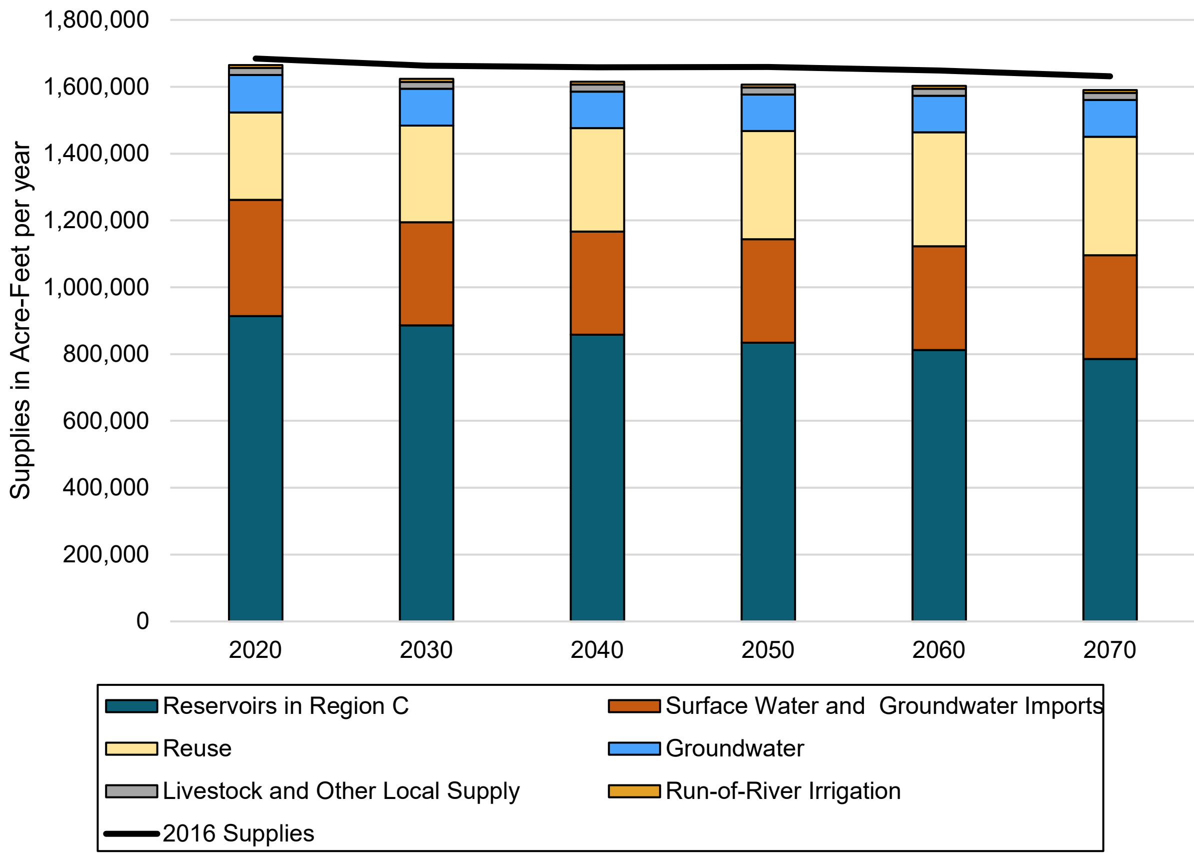


Table 3.7 Currently Available Supplies by County (Acre-Feet per Year)

County	2020	2030	2040	2050	2060	2070
Collin	243,009	226,454	228,220	233,297	233,722	232,707
Cooke	10,035	9,884	9,421	9,876	9,907	10,027
Dallas	558,730	545,266	544,101	539,610	538,786	533,486
Denton	182,897	184,121	186,227	185,199	182,650	180,105
Ellis	42,877	45,139	46,178	48,972	52,619	55,377
Fannin	14,643	15,108	15,746	15,714	15,702	15,708
Freestone	34,380	33,585	32,914	32,404	32,076	31,860
Grayson	40,189	40,785	41,183	42,255	44,660	44,790
Henderson	14,362	14,473	14,529	14,672	15,919	16,627
Jack	9,358	7,216	6,642	6,306	6,067	5,887
Kaufman	32,530	34,518	35,770	38,048	42,742	47,271
Navarro	13,220	14,246	15,022	14,972	14,900	14,879
Parker	35,333	38,020	36,853	36,609	36,073	35,390
Rockwall	23,628	26,655	32,056	32,386	33,454	33,788
Tarrant	387,554	366,080	348,590	334,618	322,088	310,835
Wise	21,949	21,776	21,586	21,775	21,777	21,703
Subtotal	*1,664,694*	*1,623,326*	*1,615,038*	*1,606,713*	*1,603,142*	*1,590,440*
Other Regions	27,818	29,806	30,924	31,104	31,427	31,940
TOTAL	**1,692,512**	**1,653,132**	**1,645,962**	**1,637,817**	**1,634,569**	**1,622,380**

3.5 Water Availability by Major Water Provider (MWP)

As part of the Senate Bill One planning process, the Texas Water Development Board requires development of water availability for each designated major water provider. The major water provider (MWP) designation is new for the 2021 Planning Cycle and is defined as "a water user group or a wholesale water provider of particular significance to the region's water supply as determined by the regional water planning group." The designated entities can include public or private entities from any water use category. The MWP designation does not replace the wholesale water provider (WWP) designation used in previous rounds of planning but is intended to serve as a way to summarize the demands, sales, and WMS data related to WUGs and WWPs. The Region C Water Planning Group designated seven entities as MWPs. These MWPs are Dallas Water Utilities, Fort Worth, Greater Texoma Utility Authority, North Texas Municipal Water District, Tarrant Regional Water District, Trinity River Authority, and Upper Trinity Regional Water District. These entities were included as MWPs because of the large number of people served and the large quantities of water provided.

Table 3.8 gives a summary of the supplies currently available to major water providers. As discussed in **Section 3.1,** currently available supplies are limited by existing physical facilities.

Lake Texoma

Table 3.8 Currently Available Supplies to Major and Regional Water Providers in Region C (Acre-Feet per Year)

Provider	Source	2020	2030	2040	2050	2060	2070
Dallas Water Utilities	Ray Roberts/Lewisville System[a]	172,975	165,580	158,185	150,791	143,396	136,001
	Lake Grapevine	7,367	7,367	7,367	7,142	6,896	6,650
	Lake Ray Hubbard	55,730	54,828	53,926	53,024	52,122	51,220
	Lake Tawakoni[a]	174,080	169,120	164,160	159,200	154,240	149,280
	Lake Fork[a]	50,120	55,080	60,040	65,000	69,960	74,920
	Direct Reuse (Golf Courses)	1,121	1,121	1,121	1,121	1,121	1,121
	Indirect Reuse	3,200	3,200	3,200	3,200	3,200	3,200
	White Rock Lake (Irrigation Only)	43,451	49,167	52,547	57,540	69,313	77,705
	DWU Total	**508,044**	**505,463**	**500,546**	**497,018**	**500,248**	**500,097**
City of Fort Worth	TRWD Supplies	278,569	278,569	278,569	278,569	278,569	278,569
	Direct Reuse	4,366	4,423	4,423	4,423	4,423	4,423
	Fort Worth Total	**282,935**	**282,992**	**282,992**	**282,992**	**282,992**	**282,992**
North Texas Municipal Water District	Lake Lavon	92,280	91,802	91,324	90,846	90,368	89,890
	Lake Texoma	69,998	73,738	76,401	76,975	76,795	76,614
	Chapman Lake	42,768	42,525	42,282	42,039	41,796	41,553
	Wilson Creek Reuse	48,896	58,626	69,999	73,014	73,014	73,014
	Lake Bonham	2,036	2,517	3,195	3,195	3,195	3,195
	East Fork Reuse	96,047	102,000	102,000	102,000	102,000	102,000
	Upper Sabine Basin	51,201	10,655	10,565	10,475	10,395	10,293
	Direct Reuse	3,713	3,713	3,713	3,713	3,713	3,713
	NTMWD Total	**406,939**	**385,576**	**399,479**	**402,257**	**401,276**	**400,272**
Tarrant Regional Water District	West Fork System[a]	94,192	92,458	90,725	88,992	87,258	85,525
	Lake Benbrook[a]	5,391	5,387	5,383	5,378	5,374	5,370
	Lake Arlington[a]	7,640	7,530	7,420	7,310	7,200	7,090
	Cedar Creek Lake[a]	158,641	156,942	155,244	153,546	151,848	150,150
	Richland-Chambers Reservoir[a]	185,230	180,984	176,738	172,492	168,246	164,000
	Richland-Chambers Reuse	35,931	40,202	44,455	49,078	53,899	59,762
	TRWD Total	**487,025**	**483,503**	**479,965**	**476,797**	**473,826**	**471,897**

Provider	Source	2020	2030	2040	2050	2060	2070
Trinity River Authority	Joe Pool Lake						
	Midlothian	*5,833*	*5,712*	*5,591*	*5,470*	*5,349*	*5,229*
	Grand Prairie	*1,272*	*1,239*	*1,207*	*1,174*	*1,141*	*1,109*
	Grand Prairie (raw)	*300*	*300*	*300*	*300*	*300*	*300*
	Cedar Creek	*7,346*	*7,346*	*7,346*	*7,346*	*7,346*	*7,346*
	Duncanville	*1,197*	*1,197*	*1,197*	*1,197*	*1,197*	*1,197*
	Navarro Mills Lake	18,333	17,325	16,317	15,308	14,300	13,292
	Bardwell Lake	9,600	9,295	8,863	8,432	8,000	7,568
	Lake Livingston (Region C)	20,000	20,000	20,000	20,000	20,000	20,000
	Reuse (Region C)	68,140	68,543	69,275	69,790	69,790	69,790
	Subtotal	**132,021**	**130,957**	**130,096**	**129,017**	**127,423**	**125,831**
	TRWD	48,633	44,474	40,902	40,635	41,144	39,287
	TRA Total in Region C	**180,654**	**175,431**	**170,998**	**169,652**	**168,567**	**165,118**
Upper Trinity Regional Water District	Chapman Lake	11,795	11,729	11,662	11,594	11,528	11,460
	DWU Contract	41,194	44,851	42,886	40,173	38,727	37,698
	Chapman Reuse	3,970	4,178	4,383	4,584	4,558	4,531
	Direct Reuse	897	897	897	897	897	897
	UTRWD Total	**57,856**	**61,655**	**59,828**	**57,248**	**55,710**	**54,586**
Corsicana	Lake Halbert and Richland-Chambers System	2,242	2,242	2,242	2,242	2,242	2,242
	Navarro Mills Reservoir	11,210	11,210	11,210	11,210	11,210	11,210
	Corsicana Total	**13,452**	**13,452**	**13,452**	**13,452**	**13,452**	**13,452**
Greater Texoma Utility Authority	Lake Texoma Raw Water	83,200	83,200	83,200	83,200	83,200	83,200
	Delivery Limited by WTP Capacity	11,210	11,210	11,210	11,210	11,210	11,210
	Usable Lake Texoma Raw Water	71,990	71,990	71,990	71,990	71,990	71,990
	Denison (for Pottsboro)	406	543	679	918	1,512	1,682
	NTMWD (Collin-Grayson MA)	4,485	5,400	5,400	5,400	5,400	5,400
	GTUA Total	**88,091**	**89,143**	**89,279**	**89,518**	**90,112**	**90,282**

[a]*The available supply reported is the safe yield because of the operations by the MWP.*

3.6 Water Availability by Water User Group (WUG)

As part of the regional water planning process, the TWDB requires development of information on currently available water supplies for each water user group (WUG) by river basin and county. The availability figures by water user group are limited by contracts and existing physical facilities, including transmission facilities, groundwater wells, and water treatment facilities. The supplies available to each WUG are shown in the TWDB database reports in **Appendix D**.

As the information on currently available water supply for WUGs was developed, several important points became apparent:

- Most water user groups in Region C will need additional water supplies over the next 50 years to meet growing demands.
- There are some significant water supplies that can be made available by the development of additional water transmission facilities. An example is the full development of Dallas Water Utilities' share of Lake Palestine in the Neches Basin.

3.7 Summary of Current Water Supplies in Region C

Region C water suppliers are currently using over 70 percent of the reliable supply available from existing sources. The projected overall water supply available to Region C in 2070 from current sources is over 2,250,000 acre-feet per year (not considering supply limitations due to the capacities of current raw water transmission facilities and wells).

The sources of supply for Region C in 2020 include:

- 54% from in-region reservoirs
- 7% from groundwater
- 1% from local supplies including run-or-river
- 14% from reuse
- 24% from imports from other regions

Considering supply limitations due to the capacities of current raw water transmission facilities and wells, the currently available supply for Region C water users in 2070 is over 1.61 million acre-feet per year, with an additional 31,000 acre-feet per year available from Region C for water users in other regions. The total available supply is over 2.25 million acre-feet per year, which is over 616,000 acre-feet per year more than the currently available supply. The difference between currently available supply and total available supply is due primarily to transmission and treatment plant capacity limitations.

Most water user groups and wholesale water providers in Region C will have to make improvements to their facilities to meet projected needs. The supply currently available to Region C from existing sources in 2070 (over 1.6 million acre-feet per year) is significantly less than the projected 2070 water demand, which is over 2.79 million acre-feet per year.

The currently available supply for 2070 presented in this plan is slightly less than what was in the 2016 Region C Plan.

3.8 Chapter 3 List of References

(1) Texas Water Development Board, *Exhibit C Second Amended General Guidelines for Regional Water Plan Development* (April 2018), Austin, [Online] Available URL: http://www.twdb.texas.gov/waterplanning/rwp/planningdocu/2021/doc/current_docs/contract_docs/2ndAmendedExhibitC.pdf?d=11541.199999992386, August 21, 2018.

(2) Texas Water Development Board: *Groundwater Pumpage Estimates, Pumpage Detail, 2000 and Later*, Austin, [Online] Available URL: http://www.twdb.texas.gov/waterplanning/waterusesurvey/historical-pumpage.asp, November 2017.

(3) Freese and Nichols, Inc., Alan Plummer Associates, Inc., CP&Y, Inc., and Cooksey Communications, Inc.: *2016 Region C Water Plan*, prepared for the Region C Water Planning Group, Fort Worth, December 2015.

(4) Texas Water Development Board: *Water Use Summary Estimates by County*, Austin, [Online] Available URL: http://www.twdb.texas.gov/waterplanning/waterusesurvey/estimates/index.asp, September 2017.

4 Identification of Water Needed

Texas Water Development Board (TWDB) guidelines require that reserves and needs for additional water supply be determined for each water user group in the region based on the comparison of current water supply and projected demand. The specific surpluses and needs shown should be treated with caution because their development requires certain assumptions which are detailed to the right.

The resulting comparison shows the reserves and needs that will exist in Region C if no steps are taken to connect existing water supplies or develop additional water supplies. This comparison is specifically required by Texas Water Development Board planning guidelines [(1)]. Development of infrastructure to make existing supplies available to users and development of new supplies are treated as water management strategies, and they will be discussed in **Chapter 5**.

Surpluses and needs shown in this chapter are based on certain assumptions:

- TWDB guidelines require that the comparison between supply and demand be based on currently connected supplies, without considering the future connection of already developed supplies [(1)].
- The division of existing supplies among users can be made in many ways. For example, the amount of groundwater available in a county on a sustainable basis was divided among users based on historical use and on well capacities. The actual future groundwater use may differ from these assumptions.

Chapter Outline

Section 4.1 – Regional Comparison of Supply and Demand

Section 4.2 – Comparison of Connected Supply and Projected Demand by Major Water Provider

Section 4.3 – Comparison of Connected Supply and Projected Demand by Other Water Providers

Section 4.3 – Summary of Projected Water Shortages

Section 4.5 – Second-Tier Needs Analysis

Related Appendices

Appendix D – DB22 Reports

4.1 Regional Comparison of Supply and Demand

Table 4.1 and **Figure 4.1** provide a comparison of total currently connected water supply and total projected water demand in Region C, considering all water user groups. If only water user groups with projected shortages (and not reserves) are considered, there is a need for approximately 67,000 acre-feet per year of additional supply by 2020, growing to a need for 1.32 million acre-feet per year of additional supply by 2070, based on currently connected supplies.

Figure 4.2 shows the projected distribution of shortages. Approximately ninety percent of the projected shortage in 2070 is for municipal users. It should be noted that most of the "shortages" shown for 2020 are fully met with expected conservation savings which is treated as a water management strategy rather than a currently available supply. This is discussed in more detail in **Section 4.5** regarding the second-tier needs analysis.

Table 4.2 shows the comparison of supply and demands by county. In 2020, all 16 counties show a net need for more water. On a regional basis, over 280 water users in Region C are predicted to have a need for additional water by 2070. In general, the largest water needs are in Collin, Dallas, Denton and Tarrant Counties

The comparison of supply and demand in **Table 4.1** and **Figure 4.1** focuses on currently connected supplies. These currently connected supplies differ from "existing supplies" in TWDB's online regional planning database (DB22) because DB22 does not recognize connected but unused supplies. For example, all of the groundwater in Region C is considered existing in DB22, but the connected supplies presented here do not consider unused groundwater an existing/connected supply. Region C also has a significant amount of unconnected supplies that could be made available to the region. An unconnected water supply is an existing and permitted supply that is not currently available due to infrastructure limitations.

Table 4.3 and **Figure 4.3** show the comparison of total supply with demand for Region C, including connected and unconnected supply and surface water imports from other regions. By 2050, the projected demand for Region C exceeds total connected and unconnected supply.

Table 4.1 Comparison of Connected Supply with Projected Demand by Decade

	Values in Acre-Feet per Year					
	2020	2030	2040	2050	2060	2070
Connected Supply in Region C	1,664,694	1,623,326	1,615,038	1,606,713	1,603,142	1,590,440
Projected Demand	1,733,893	1,936,605	2,151,925	2,390,623	2,641,476	2,898,540
Total Regional Need	69,199	313,279	536,887	783,910	1,038,334	1,308,100
Regional Need Considering Only WUGs with Needs	65,972	306,639	529,620	769,499	1,015,780	1,278,427
Counties with Needs	16	16	16	16	16	16
User Groups with Needs	156	238	257	268	276	281

Figure 4.2 Comparison of Connected Supply with Projected Demand by Decade for Region C

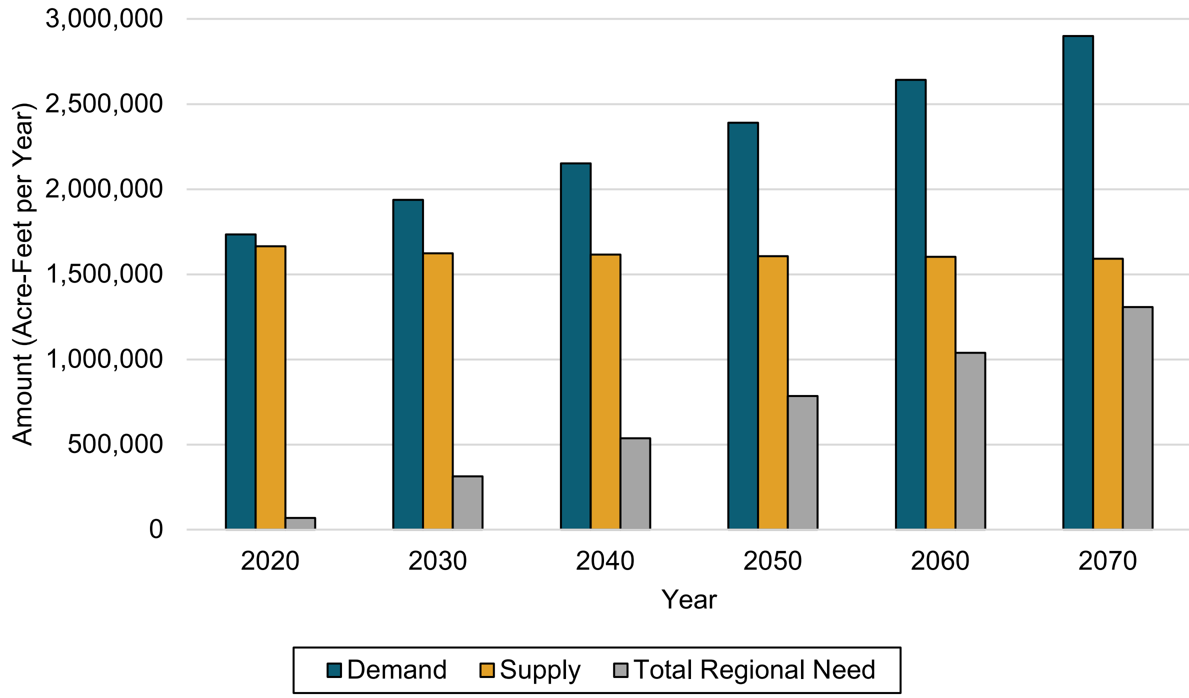


Figure 4.1 Projected Shortage by Use Type for Region C in 2070

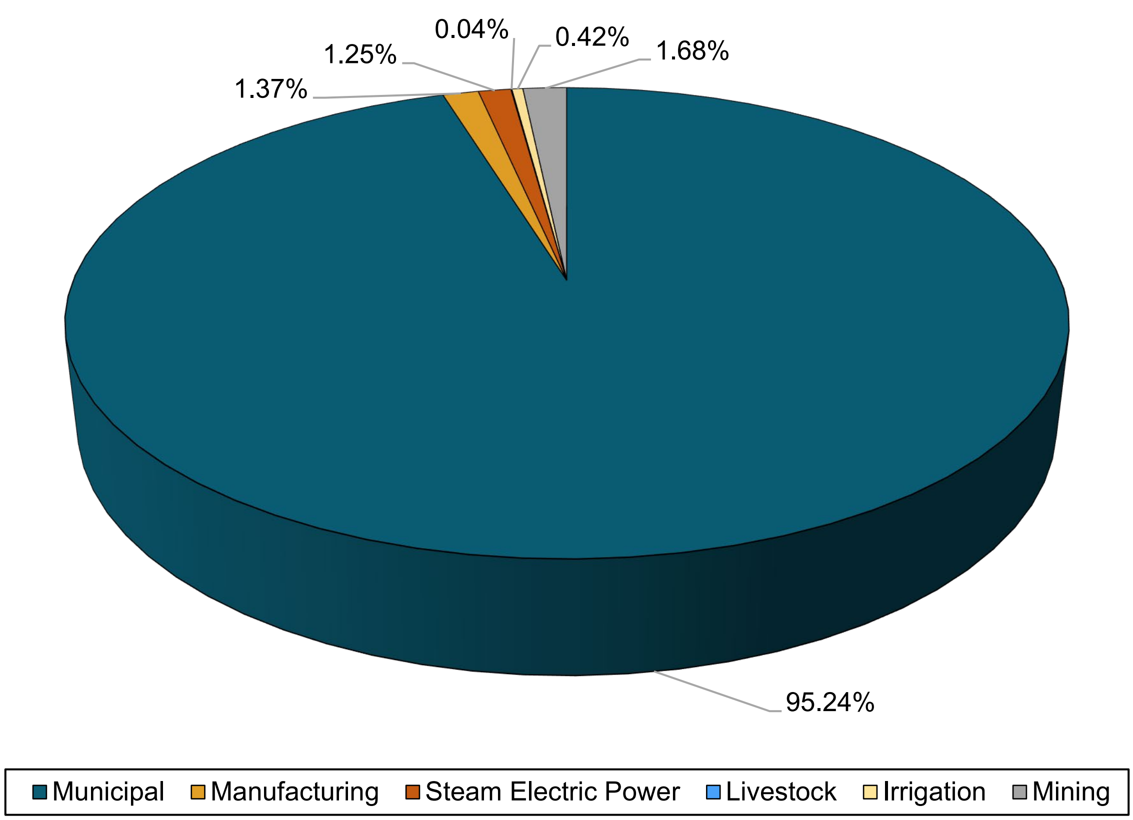


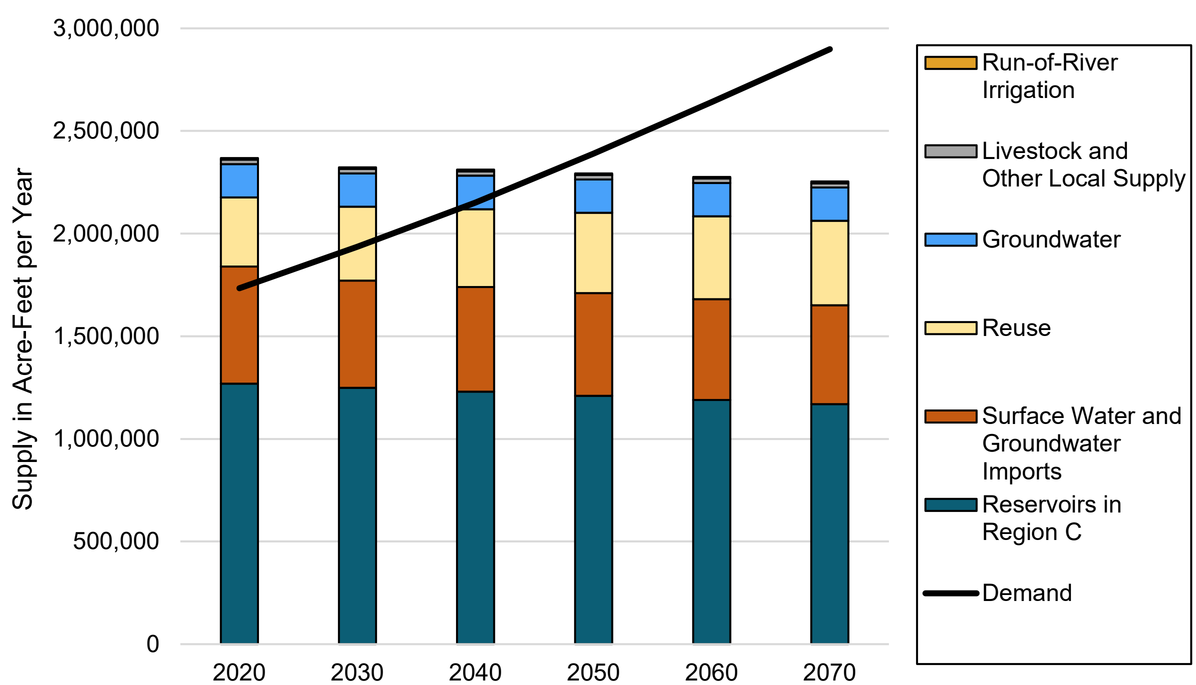
Table 4.2 Need by County for Region C (Acre-Feet per Year)

County	2020	2030	2040	2050	2060	2070
Collin	2,557	50,183	90,354	142,013	192,375	237,749
Cooke	588	220	301	447	1,828	5,922
Dallas	16,473	73,982	126,168	174,502	211,482	240,513
Denton	3,954	39,717	75,403	118,823	168,623	210,453
Ellis	3,365	10,621	15,249	24,845	39,005	64,739
Fannin	4,358	4,618	5,006	7,088	10,890	15,112
Freestone	11,199	11,790	12,821	14,377	15,755	19,226
Grayson	1,167	2,442	3,260	5,050	10,955	27,722
Henderson	861	1,311	1,740	2,405	4,752	8,515
Jack	162	768	1,238	1,614	1,905	2,190
Kaufman	997	5,572	10,590	16,698	26,279	39,375
Navarro	217	262	355	1,775	3,321	5,664
Parker	2,864	9,035	13,244	24,002	39,331	55,985
Rockwall	126	4,820	9,399	13,808	19,392	24,256
Tarrant	10,131	80,903	150,213	202,090	244,365	286,599
Wise	6,953	10,395	14,279	19,962	25,522	34,407
Total	**65,972**	**306,639**	**529,620**	**769,499**	**1,015,780**	**1,278,427**

Table 4.3 Comparison of Total Connected and Unconnected Supply with Demand (Acre-Feet per Year)

	2020	2030	2040	2050	2060	2070
Total Connected and Unconnected Supply	2,368,784	2,323,328	2,311,736	2,293,710	2,276,815	2,254,229
Demand	1,733,893	1,936,605	2,151,925	2,390,623	2,641,476	2,898,540
Reserve (Need)	634,891	386,723	159,811	(96,913)	(364,661)	(644,311)

Figure 4.3 Comparison of Connected and Unconnected Supply and Demand for Region C



4.2 Comparison of Connected Supply and Projected Demand by Major Water Provider

Under the planning rules, a major water provider (MWP) is defined as "a water user group or a wholesale water provider of particular significance to the region's water supply as determined by the regional water planning group." [1]. The Region C Water Planning Group has designated six major water providers for Region C. In addition, two other wholesale water providers are considered "regional" water providers. **Table 4.4** shows the projected reserves or needs for additional supply for each major and regional water provider. Steps to meet these projected needs will be discussed in **Chapter 5D**.

Table 4.4 Reserve or (Need) by Major Water Provider Using Only Connected Supplies (Acre-Feet per Year)

Water Provider	Projected Reserve or (Need) for Current and Future Customers					
	2020	2030	2040	2050	2060	2070
Major Water Providers						
Tarrant Regional Water District	(8,094)	(98,569)	(182,781)	(270,701)	(353,698)	(454,958)
Municipal	*(2,958)*	*(89,331)*	*(170,082)*	*(254,479)*	*(334,406)*	*(431,521)*
Irrigation	*0*	*(265)*	*(492)*	*(670)*	*(793)*	*(899)*
Livestock	*0*	*0*	*0*	*0*	*0*	*0*
Manufacturing	*0*	*(770)*	*(1,362)*	*(1,749)*	*(2,356)*	*(3,276)*
Mining	*(5,136)*	*(6,253)*	*(7,402)*	*(9,145)*	*(10,616)*	*(13,005)*
Steam Electric Power	*0*	*(1,950)*	*(3,443)*	*(4,658)*	*(5,527)*	*(6,257)*
North Texas Municipal Water District	(1,766)	(82,267)	(141,385)	(216,720)	(295,275)	(368,961)
Municipal	*(1,759)*	*(80,956)*	*(139,515)*	*(214,201)*	*(292,155)*	*(365,380)*
Irrigation	*8*	*8*	*8*	*8*	*8*	*8*
Livestock	*0*	*0*	*0*	*0*	*0*	*0*
Manufacturing	*(13)*	*(1,140)*	*(1,623)*	*(2,186)*	*(2,703)*	*(3,102)*
Mining	*0*	*0*	*0*	*0*	*0*	*0*
Steam Electric Power	*(2)*	*(179)*	*(255)*	*(341)*	*(425)*	*(487)*
Fort Worth	(6,640)	(64,018)	(125,332)	(170,675)	(210,072)	(250,890)
Municipal	*(6,640)*	*(62,767)*	*(123,031)*	*(167,570)*	*(206,378)*	*(246,685)*
Irrigation	*0*	*0*	*0*	*0*	*0*	*0*
Livestock	*0*	*0*	*0*	*0*	*0*	*0*
Manufacturing	*0*	*(1,251)*	*(2,301)*	*(3,105)*	*(3,694)*	*(4,205)*
Mining	*0*	*0*	*0*	*0*	*0*	*0*
Steam Electric Power	*0*	*0*	*0*	*0*	*0*	*0*
Dallas Water Utilities	(20,466)	(47,873)	(107,474)	(174,706)	(238,482)	(281,878)
Municipal	*(20,066)*	*(46,295)*	*(103,815)*	*(169,232)*	*(231,779)*	*(274,329)*
Irrigation	*434*	*212*	*(201)*	*(510)*	*(685)*	*(820)*
Livestock	*0*	*0*	*0*	*0*	*0*	*0*

Water Provider	Projected Reserve or (Need) for Current and Future Customers					
	2020	2030	2040	2050	2060	2070
Manufacturing	*(744)*	*(1,690)*	*(3,174)*	*(4,343)*	*(5,041)*	*(5,554)*
Mining	*(50)*	*(14)*	*(112)*	*(384)*	*(704)*	*(874)*
Steam Electric Power	*(40)*	*(86)*	*(172)*	*(237)*	*(273)*	*(301)*
Trinity River Authority	(2,177)	(66,871)	(90,145)	(106,993)	(124,794)	(153,235)
Municipal	*(1,153)*	*(63,890)*	*(86,060)*	*(101,759)*	*(118,635)*	*(146,142)*
Irrigation	*300*	*221*	*196*	*177*	*161*	*152*
Livestock	*0*	*0*	*0*	*0*	*0*	*0*
Manufacturing	*(1,320)*	*(1,439)*	*(1,580)*	*(1,882)*	*(2,128)*	*(2,440)*
Mining	*0*	*(387)*	*(510)*	*(692)*	*(869)*	*(1,086)*
Steam Electric Power	*(4)*	*(1,376)*	*(2,191)*	*(2,837)*	*(3,323)*	*(3,719)*
Upper Trinity Regional Water District	7,522	(14,197)	(37,823)	(64,393)	(85,440)	(107,774)
Municipal	*7,473*	*(13,521)*	*(36,108)*	*(60,745)*	*(80,929)*	*(102,256)*
Irrigation	*19*	*(589)*	*(1,178)*	*(2,353)*	*(2,353)*	*(2,353)*
Livestock	*0*	*0*	*0*	*0*	*0*	*0*
Manufacturing	*0*	*(12)*	*(23)*	*(26)*	*(29)*	*(32)*
Mining	*30*	*(75)*	*(514)*	*(1,269)*	*(2,129)*	*(3,133)*
Steam Electric Power	*0*	*0*	*0*	*0*	*0*	*0*
Regional Water Providers						
Greater Texoma Utility Authority	2,743	(21,816)	(37,947)	(45,883)	(58,163)	(74,153)
Corsicana	2,138	978	(58)	(1,404)	(2,979)	(5,346)

4.3 Comparison of Connected Supply and Projected Demand by Other Water Providers

Projected supplies, demands, reserves, and shortages are summarized for each wholesale water provider and water user group in **Chapters 5D** and **5E**. As shown on **Table 4.1** there are over 280 water user groups with projected water shortages by 2070.

Chapter 5E of this plan discusses the selection of water management strategies to address the requirements for additional supply. Many water user groups in Region C are served by wholesale water providers, and the needs of these water user groups will be addressed by obtaining additional supplies from the wholesale water providers. Other water user groups will require the development of individual water management strategies to address their needs.

4.4 Summary of Projected Water Shortages

All of the Region C counties have net needs beginning in 2020. There are over 150 water user groups that are projected to need more supply in 2020, growing to over 280 water user groups by 2070.

If no new supplies are developed, the total projected overall shortage in Region C is approximately 69,000 acre-feet per year by 2020, growing to over 1.31 million acre-feet per year by 2070. Many of the shortages in 2020 are fully addressed by water conservation measures.

Additionally, there are substantial unconnected supplies in Region C that could be made available by completing water transmission facilities. However, many Region C water suppliers depend on the region's major and regional water providers for all or part of their supplies. Most of the major and regional water providers will need to connect or develop additional supplies by 2020, and all will need additional supplies by 2040.

4.5 Second-Tier Needs Analysis

Regional planning rules require a second-tier needs analysis for all WUGs and MWPs for which conservation and direct reuse are recommended WMSs. The second-tier needs analysis determines water needs that would remain if recommended conservation and direct reuse strategies were fully implemented.

TWDB has provided a second-tier water needs analysis report from DB22. This report is included in **Appendix D**. **Table 4.5** summarizes the second-tier needs by WUG category and **Table 4.6** summarizes second-tier needs by major water provider.

Table 4.5 Second-Tier Water Needs by WUG Category

	Values in Acre-Feet per Year					
WUG Category	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Municipal	8,235	137,873	340,473	547,150	755,861	966,163
County Other	1,668	2,052	2,327	7,500	18,597	43,334
Manufacturing	402	5,342	9,072	12,148	14,601	17,532
Mining	5,770	5,308	6,126	7,283	8,780	11,247
Steam Electric Power	6,824	9,041	10,597	11,873	12,835	13,663
Livestock	478	478	478	478	478	478
Irrigation	4,582	4,616	4,638	4,664	4,838	5,151
Total	**27,959**	**164,710**	**373,711**	**591,096**	**815,990**	**1,057,568**

Table 4.6 Second-Tier Water Needs by Major Water Provider

WUG Category	Values in Acre-Feet per Year					
	2020	2030	2040	2050	2060	2070
Tarrant Regional Water District	0	37,845	130,727	214,079	291,500	386,000
North Texas Municipal Water District	0	53,681	107,924	174,580	243,720	308,263
Fort Worth	0	14,814	80,173	124,748	163,463	203,772
Dallas Water Utilities	0	8,156	54,409	112,788	170,435	209,008
Trinity River Authority	0	59,719	78,901	95,906	113,562	141,854
Upper Trinity Regional Water District	0	9,589	31,638	55,897	75,879	97,047
Total	**0**	**183,804**	**483,772**	**777,998**	**1,058,558**	**1,345,943**

4.6 Chapter 4 List of References

(1) Texas Water Development Board, *Exhibit C Second Amended General Guidelines for Fifth Cycle Regional Water Plan Development* (April 2018), Austin, [Online] URL: http://www.twdb.texas.gov/waterplanning/rwp/planningdocu/2021/doc/current_docs/contract_docs/2ndAmendedExhibitC.pdf?d=1570051503683, April, 2018.

Chapter 5 Water Management Strategies

Chapter 5 identifies and discusses the water management strategies to meet identified water needs as outlined in **Chapter 4**. These needs are met through a variety of strategies that have been developed through coordination with the water users in Region C.

Over the planning period water users may need to upgrade or modify their water supply systems or develop new supplies in ways that are not specifically identified in this plan. For aggregated water users, such as county other, the identification of needs and projects can be challenging due to the county-wide nature of the planning effort. It is the intent of this plan to include all water systems that demonstrate a need for water supply. This includes established water providers and new water suppliers that may be formed in the future to provide a reliable water supply.

The Region C Regional Water Plan outlines a potential approach that water suppliers can take to meet their projected water needs. Actual implementation of the water management strategies discussed within this plan is the responsibility of the water suppliers. The details of strategies will evolve as they are implemented. The Region C Regional Water Planning Group will not be implementing water management strategies and does not want this plan to be an obstacle in the development of needed water supplies.

Chapter Outline

5A - Methodology for Evaluation and Selection of Water Management Strategies

5B - Conservation and Reuse

5C - Major Water Management Strategies

5D - Major Water Providers

5E - Water Management Strategies by County

5F - Summary of Recommended Plan

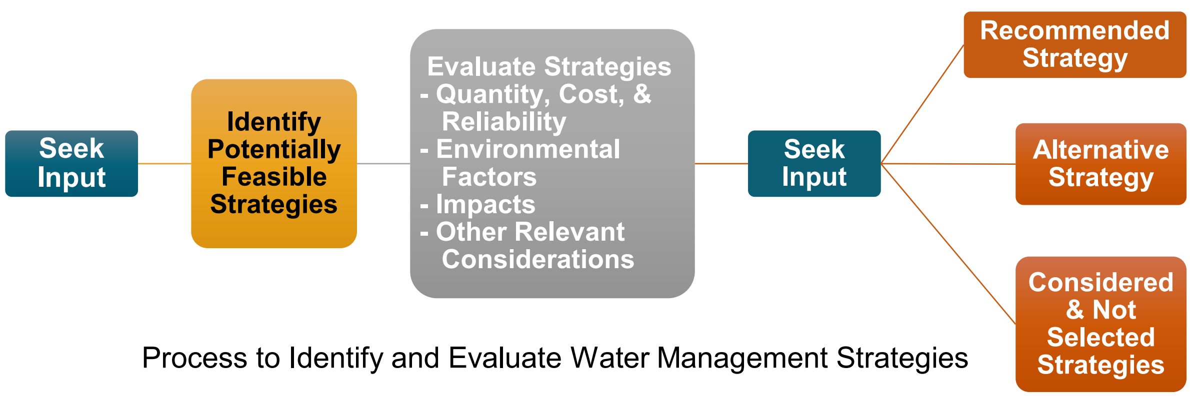
5A Methodology for Evaluation and Selection of Water Management Strategies

This section describes the process to determine potentially feasible strategies for Region C as well as the methods used to evaluate potentially feasible strategies and select recommended or alternative strategies.

The steps in the identification of water management strategies for Region C include:

- Review previous plans for water supply in Region C, including locally developed plans and the 2017 State Water Plan [(1)];
- Consider the types of water management strategies required by Senate Bill One regional planning guidelines [(2)];
- Consider feasibility screening criteria for management strategies (the strategy must have an identifiable sponsor, must be technically feasible, and must meet existing regulations);
- Seek input from water providers and RCWPG members on potential strategies;
- Evaluate strategies based on the criteria set forth by the TWDB;
- Present the data to the potential sponsors and seek concurrence with recommendations;
- Select recommended strategies for Region C for approval by the RCWPG.

The process to identify potentially feasible water management strategies was presented at a public meeting and approved by the RCWPG on December 18, 2017. A list of the identified potentially feasible water management strategies is included in **Appendix F**.



Process to Identify and Evaluate Water Management Strategies

Chapter Outline

Section 5A.1 – Types of Water Management Strategies

Section 5A.2 – Methodology for Evaluating Water Management Strategies

Related Appendices

Appendix F – Potentially Feasible Water Management Strategies

Appendix G – Water Management Strategy Evaluations

5A.1 Types of Water Management Strategies

Regional Planning guidelines require that certain types of water management strategies be considered for developing additional water supplies [2].

The Region C Water Planning Group reviewed each of these types of water management strategies and determined whether there were potentially feasible strategies to develop water supply in Region C within each type. Water conservation strategies are discussed in **Chapter 5B**. Drought response planning is discussed in **Chapter 7**.

Other types of management strategies are discussed below, and a detailed listing of potentially feasible water management strategies for Region C is included in **Appendix F**. The evaluations of the potential water management strategies are discussed in **Appendix G**.

5A.1.1 Water Conservation

Water conservation is defined as "those practices, techniques, and technologies that will reduce the consumption of water, reduce the loss or waste of water, improve the efficiency in the use of water, or increase the recycling and reuse of water so that a water supply is made available for future or alternative uses."[3] Water conservation measures typically result in long-term, on-going changes in water use.

Water conservation is a valued water management strategy in Region C because it helps reduce the growing demands of the region. It is recommended for all individual municipal water users, whether the user has a defined shortage or not. For rural municipal water users, conservation is recommended for County Other users with per capita use above 140 gallons per

Water Management Strategies

The RWPGs shall consider, but not be limited to considering, the following types of WMSs for all identified water needs:

- Water Conservation
- Drought Management Measures
- Water Reuse
- Management and/or Expanded Use of Existing Supplies
    - System Optimization
    - Connection of Existing Supplies
    - Conjunctive Use
    - Reallocation of Reservoir Storage
    - Voluntary Redistribution of Water Resources
    - Voluntary Subordination of Water Rights
    - Yield Enhancement
    - Water Quality Improvements
- New Supply Development
    - Surface Water Resources
    - Groundwater Resources
    - Desalination
    - Water Right Cancellation
    - Brush Control
    - Rainwater Harvesting
    - Precipitation Enhancement
- Aquifer Storage and Recovery (ASR)
- Interbasin Transfers
- Emergency Transfers of Water

person per day, which is a recommended GPCD goal from the Water Conservation Implementation Task Force. Conservation is also recommended for all non-municipal users that are shown to have a shortage, as appropriate.

Summary of Decision: Consider conservation for all individual municipal water users, County Other water user groups with per capita use above 140 gallons per person per day, and non-municipal water users with a need, as appropriate.

5A.1.2 Drought Management Measures

Drought management measures are actions taken by a water provider during drought to reduce demands. Region C did not consider drought management as a feasible strategy to meet long-term growth in demands or currently identified needs. Drought management measures are temporary actions to conserve available water supplies during times of drought or emergencies. These measures minimize the adverse impacts of water supply shortages during drought. Drought management will be employed in the region through the implementation of local drought contingency plans. Region C is supportive of the development and use of these plans during periods of drought or emergency water needs.

Summary of Decision: Do not consider Drought Management Measures to meet long-term water needs.

5A.1.3 Water Reuse

Water reuse utilizes treated wastewater effluent either by direct diversion from a wastewater plant to a use (direct reuse) or by delivery of water through streams or lakes for use (indirect reuse). Water reuse is a major source of water for Region C water providers. As demands increase, the available wastewater effluent also increases. Some providers have projects in place today to utilize the increased effluent. Others are planning to construct new projects to treat and transport the reuse water to the end user. Several major water providers are working together to maximize the available reuse to the region.

Summary of Decision: Include water reuse as part of the water management strategies considered in the Region C plan.

5A.1.4 Management and/or Expanded Use of Existing Supplies

Expanded use of existing supplies includes eight subcategories ranging from selling developed water that is not currently used to enhancing existing supplies through operations, storage, treatment or other means. Each of these subcategories was considered during identification of potentially feasible strategies, and the applicability to Region C is discussed below.

System Optimization. System optimization is the coordinated use of multiple sources of supply, usually surface water reservoirs. This can also include development of regional water supply facilities or providing regional management of existing water supply facilities. System optimization is widely used throughout Region C, and can be implemented for many purposes, including gaining yield, reducing pumping costs, or maintaining acceptable water quality. Most of the systems in Region C are operated primarily to reduce pumping costs. For the purpose of the Region C planning process, only system operation that results in increased yield will be considered as potentially feasible water management strategies. Generally, only system operation with new water supplies is considered for evaluation as a water management strategy for the Region C Water Plan. Any increase in supplies due to system optimization is included as part of the respective strategy. No strategies were identified for existing reservoir system operations that increase yield above the current supply amounts.

Summary of Decision: System optimization is widely used in Region C, primarily to reduce pumping costs. Potentially feasible system operation strategies to provide additional yield should be investigated as part of other new strategies.

Connection of Existing Supplies. The connection of existing supplies that are not yet being fully utilized is a major element of the *Region C Water Plan*. There are several sources of water supply that have long been committed for use in Region C and could be connected to provide additional water supply. Region C water suppliers could potentially connect to currently uncommitted supplies in other regions through new, renewed or increased contracts or agreements with the seller of the water. This category also includes improvements to infrastructure to utilize the water, such as new or renovated transmission systems and water treatment plants.

Major sources of existing water considered for new connections to Region C water users include: Lake Palestine, Lake Texoma, Toledo Bend Reservoir, Lake O' the Pines, and water from Oklahoma. Other existing sources are considered for expanded use and voluntary sales to others.

Summary of Decision: Include connection of existing supplies as a major component of the Region C plan. Evaluate specific potentially feasible strategies for connection of existing supplies.

Conjunctive Use of Groundwater and Surface Water. In Region C only about 6 percent of the water used currently comes from groundwater. However, as water providers expand their portfolios of water sources, groundwater and conjunctive use will become more important in developing resilient supplies. When used conjunctively, groundwater can help meet higher dry year demands in systems that have both groundwater and surface water supplies, while more surface water is used during normal to wet years.

Summary of Decision: Consider conjunctive use for Region C providers that have both groundwater and surface water sources. Generally, this will be considered as part of new groundwater strategies.

Reallocation of Reservoir Storage. Reallocation of water storage from a non-water supply use (such as hydropower generation or flood control) is the development of new water supply. Evaluation of reallocation of reservoir storage must consider available unappropriated water and seek appropriate authorizations. This strategy type can only apply to those reservoirs that dedicate storage for a non-water supply use. For Region C, that includes mainly reservoirs operated by the USACE.

Summary of Decision: Evaluate storage reallocation to water supply for Lake Texoma, Wright Patman Lake, and Bardwell Lake.

Voluntary Redistribution of Water Resources. In many cases, the connection of existing sources and the development of new sources require the voluntary redistribution of water resources by sale from the owner of the supply to the proposed user. (This would be true unless the proposed user is also the owner of the supply.) The water management strategies involving the voluntary redistribution of water resources are often discussed under other categories.

Summary of Decision: Evaluate potentially feasible strategies involving the voluntary redistribution of water resources as a unique strategy or as part of other strategies.

Voluntary Subordination of Water Rights

Voluntary subordination of water rights is useful where senior water rights limit reservoir yields under the prior appropriations doctrine.

Very little additional yield is available for existing reservoirs in Region C by voluntary subordination. This strategy is appropriate for new water supply sources that would have junior water rights.

In Region C, subordination of water rights is necessary to obtain the permitted amount for Muenster Lake in Cooke County.

Summary of Decision: Include voluntary subordination of water rights as a source of water supply for Muenster Lake and others as appropriate.

Yield Enhancement

Enhancement of surface water yields would generally include system optimization and conjunctive use, which are listed separately.

Enhancement of groundwater yields would include artificial recharge, which could include several methods. Artificial recharge of aquifers has not been implemented or studied in depth in Region C. If artificial recharge were to be implemented, it would likely be as part of an aquifer storage and recovery (ASR) program, which is discussed separately.

Summary of Decision: Do not include enhancement of yields of existing sources as a source of water supply for Region C water users except as discussed under other categories.

Water Quality Improvements

Water quality improvements allow for the use of impaired water for municipal or other uses. Generally, this strategy is considered for users with existing water supplies but impaired water quality. In Region C, there are some users of brackish surface water and groundwater. Water quality improvement for these sources are typically accomplished through desalination or blending. This is discussed under the strategy type "Desalination". Other types of water quality improvements can be applied at a watershed level, such as the Red River Chloride Control Project. The Chloride Control Project is only partially implemented. Should this project move forward, some benefits may be realized in Lake Texoma. While chloride control is a concern for some users in Region C, this strategy type also would apply to treatment of other water quality parameters.

Summary of Decision: Consider water treatment improvements for users of supplies with impaired water quality.

5A.1.5 New Supply Development

New supply development is a critical component of the *Region C Water Plan*. With a regional projected water need of 1.3 million acre-feet per year by 2070, these shortages cannot be met through conservation and existing supplies alone. Most of the new supply development will be new surface water, but other strategy subtypes were also considered.

Surface Water Resources

New surface water includes a variety of strategies, but all include new appropriations of state water. New reservoirs represent a large source of potential supply for Region C. To develop a new reservoir, both a state water right permit and a federal Section 404 permit are required. The permitting process alone can take multiple decades, depending upon the project. Design, construction and filling of the reservoir can add another 10 to 15 years. Because of the large amount of time needed to implement new reservoir strategies, long-term planning for these types of strategies is essential for implementation by the time the supply is needed. As a result, many of these potential reservoirs have been previously studied. Seven potential new reservoirs are being considered for the *Region C Water Plan*.

Other new surface sources include two proposed river diversions with off-channel storage, Neches Run-of-River and Red River Off-Channel Reservoir.

In addition, DWU is proposing to construct an off-channel reservoir in Ellis County for impounding wastewater return flows and potentially new appropriations. This strategy is considered under water reuse.

Summary of Decision: Evaluate new reservoirs and river diversions as potentially feasible strategies.

Groundwater Resources

New groundwater supplies within Region C are limited since most of the available groundwater supplies are already developed. However, there may be opportunities to expand current use in specific areas. In this round of planning, there are no recommended water management strategies utilizing brackish groundwater desalination because municipal needs are able to be met through other strategies. However, brackish groundwater desalination was considered and is included as an alternative water management strategy for MEN WSC. Also, several water providers are considering importing groundwater from outside the region.

Summary of Decision: Evaluate the importation of groundwater as considered by potential sponsors. Evaluate specific potentially feasible groundwater supplies within Region C.

Desalination

The salinity of water in Lake Texoma and the Red River is too high for municipal use. The water must be desalinated or blended with higher quality water to meet drinking water standards. For strategies that propose new development of water from these sources, desalination would be needed. The cost of desalination has decreased in recent years, and the process is being used more frequently.

Desalination is a potentially feasible strategy to use supplies from the following sources:

- Lake Texoma and the Red River
- Brackish groundwater
- Water from the Brazos River
- Water from the Gulf of Mexico

Potential New Reservoirs

- Bois d'Arc Lake
- Lake Ralph Hall
- Lake Tehuacana
- Lake Columbia
- Marvin Nichols Reservoir
- George Parkhouse Lake (North)
- George Parkhouse Lake (South)

- Local projects from other sources, if pursued by water suppliers.

Summary of Decision: Include desalination as a potentially feasible water management strategy to utilize supplies that require desalination for the planned use.

Water Right Cancellation

The Texas Commission on Environmental Quality has the power to cancel water rights after ten years of non-use, but this involuntary cancellation authority has seldom been used. The Water Availability Models showed that very little additional supply would be gained from water right cancellation in Region C [(4)]. Therefore, water rights cancellation is not recommended as a potentially feasible water management strategy for Region C.

Summary of Decision: Do not consider water rights cancellation as a potentially feasible strategy for the development of additional water supplies.

Brush Control

Brush control is the process of removing non-native brush from the banks along rivers and streams and upland areas to reduce water consumption by vegetation and increase stream flows and groundwater availability. Studies and pilot projects of brush control in West Texas show promising results. Two reservoirs in Region C, Lake Jacksboro and Lake Weatherford, were listed in the State Brush Control Plan as potential watersheds where brush control could enhance supplies. No formal studies have been conducted for either watershed. Given that there is no quantifiable evidence that brush control would increase water supply in either reservoir, brush control is not recommended as a potentially feasible water management strategy for any specific water user group (WUG) in Region C. However, brush control may be a management strategy for localized areas within the region, especially as a means to help meet localized livestock water supply needs.

Summary of Decision: Allow for studies and localized pilot projects to further investigate brush control. Do not consider brush control as a potentially feasible strategy for the development of additional water supplies.

Rainwater Harvesting

Rainwater harvesting is an ancient practice involving the capture, diversion, and storage of rainwater for landscape irrigation, drinking and domestic use, aquifer recharge, and in modern times, stormwater abatement. Due to a lack of detailed data on the quantity of supplies that would be made available through rainwater harvesting, this strategy is not recommended as a potentially feasible water management strategy for any specific water user in Region C. However, there may be localized areas in Region C that might benefit from such a management strategy.

Summary of Decision: Allow for studies and localized pilot projects to further investigate rainwater harvesting. Do not consider rainwater harvesting as a potentially feasible strategy for the development of additional water supplies.

Precipitation Enhancement

Precipitation enhancement involves seeding clouds with silver iodide to promote rainfall. Such programs are generally located within areas where the rainfall is lower than in Region C. Given that Region C has adequate rainfall, and that there are no studies showing what impact precipitation enhancement would have on streamflow and reservoirs in Region C, precipitation enhancement is not recommended as a potentially feasible water management strategy for Region C. However, there may be localized areas in Region C that might benefit from such a management strategy.

Summary of Decision: Do not include precipitation enhancement as a potentially feasible strategy for the development of additional water supplies. Allow for studies and localized pilot projects to further investigate precipitation enhancement.

5A.1.6 Aquifer Storage and Recovery

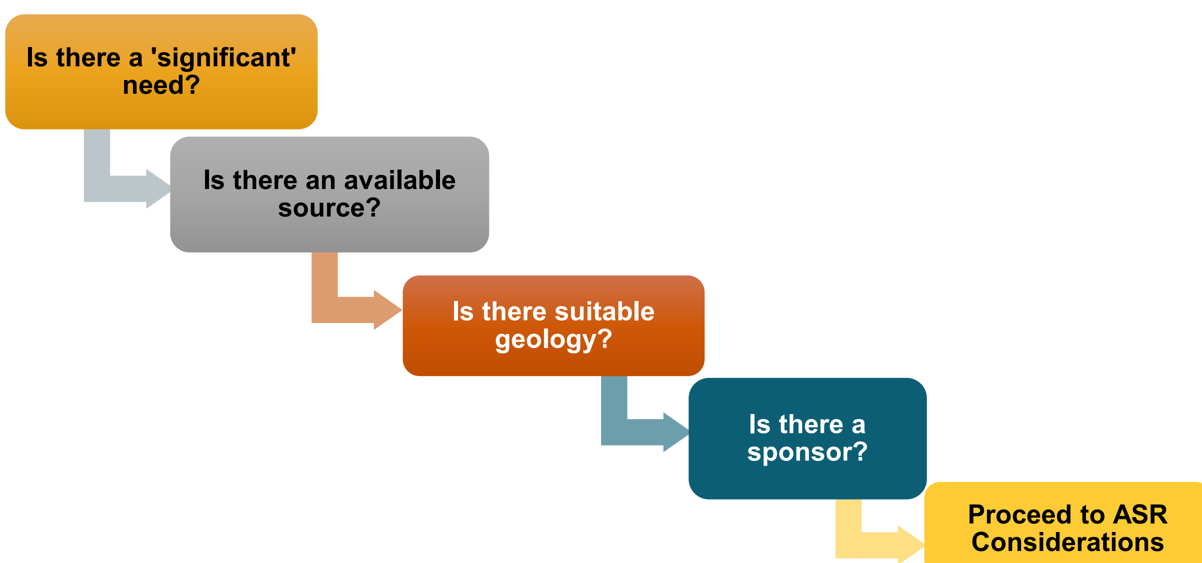
Aquifer storage and recovery (ASR) involves storing water in aquifers and retrieving this water when needed. The water to be stored can be introduced through enhanced recharge or more commonly injected through a well into the aquifer. If an injection well is used, Texas law requires that the water not degrade the quality of the receiving aquifer. Source water for ASR can include excess surface water, treated wastewater, or groundwater from another aquifer.

Recent legislation passed by the 86th Texas Legislature and signed by the Governor on June 10, 2019 requires the regional water plans to consider ASR and provide a specific assessment of this strategy if the region has significant needs. The definition of significant need is deferred to each region. For purposes of this assessment, the Region C major water providers are shown to have significant needs.

To determine the feasibility and applicability of ASR, there are several technical considerations. Specifically,

- ASR requires suitable geological conditions for implementation. Since geologic conditions vary by location, studies must be performed to determine what specific locations would be suitable for ASR. There is little data available on the suitability of ASR in Region C.
- Raw surface water and water reuse most likely will require pretreatment prior to injection and treatment to drinking water standards after retrieval.

ASR Decision Process



- Operation of an ASR system could significantly impact the amount of water that is retrievable.

Summary of Decision: Develop a large-scale generic strategy for ASR that could be implemented by one or more of the Region C major water providers. Consider small-scale projects that are more likely to be implemented. Support continuing studies of ASR and implementation of pilot projects.

5A.1.7 Interbasin Transfers

Interbasin transfers are a legal requirement associated with moving surface water from one basin to another. This legal requirement potentially will be in effect for new surface water supplies developed in one river basin and used in a different river basin. Additional detailed studies for the receiving and the source basins will be required as part of the permitting process for new interbasin transfers. This strategy category may be a component of several other strategy types, including new surface water development, connecting to existing supplies, and voluntary transfer of water. Development of adequate supplies for Region C and the other growing areas of Texas will require interbasin transfers.

Summary of Decision: Include interbasin transfers as part of the management strategies considered in the Region C plan.

5A.1.8 Emergency Transfers of Water

Emergency transfers of water could include interim water sales during drought or emergency conditions, transfers of water from one use type to another use type, emergency interconnections, and other similar types of projects. Like drought management, such transfers are considered temporary and not appropriate to meet long-term growth water demands. This type of strategy is reserved for emergency use only.

Summary of Decision: Emergency transfers of water are reserved for emergency use only.

5A.1.9 Summary of Potentially Feasible Strategies

Appendix F includes a listing of potentially feasible water management strategies for Region C for major and regional water providers, wholesale water providers, and for all water user groups by county.

A list of the major strategies, defined as providing more than 30,000 acre-feet per year, is presented in **Table 5A.1**. The results of the evaluation and the recommended strategies for Region C are discussed in the subsequent sections of **Chapter 5** and detailed in **Appendix G**.

Table 5A.1 List of Major Potentially Feasible Water Management Strategies

Potentially Feasible Water Management Strategy	Potential Sponsor	Maximum Supply Available (Ac-Ft/Yr)
Reuse Strategies		
Cedar Creek Wetland Reuse	TRWD	88,059
Reuse from TRA Central WWTP	TRWD	60,000
Additional Indirect Reuse Implementation	DWU	62,559
Main Stem Balancing Reservoir	DWU	95,829
Additional Lavon Watershed Reuse	NTMWD	38,780
Expanded Wetland Reuse	NTMWD	37,510
Connection of Existing Supplies		
Integrated Pipeline	TRWD, DWU	313,880
Connect to Lake Palestine (IPL Delivery Point to Bachman WTP)	DWU	105,370
Lake Texoma (Blending)	NTMWD and UTRWD	138,933
GTUA Regional System	GTUA	35,872
Water from Oklahoma	NTMWD, UTRWD, Irving	55,000
Sabine Conjunctive System Operations	DWU	104,200
Toledo Bend Reservoir	NTMWD, TRWD, UTRWD, DWU	350,000
Lake O' the Pines (Cypress Basin Supplies)	NTMWD	50,000
New Surface Water		
Bois d'Arc Lake	NTMWD	120,200
Lake Ralph Hall	UTRWD	39,220
Lake Ralph Hall Indirect Reuse	UTRWD	15,428
Marvin Nichols Reservoir	NTMWD, UTRWD, TRWD, DWU and/or Irving	361,200
George Parkhouse Reservoir (North)	NTMWD and/or UTRWD	85,200
George Parkhouse Lake (South)	NTMWD and/or UTRWD	92,800
Wright Patman Reallocation	NTMWD, UTRWD, TRWD, DWU and/or Irving	122,200
Lake Columbia	DWU	56,000
Red River Off Channel Reservoir	DWU, UTRWD	114,000
Neches River Run-of-the-River Diversion	DWU	47,250
New Groundwater		
Carrizo-Wilcox Groundwater	NTMWD, TRWD, DWU	104,000
Desalination		
Gulf of Mexico with Desalination	Multiple	200,000
Lake Texoma with Desalination	NTMWD, GTUA, DWU, Denison	223,000
Aquifer Storage and Recovery (ASR)		
Aquifer Storage and Recovery	Multiple	50,000

5A.2 Methodology for Evaluating Water Management Strategies

The TWDB guidelines set forth certain factors that are to be considered by the regional water planning groups in the evaluation of water management strategies [(2)]. This subsection discusses the specific evaluation factors selected by the Region C Water Planning Group for the potentially feasible water management strategies, including the environmental evaluation of alternatives and the development of costs. Additional details on the evaluation of strategies are included in various appendices.

5A.2.1 Factors Considered in Evaluation

The factors specifically considered by the Region C Water Planning Group in the evaluation of potential water management strategies are summarized in the blue box at the right. As required, the evaluation of water management strategies includes the quantitative reporting of quantity, reliability, costs and environmental factors. While the quantitative reporting of water made available and the unit cost of delivered and treated water can readily be developed, data for the quantitative reporting of environmental factors are limited. The detailed quantitative assessment of environmental factors requires data from site-specific studies, which are often not conducted at the planning level. Available data for environmental factors are used in the evaluation.

Consistency with plans of Region C water suppliers is an important factor in the evaluation of strategies. It is the intent of the Region C Water Planning Group to consider the existing plans of the water suppliers in the region, especially the major and regional wholesale water providers, in the development of the *Region C Water Plan*.

Water Management Strategy Evaluation Factors

- Quantity of water made available
- Reliability of supply
- Unit cost of delivered and treated water
- Environmental factors including:
  - Total acres impacted
  - Wetland acres
  - Environmental water needs
  - Wildlife habitat
  - Threatened and endangered species
  - Cultural resources
  - Bay and estuary flows
  - Water quality
  - Other
- Impacts on agricultural and rural areas
- Impacts on natural resources
- Impacts on other water management strategies and possible third-party impacts
- Impacts to key water quality parameters
- Consistency with plans of Region C water suppliers
- Consistency with other regions

Equitable comparison of all feasible strategies is not included as an explicit evaluation factor because it describes the way the entire evaluation is conducted. This factor was considered in the development of the methodology for evaluations. Interbasin transfer requirements in the Texas Water Code were considered in the development of strategies.

5A.2.2 Environmental Evaluation

The environmental evaluation of potentially feasible management strategies is summarized in **Appendix G**. Factors reported quantitatively include the total acres impacted by the strategy and the number of threatened and endangered species listed in the counties of the proposed water source. For existing water sources, only the species that are water dependent are included in the count of threatened and endangered species. Other factors were assigned a high, moderate, or low rating based on existing data and the potential to avoid or mitigate each of the environmental factors. These evaluations were summarized in an overall environmental evaluation for the strategy. Certain management strategies were evaluated as a category rather than individually because their environmental effects do not vary greatly. Examples of evaluation by category include purchasing water from another provider and development of new wells in aquifers with additional water available.

5A.2.3 Agricultural Resources and Other Natural Resources

The evaluation of impacts to agricultural resources and rural areas assesses the ability to continue current agricultural and livestock activities. Strategies that move considerable amounts of water from rural to urban areas were also considered under this category. The impacts of recommended strategies on these factors are discussed in more detail in **Chapter 6**.

Impacts to other natural resources include potential impacts to water resources that are not the direct source for the strategy and impacts to mineral resources, oil and gas, timber resources, and parks and public lands. (Impacts to the water resources that are the source for the strategy are included under environmental factors.) The considerations of the impacts to agricultural and natural resources are used to assess how the regional water plan is consistent with the protection of the state's resources. This discussion is also summarized in **Chapter 6** of the plan.

5A.2.4 Recommended Water Management Strategies

Water management strategies are recommended based on the overall factors set forth in the strategy evaluations. As discussed above, consistency with the on-going water development plans of regional water providers is an important factor in the strategy selection. All factors are considered in the selection process. The recommended strategies are based on the ability to supply the quantity of water needed at a reasonable cost, while providing long-term protection of the state's resources.

5A.3 Chapter 5A List of References

(1) Texas Water Development Board: *Water for Texas – 2017*, Austin, January 2017.

(2) Texas Water Development Board: Chapter 357, *Regional Water Planning Guidelines*, Austin, November 2019.

(3) Texas Water Code, Title 2, Subtitle B, Chapter 11, Subchapter A. Section 11.002(8)(B). Online: https://statutes.capitol.texas.gov/Docs/WA/htm/WA.11.htm

(4) Freese and Nichols, Inc., Alan Plummer Associates, Inc., CP&Y, Inc., and Cooksey Communications, Inc.: *2011 Region C Water Plan*, prepared for the Region C Water Planning Group, Fort Worth, October 2010.

5B Water Conservation and Reuse Recommendations

The Region C Water Planning Group places strong emphasis on water conservation and reuse as a means of meeting projected water needs. This chapter consolidates the water conservation and reuse recommendations in the *Region C Water Plan*.

It also includes:

- Background on the historical context of water use and conservation in Region C
- Summary of Region C Water Planning Group decisions regarding water conservation and reuse
- Discussion of existing water conservation and reuse in Region C
- Review of the historical and projected per capita use in Region C

Although both water conservation and reuse recommendations are included within this chapter, it is important to note that reuse is considered a unique strategy type for regional water planning purposes and is reported separately in DB22.

Chapter Outline

Related Appendices

5B.1 **Background**

5B.1.1 2016 Region C Recommendations

In the *2016 Region C Water Plan* [1], the recommended water management strategies for Region C were projected to achieve water conservation savings of 4.6 percent of the total projected water demand for the region by 2070. This 4.6 percent savings was in addition to the 8.7 percent water conservation savings (primarily from low-flow plumbing fixture rules) that were already assumed in the water demand projections.

Active measures were categorized based on potential for water savings, opinions of probable cost, and likelihood of implementation. The Water Conservation Package was recommended for every municipal water user group (WUG) in Region C.

Since the Region C Water Planning Group made these recommendations, new water conservation legislation has passed, new water conservation data have become available, a new water conservation tool has been developed, new water conservation studies have been produced, and the TWDB has updated the regional water planning rules [2]. Relevant water conservation legislation passed since the 2016 plan will also influence recommended water conservation strategies. New information is discussed in the next section.

5B.1.2 Information Developed Since 2016 Region C Water Plans

Since the 2016 Region C Water Plan, the Texas Legislature has implemented new water conservation legislation across

2016 Region C Water Conservation Package

- **Municipal Measures**
  - Low flow plumbing fixture rules
  - Efficient new residential clothes washer standards
  - Efficient new residential dishwasher standards
  - Enhanced public and school education
  - Price elasticity/rate structure impacts
  - Enhanced water loss control program
  - Time-of-day irrigation restriction
  - Water waste prohibition
- **Non-Municipal Measures**
  - Manufacturing and irrigation rebates
- **Other**
  - Twenty-four reuse water management strategies
  - Encourage adequate state funding for the Water Conservation Advisory Council (WCAC) and for a statewide water conservation awareness campaign
  - Encourage the Texas Water Development Board (TWDB) and Texas Commission on Environmental Quality (TCEQ) to work with the Federal government on Section 316(b) regulations to allow the efficient use and conservation of water supplies for power plants

three sessions, the WCAC and the TWDB have developed new water conservation information, and statewide studies have been performed to quantify existing water conservation savings and future water conservation savings potential.

Water Conservation Legislation. In the 84th, 85th, and 86th Regular Sessions, the Texas Legislature passed four bills, House Bill 1902, Senate Bill 551, House Bill 1573, and House Bill 1648, which have a direct bearing on water conservation and regional water planning.

House Bill 1902 sets minimum standards for indoor and outdoor use and reuse of alternative on-site water, including rainwater, air-conditioner condensate, foundation drain water, storm water, cooling tower blowdown, swimming pool backwash and drain water, reverse osmosis reject water, or any other source of water considered appropriate by the TCEQ. It specifically allows use of graywater and alternative on-site water for toilet and urinal flushing. HB 1902 took effect on June 16, 2015.

Every other year the WCAC authors a review of progress made in water conservation in Texas. **Senate Bill 551**, effective September 1, 2015, requires the WCAC to submit recommendations for legislation to advance water conservation in Texas.

House Bill 1573, effective September 1, 2017, states that water loss audits required of retail public utilities must be done by a person trained to conduct water loss auditing and requires the TWDB to provide water loss audit training.

House Bill 1648 requires a retail public utility that provides potable water service to 3,300 or more connections to designate a person as the water conservation coordinator responsible for implementing the water conservation plan and to identify the water conservation coordinator to the TWDB executive administrator, effective September 1, 2017. This requirement is incorporated into the TWDB's Best Management Practices for Municipal Users (discussed in Section 5B.3.2) as Municipal BMP 2.1 Conservation Coordinator [(3)].

House Bill 807, passed by the Texas Legislature in 2019, requires the RWPGs to set specific goals for per capita water use for municipal water users for each decade of the period covered by the Regional Water Plan. This requirement became effective on June 10, 2019 and applies to this regional water planning cycle.

Definitions

Conservation: "The development of water resources; and those practices, techniques, and technologies that will reduce the consumption of water, reduce the loss or waste of water, improve the efficiency in the use of water, or increase the recycling and reuse of water so that a water supply is made available for future or alternative uses." TAC §11.002(8)

Drought/Emergency Management: Temporary measures that are implemented when certain criteria are met and are terminated when these criteria are no longer met.

Water Conservation Advisory Council. In 2007, the 80th Texas Legislature created the Water Conservation Advisory Council (WCAC), a group consisting of 23 experts representing various agencies, political subdivisions, water users, and interest groups.

Each biennium, the WCAC reports on the progress of water conservation in Texas. In the December 2018 document, reported achievements included [4]:

- Approximately 82 percent of irrigated acres in Texas employ high-efficiency center-pivot irrigation systems and 6 percent have adopted advanced efficiency systems (such as drip tape or trickle systems). The remaining 12 percent furrow and/or flood irrigate; however, in most instances, the farmers that still use these practices have laser-leveled fields and utilize irrigation scheduling to maximize water use efficiencies. In addition, some irrigation districts and wholesale providers of surface water have made substantial upgrades to water delivery infrastructure in an effort to reduce transportation loss.
- An analysis conducted in 2016 showed a reduction in water use per unit of output in manufacturing. As an example, over the last two decades, Texas refiners have reduced water usage by as much as 30 percent while output revenue has increased steadily.
- Statewide total municipal per capita water use decreased from 148 gallons per capita per day (gpcd) in 2013 to 142 gpcd in 2017. During the same period, residential gpcd decreased from 82 gpcd to 76 gpcd, and water loss decreased from 20 gpcd to 18 gpcd. (Note that conservation is not the only contributor to changes in water use from year to year; climatic conditions and other factors may also have an impact.)
- The Statewide Water Conservation Quantification Project (discussed below) estimated the volume of water conservation savings for a select group of water utilities to determine whether activities will save enough water to meet the

WCAC Duties

- Monitoring trends in water conservation implementation
- Monitoring new technologies for possible inclusion as best management practices
- Monitoring the effectiveness of the statewide water conservation public awareness program and associated local involvement in implementation of the program
- Developing and implementing a state water management resource library;
- Developing and implementing a public recognition program for water conservation
- Monitoring the implementation of water conservation strategies by water users included in regional water plans; and
- Monitoring target and goal guidelines for water conservation to be considered by the TWDB and TCEQ

municipal conservation water management strategies in the 2017 State Water Plan.

- About 80 percent of utilities are reporting their water use on the Annual Water Use survey by customer sectors (single family, commercial, industrial, multifamily, institutional, and agricultural), allowing better tracking of water use trends.
- 55 wholesale water suppliers conserved over 51 billion gallons of water in 2017.
- The WCAC created the Blue Legacy Awards to recognize water conservation in the municipal and agricultural sectors.

The WCAC also made the following legislative recommendations in its 2018 report [4]:

- Enhanced data collection, management, and accessibility: Increase appropriations to the TWDB to enhance existing data collection, management, and accessibility efforts and to ascertain what cities and water utilities need to do to begin collecting the necessary information.
- Funding of a statewide water conservation public awareness program: Appropriate up to $3 million per year to the TWDB to implement a statewide water conservation public awareness program as directed by the Texas Legislature in 2007 with the passage of Senate Bill 3 and House Bill 4.
- Maintain funding for agricultural water conservation and research programs: Maintain funding levels for agricultural water conservation research, education, training, conservation programs with best management practices that reduce evapotranspiration, and financial assistance programs focused on improving water use efficiency in agricultural irrigation.
- Funding to enhance the accuracy and value of water loss audits:

Region C Recipients of Blue Legacy Award

- NTMWD for its water conservation public awareness campaign (2011)
- City of McKinney's Office of Environmental Stewardship for its public awareness outreach program (2012)
- City of Fort Worth Water Department for its SmartWater ICI Audit Program (2013)
- City of Frisco for its evidence-based educational approach to water conservation (2015)
- NTMWD for its collaborative effort with the Irrigation Technology Program of the Texas A&M AgriLife Extension Service to provide its customers with weather-based irrigation recommendations (2015)
- City of Mansfield for building relationships with unconventional partners to spread conservation messages (2017)

Appropriate $500,000 to the TWDB for the 2020-2021 biennium for an expanded water loss program (including three additional Full Time Employees) to assist water utilities in the design and implementation of water loss audits and another $500,000 for the 2020-2021 biennium to the TWDB for competitive grants for up to six utilities of varying sizes to conduct pilot projects for validation of their water loss audits.

- Restore funding for the Texas Ag Water Efficiency Education and Demonstration Project facility: Fund the Texas Ag Water Efficiency Education & Demonstration Project for the education, research, and development of agricultural water conservation initiatives at $150,000 to $200,000 per year, through general revenue appropriations deposited and distributed through the TWDB's Agricultural Water Conservation Grants Program, and establish this level of annual funding through baseline general revenue appropriations to the TWDB in future years.

In addition, the WCAC works with the TWDB and the TCEQ to develop new water conservation best management practices (BMPs) and to review and update the BMPs originally published in 2004 [(3)]. Several new best management practice documents have been developed, including: Custom Conservation Rebates, Customer Characterization, Outdoor Watering Schedule, and Plumbing Assistance Programs for Economically Disadvantaged Customers. In addition, the Public Outreach and Education and Conservation Coordinators BMPs have been updated to ensure that they include the most recent information. The most current BMPs can be accessed at www.twdb.texas.gov/conservation/bmps/index.asp.

Water Usage by Texas Water Utilities. Each biennium, the TWDB reports on statewide water usage by water utilities. For Texas water utilities to develop effective programs to save water, they must have a comprehensive understanding of how that water is used. The report to the 86th Texas Legislature, which was based on 2017 reported water use, includes the following findings [(5)]:

- About 80 percent of the water utilities reported water use by the defined customer sectors (single family, commercial, industrial, multifamily, institutional, and agricultural). The fact that some water utilities did not report by defined customer sectors was mostly because they did not report single-family and multifamily sectors separately for residential water use.
- The share of the water volume that can be associated with individual customer sectors increased from an average of 70 percent to 80 percent from 2012 to 2017, therefore improving the understanding of how water is being used. With this knowledge, water utilities are better able to select the most appropriate conservation strategies, measure their implementation, identify areas of further potential water savings, and plan for long-term needs.
- On average, more than half of metered municipal water is delivered to single-family and multifamily residential customers.
- In general, as utilities become larger, the relative percentage of their metered water delivered to residential sectors decreases, and deliveries to non-residential sectors increases. The utilities were analyzed in four size categories; in

the smallest category, residential sectors averaged 61 percent of total deliveries, while in the largest, an average of 35 percent of the deliveries went to residential connections.

Municipal Water Conservation Planning Tool. The TWDB sponsored development of the Municipal Water Conservation Planning Tool to assist water utilities with their water conservation planning and reporting and to assist regional water planning groups with development of their municipal conservation water management strategies (6). The Excel-based tool includes a library of 16 pre-defined water conservation measures with savings and cost assumptions for single-family, multi-family, and industrial, commercial, and institutional (ICI) implementation. Space is provided for evaluation of up to 20 user-defined water conservation measures. The tool can be used to evaluate water savings and costs for a single water user group for different combinations of water conservation measures.

The tool comes pre-loaded with 2020-2070 projections for 96 Region C water user groups, including population, connections, water demand, and water loss. However, the pre-loaded water demand projections are not the same as those used for regional water planning.

Statewide Water Conservation Quantification Project. The TWDB sponsored a *Statewide Water Conservation Quantification Project* (SWCQP) to identify the quantity of water saved by various conservation practices (7). Statewide, the SWCQP surveyed 170 utilities regarding their water conservation activities. In Region C, 63 utilities were surveyed, representing 81 percent of the 2020 projected Region C population and 90 percent of the region's recommended 2020 municipal conservation water management strategy supply volume. Based on the survey results, the SWCQP projected annual savings for currently implemented water conservation measures. The study projected that the current conservation activities of the participating Region C utilities will exceed the recommended municipal conservation water management strategy supply volumes from the *2016 Region C Water Plan*. The surveyed utilities averaged 3.4 water conservation activities. Information from the SWCQP was used to estimate water demand reduction since 2011 (the base planning year), although certain assumptions were revised as described in **Appendix I**.

Interview responses showed that many utilities are largely unaware of impending regional shortages or any recommendations made by the regional water planning group to specifically address municipal conservation. In addition, utilities often do not know what their role is regarding regional conservation supply volumes. The SWCQP recommended that utilities participate in the regional water planning process and that the RCWPG educate utilities about their specific municipal conservation water management strategy supply volumes.

The SWCQP suggested that Region C utilities adopt advanced municipal conservation activities, including an automatic metering infrastructure (AMI) system with a customer portal, twice-per-week (or less) outdoor watering ordinances, strategic water rate increases, and rain barrels.

Direct Potable Reuse Resource Document. The TWDB sponsored development of a Direct Potable Reuse Resource Document, a technical resource for utilities, consultants, planners, academicians, and other parties interested in evaluating the feasibility of implementing Direct Potable Reuse (DPR) or for utilities that have determined that DPR is feasible and are entering the planning phase of a project [8].

Topics addressed in the document include:

- Chemical contaminants of concern in Texas
- Water quality performance targets
- Enhanced source control
- Treatment strategies
- Chemical quantitative relative risk assessment
- Pilot- and bench-scale testing for treatment studies
- Regulatory and legal considerations in Texas
- Public outreach programs

Water Conservation by the Yard: A Statewide Analysis of Outdoor Water Savings Potential. As an activity of the Texas Living Waters Project, the Lone Star Chapter of the Sierra Club and the National Wildlife Federation sponsored an analysis of the potential water savings from statewide implementation of no more than twice per week watering restrictions [9]. This study projected that utilities in Region C could save 7 to 11 percent of total municipal water demand, depending on the level of education and enforcement employed in implementing the restrictions. Based on municipal water demands from the *2017 State Water Plan*, this report projected the potential water savings in Region C and the percentage of water needs that could be met through implementation of no more than twice per week watering restrictions.

5B.1.3 New Regional Planning Requirements

The TWDB has revised its planning guidelines since the last round of regional water planning. The main new water conservation-related requirements are:

- The RWPGs shall develop specific goals for per capita water use for municipal water users for each decade of the period covered by the Regional Water Plan.
- The Board shall consider approval of a Regional Water Plan that includes unmet municipal water needs provided that the RWPG includes adequate justification, including that the Regional Water Plan documents considered all potentially feasible water management strategies, including drought management water management strategies, and contain an explanation of why additional conservation and/or drought management water management strategies were not recommended to address the need [31 TAC 357.50(j)(1)].

A summary of water conservation-related regional planning requirements and how they have been addressed in Region C is presented in **Section 5B.7**.

5B.2 Summary of Region C Water Planning Group Decisions

TWDB planning rules require Regional Water Planning Groups (RWPGs) to "evaluate potentially feasible water management strategies for all water user groups (WUGs) and wholesale water providers (WWPs) with identified water needs," including water conservation measures and reuse of treated wastewater effluent.

This section summarizes the decisions of the Region C Water Planning Group for these water management strategies and addresses decisions made regarding new information available since the *2016 Region C Water Plan*.

> **Potential Applications for Water Reuse in Region C**
>
> - Landscape irrigation
> - Agricultural irrigation
> - Industrial and power generation reuse
> - Recreational/environmental uses
> - Supplementing potable water supplies through indirect reuse

5B.2.1 Water Conservation

Water Conservation Strategies

As discussed above, the legislature, the WCAC, and the TWDB have been active in the area of water conservation since the development of the *2016 Region C Water Plan* [1]. New information about the potential for water conservation in Region C has been developed, and the planning rules require consideration of water conservation strategies for water user groups with needs.

Summary of Decisions: Incorporate water management strategies involving water conservation as a major component of the long-term water supply for Region C. Consider water conservation for all municipal non-municipal WUGs with a need. Conservation will not be evaluated for manufacturing and steam electric power. The TWDB decision to assume no growth in manufacturing and power demands after 2030 was justified in part by the assumption that conservation will offset growth in these areas. Thus conservation is built into the demand projections. Also, manufacturing and steam electric conservation measures are typically facility specific rather than regional. Encourage planning and implementation of water conservation projects. Monitor legislation and regulatory actions related to water conservation.

Water Conservation Tools

New data have been developed and the TWDB has developed a tool to assist entities with developing water conservation plans (Municipal Water Conservation Tool). This tool focuses on management practices that provide measurable water savings. As a result, many of the pre-defined conservation measures include variations of rebates for plumbing fixtures, which are less effective for new development. In addition, savings from plumbing fixtures are incorporated in the TWDB demands over time. Also, the pre-defined measures in the Municipal Water Conservation Tool do not include many measures considered for Region C water users.

Summary of Decision: Continue to use the conservation tool developed specifically for Region C and used in previous planning cycles. Update the tool with new data as appropriate.

Water Conservation Data Reports

Several new studies were published that attempted to quantify water conservation savings. Much of the reporting estimates for outdoor water use relied on data obtained for typical high-water use months during drought. Other data were difficult to assign to single measures. Based on recent unpublished studies for several Region C water providers, year-round outdoor watering restrictions show substantially less water savings than temporary restrictions during drought.

Summary of Decision: Consider findings of new studies and adjust data assumptions as appropriate for Region C.

5B.2.2 Reuse of Treated Wastewater Effluent

Reuse of treated wastewater effluent is an increasingly important source of water in Region C and across the state of Texas. The *2016 Region C Water Plan* [1] projected that reclaimed water would provide supply equal to approximately 19 percent of the 2070 Region C water supply. There are a number of water reuse projects in operation in Region C, and many others are currently in the planning and permitting process. Reuse will serve a major role in meeting future water supply requirements for the region.

There are several benefits associated with water reuse as a water management strategy:

- Water reuse represents an effective water conservation measure.
- Water reuse provides a reliable source that remains available in a drought.
- Water reuse quantities typically increase as population increases.
- Water demands that can be met by reuse are often near reuse sources.
- Water reuse is a viable way to defer or avoid construction of new surface water supplies.

Available reuse quantities are dependent on water use, and as such are subject to reduced supplies from ongoing conservation strategies. It should also be noted that reliable reuse quantities should be based on dry-weather flows, which are likely to occur during periods of drought.

Direct Reuse

Direct reuse and indirect reuse have significantly different permitting requirements and potential applications. Direct reuse occurs when treated wastewater is delivered from a wastewater treatment plant to a water user, with no intervening discharge to waters of the state. Direct nonpotable reuse requires a notification to the Texas Commission on Environmental Quality (TCEQ), which is routinely accepted so long as the requirements of the agency's regulations regarding direct nonpotable reuse, designed to protect public health, are met. Direct nonpotable reuse is most commonly used to supply water for landscape irrigation (especially golf courses) and industrial uses (especially cooling for steam electric power plants).

Since the *2016 Region C Water Plan*, no new entities in Texas have constructed or begun operating direct potable reuse (DPR) projects. However, El Paso Water has completed a portion of the permitting process for a new DPR project and has initiated design. That project, when constructed, would be the first DPR project in Texas and the United States to deliver purified water directly to the distribution system (rather than first blending with other raw water supplies upstream of a conventional surface water treatment plant).

Summary of Decision: Incorporate direct reuse water management strategies for municipal and non-municipal water needs where feasible and if requested by the sponsoring entity.

Indirect Reuse

Indirect reuse occurs when treated wastewater is discharged to a stream or reservoir and is diverted downstream or out of a reservoir for reuse. The discharged water mixes with ambient water in the stream or reservoir as it travels to the point of diversion. Many of the water supplies within Region C have historically included return flows from treated wastewater as well as natural runoff.

New indirect reuse projects may require a water right permit from the TCEQ and may also require a wastewater discharge permit from the TCEQ if the discharge location is changed as part of the reuse project. Many Region C reservoirs have water right permits in excess of firm yield and are currently using return flows in their watersheds to provide a supplement to supply. These return flows may not be a long-term reliable supply if they are diverted for future direct reuse projects or redirected to other water bodies for future indirect reuse projects.

In general, indirect reuse strategies will require the use of multiple barriers (such as industrial pretreatment, advanced water/wastewater treatment, blending, residence time, and/or monitoring) to mitigate potential negative impacts to public health, the environment, agricultural resources, and other resources.

Sources of wastewater effluent needed for new reuse projects are generally limited to owners and operators of large wastewater treatment plants. These include TRA, NTMWD, the Cities of Fort Worth and Dallas, as well as several smaller cities.

Summary of Decision: Incorporate water management strategies involving indirect reuse as a major component of the long-term water supply for Region C. Encourage planning and implementation of additional reuse projects. Monitor legislation and regulatory actions related to reuse.

John Bunker Sands Wetlands Center

Located near Seagoville, this reuse project allows NTWMD to divert up to 91 MGD of return flow from the Trinity River and return it to Lake Lavon to be reused. The Wetlands Center is a unique public private partnership between NTWMD and The Rosewood Corporation to provide education, research and conservation opportunities pertaining to water reuse and supply, wetland systems and wildlife habitat.

TRWD George Shannon Wetlands Water Reuse Project

This wetlands project is one way TRWD is extending its current resources to meet a rapidly growing population. A joint effort with Texas Parks and Wildlife Department, this 2,200-acre facility near Richland-Chambers Lake was completed in 2013 and consists of a series of sedimentation ponds and wetland cells that naturally filter water diverted from the Trinity River, providing an addition 90 MGD of supply for TRWD customers.

5B.3 **Historical Water Use in Region C**

The first step in developing effective water conservation and reuse recommendations for Region C is to understand current water use. This section discusses historical water use in Region C, describes normalization of water use data, shows Region C water use in a statewide context, reports historical reclaimed water use, and reports historical water losses.

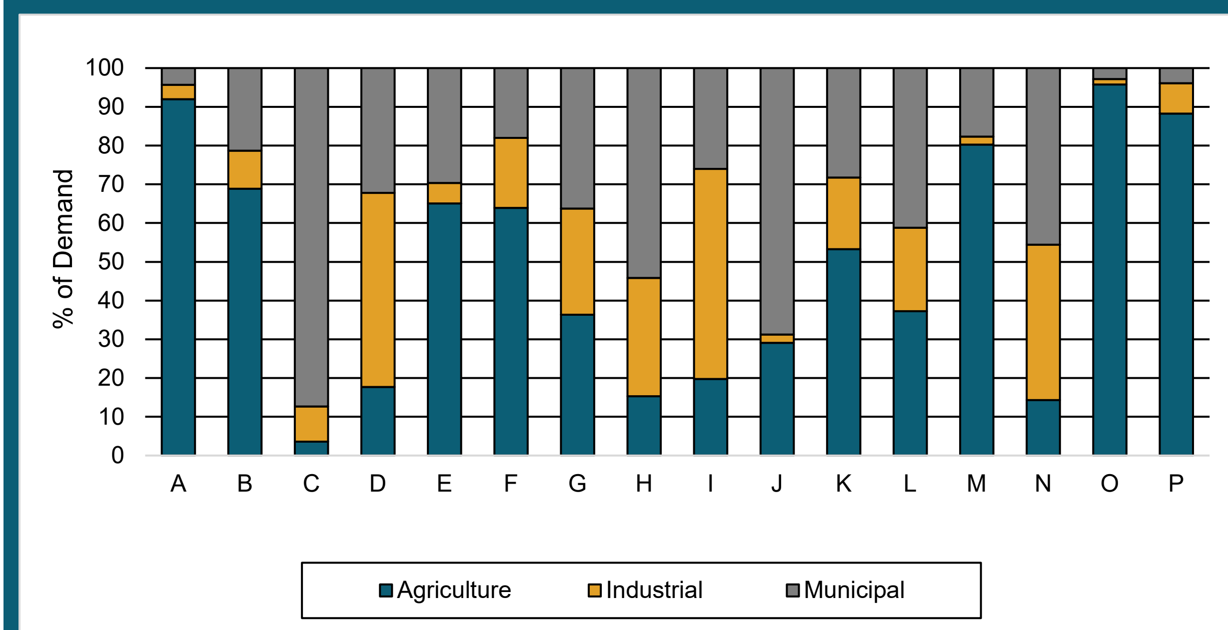
5B.3.1 Historical Water Use in Region C and Other Parts of the State

Water use data obtained from the TWDB [10] were used to analyze historical water use in Region C. **Table 5B.1** shows the summary of water use in Region C for year 2017. According to these data, 90.3 percent of the water use in Region C in the year 2017 was for municipal purposes.

Table 5B.1 TWDB Region C Summary of Water Use for Year 2017

Category	Reported Water Use (acre-feet)	Percentage of Regional Water Use
Irrigation	29,795	2.2%
Livestock	17,941	1.3%
Manufacturing	40,436	3.0%
Mining	7,508	0.6%
Municipal	1,225,931	90.3%
Power	36,694	2.7%
TOTAL	1,358,305	100.0%

Composition of Water Use Across Texas – 2020



Normalized Historical Water Use Data

Normalizing water use by the service population to obtain a per capita water use (gpcd) is often used to gain a sense of whether water is being used efficiently. The TWDB/TCEQ/WCAC *Guidance and Methodology for Reporting on Water Conservation and Water Use* [11] recommends calculating net municipal per capita water use by this formula:

$$GPCD = \frac{\text{(water diverted and/or purchased)} - \text{(wholesale sales + industrial sales + power sales)}}{\text{(Population of retail service area)} \cdot \text{(365 days)}}$$

This formula provides an estimate of municipal per capita water use that includes commercial, residential, some light industrial, and institutional water users and in some cases, municipal golf course irrigation. This definition provides a historical context for water use by a single water provider and may be a reasonable tool to assess water conservation trends over time for that provider.

The *Guidance* also recommends using total per capita water use for comparison to targets and goals. The recommended formula for total per capita water use credits indirect reuse against total diversion volumes but does not credit wholesale, industrial, or power sales:

$$\text{Total } GPCD = \frac{\text{(total water diverted and/or purchased)} - \text{(indirect reuse)}}{\text{(Population of retail and wholesale service area)} \cdot \text{(365 days)}}$$

The *Guidance* does not quantify specific per capita water conservation targets or goals.

Due to local and regional differences in the factors that drive water use, the *Guidance* does not recommend comparison of municipal gpcd or total gpcd between utilities or regions. Differences in the following factors can significantly influence per capita water use of one utility relative to another:

- Composition of the customer base. Some utilities have a much greater commercial and industrial base than others, and experience greater commercial and institutional water usage than others. In addition, most of the major water users in some regions receive water from municipal providers, while in other regions, there are significant self-supplied users. (Large users tend to develop their own supplies in areas where major groundwater wells can easily be developed and in areas where substantial surface water supplies are available.)
- Climate
- Economic conditions
- Water prices
- Availability of water supplies
- Presence of an active water conservation program

Without additional data and analysis, comparison of municipal gpcd or total gpcd between utilities or regions may lead to inaccurate conclusions about comparative

Municipal GPCD

Total municipal water use less wholesale and industrial sales divided by the service population

Total GPCD

Total water use divided by the service area population (this includes both municipal and non-municipal water use) water use efficiencies. Instead, these quantities should be used to track water conservation progress over time for a single water provider. However, even for a single provider, if there are significant shifts in development patterns or in the percentages of commercial/institutional water use to residential use, these measurements may not accurately reflect changes in water use due to conservation practices.

For more comprehensive analysis of a utility's water use, the *Guidance* recommends dividing water use into residential, industrial, commercial, institutional, and agricultural sectors and normalizing water use in each sector by factors that drive water use in each sector.

Example normalization factors are shown in **Table 5B.2.**

Each utility must determine appropriate factors for its service area and water use sectors.

Clear, consistent definitions of each water use sector and normalization factor are required to ensure that data are comparable for each reporting entity. Utilities will likely choose different factors to characterize their water uses. Even for residential water use, there are potential inconsistencies. For example, different utilities report multi-family usage as either residential or commercial usage, making even residential comparisons difficult. Furthermore, there is little historical data at this level of detail.

Table 5B.2 Example Normalization Factors for Water Use Analysis by Sector

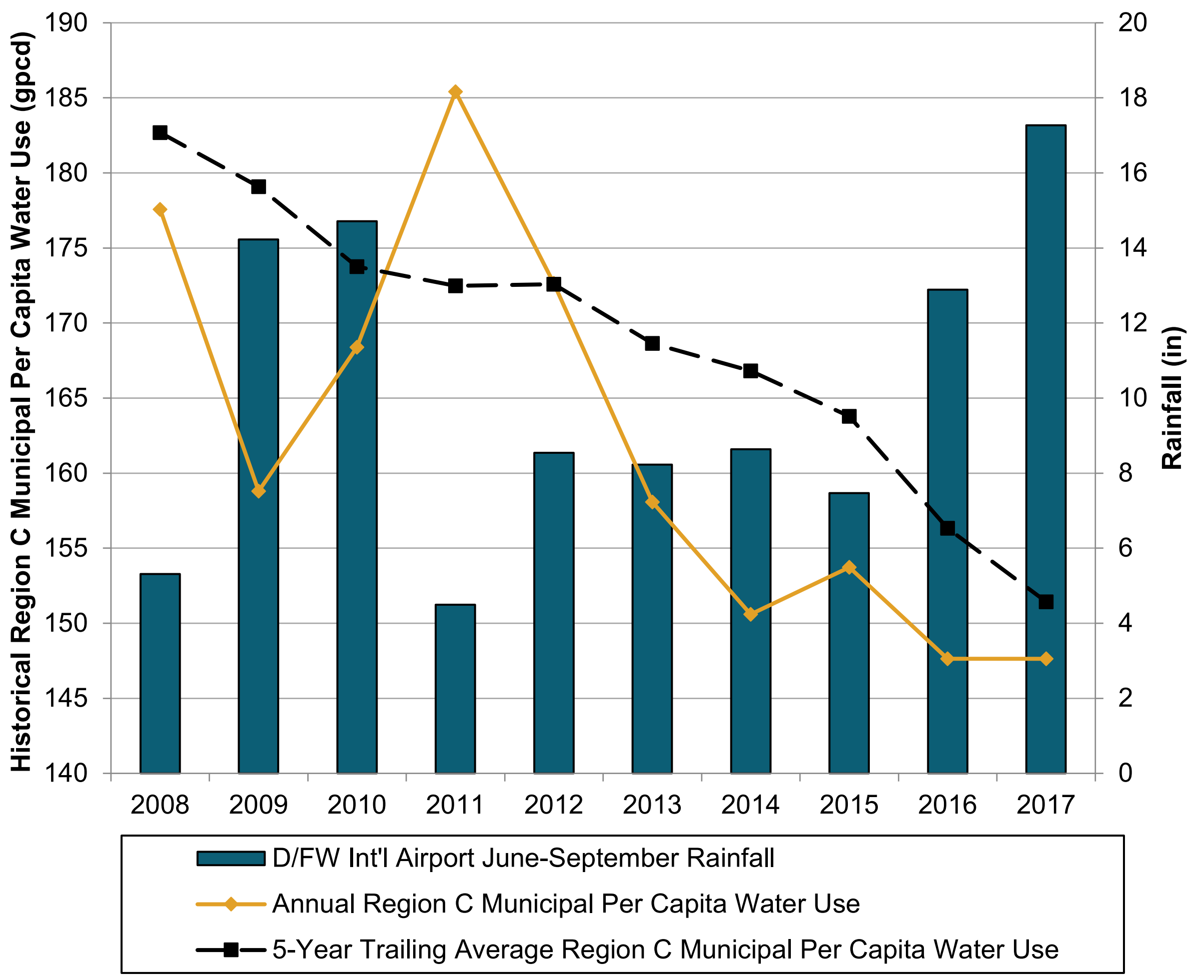
Water Use Sector	Example Normalization Factor
Total residential	Total residential population
Single-family residential	Single-family residential population
Multi-family residential	Multi-family residential population
Industrial	Unit of production/output (e.g., tons of paper produced) Unit of input (e.g., barrels of oil refined)
Commercial	Hotels: occupied room-nights Restaurants: number of customers Retail: number of employees
Institutional	Hospitals: occupied bed-days Universities and schools: number of students Prisons: inmate population
Agricultural	Livestock: head of cattle Nursery: square foot of nursery space Crops: irrigated acres

[a]Information in table is from source [(11)]. Water use in each sector is divided by a normalization factor to allow better tracking/comparison of water use over time. For example, crop water use could be calculated in terms of gallons per irrigated acre per day.

Figure 5B.1 shows historical municipal per capita water use in Region C on an annual basis and as a five-year trailing average. The five-year trailing average, which eliminates some of the variability due to changes in annual rainfall, shows a steady decrease in Region C municipal per capita water use in recent years. Many Region C utilities implemented drought response stages during 2011-2014, which contributed to the reduction in municipal per capita water use. However, when rainfall became more abundant in 2015-2017 and drought response stages were lifted, municipal per capita water usage remained low.

There is a significant negative correlation (-0.59) between Region C municipal per capita water use and June through September rainfall at Dallas/Fort Worth International Airport. For years with more than 12 inches of June-September rainfall, the per capita use in recent years (148 gpcd in 2016-2017) is less than per capita use in earlier years (159-168 gpcd in 2009-2010). This also suggests that the decreasing trend in municipal per capita water use is not entirely driven by climatic effects.

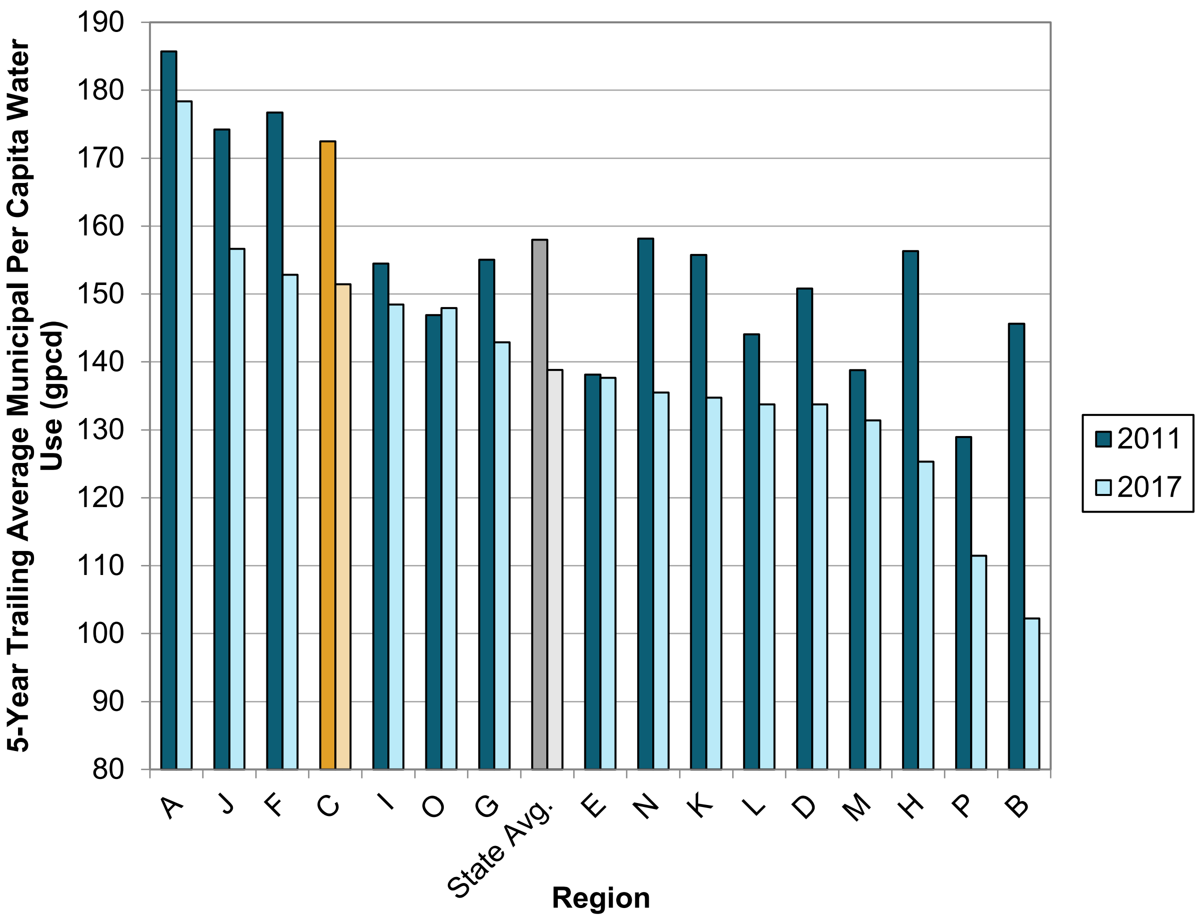
Figure 5B.1 Region C Historical Municipal Per Capita Water Use



The usefulness of comparing water use between the planning regions will be improved when residential water use data are available and when uniform normalizing factors are developed for the non-municipal sectors. However, at present, the regional data available from the TWDB only support calculation of municipal per capita water use and total per capita water use. Therefore, **Figure 5B.2** and **Figure 5B.3** show five-year trailing average 2011 and 2017 municipal per capita water use and total per capita water use for Region C in a statewide context. (Trailing averages normalize yearly variations due to weather and other factors.) These figures were developed using data reported to the TWDB from water use surveys and are intended to show recent changes in water use [(10)].

As shown in **Figure 5B.2**, the year 2017 five-year trailing average municipal per capita water use varies among the planning regions from 102 gpcd to 178 gpcd. Each region except Region O shows a decreasing trend in municipal per capita water use.

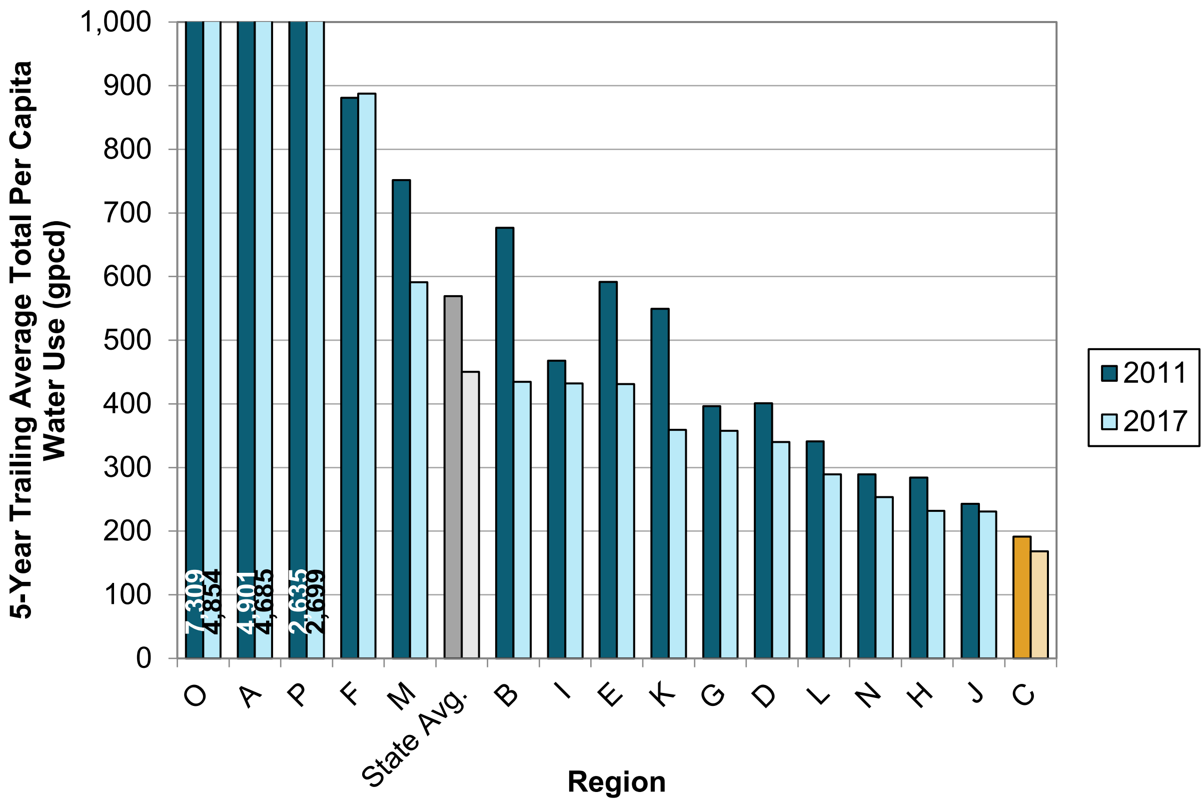
Figure 5B.2 2011 and 2017 Five-Year Trailing Average Municipal Per Capita Water Use by Region



As shown in **Figure 5B.3**, the year 2017 five-year trailing average total per capita water use (includes both municipal and non-municipal water use) in Region C is by far the lowest of any region in the state at 168 gpcd and was much lower than the statewide average of 450 gpcd. Regions with high total per capita water use have large non-municipal demands and relatively small populations. This is evidenced by the extremely high total gpcd for Regions O and A that have large irrigation demands. Except for Regions P and F, each region shows a decreasing trend in total per capita water use.

There are several reasons for differences in municipal per capita water use across the state, most of which have already been discussed**.** Some of the differences lie in the accounting of water use and the ability of some municipalities to accurately separate municipal water use from other uses that are supplied through the municipal retail provider.

Figure 5B.3 2011 and 2017 Five-Year Trailing Average Total Per Capita Water Use by Region



Historical Reclaimed Water Use in Region C

The Region C consultant team contacted Chapter 210 reuse providers and indirect reuse providers in Region C to identify historical reclaimed water use. The resulting data for Region C are summarized in **Table 5B.3.**

Direct reuse systems that replace potable water result in immediate reductions in per capita potable water usage. The higher levels of reclaimed water usage experienced during drought periods also further aid in offsetting water supply requirements during these critical periods. The

Region C Water Plan estimates that the direct reuse projects included in **Table 5B.3** will collectively provide over 31,500 acre-feet per year of water by the year 2020.

Table 5B.3 Reported Historical Reclaimed Water Reuse in Region C (Acre-Feet per Year)

Sponsor	Source WWTP	Project/Receiving Water	Use	2020 Estimate	Reported Reclaimed Water Use				
					2012	2013	2014	2015	2016
Direct Reuse									
Annetta	Annetta WWTP	Annetta Reuse	Irrigation	126	111	114	113	126	121
Azle	Azle WWTP	Cross Timbers Golf Course	Irrigation	300	212	124	154	130	102
Bryson	Bryson WWTP	Jack County Reuse	Irrigation	27	n/a	n/a	n/a	n/a	n/a
Crandall	Crandall WWTP	Creekview Golf Club	Irrigation	446	n/a	n/a	n/a	n/a	n/a
Dallas	Dallas Central WWTP	Cedar Crest/Stevens Park Golf Courses	Irrigation	1,121	197	159	190	210	184
Denton	Pecan Creek WWTP	Garland Power & Light	Cooling water	173	87	49	24	41	60
		Oakmont Country Club	Irrigation	265	305	408	574	455	544
		Denton Regional Medical Center	Irrigation		40	28	39	28	27
		Denton Landfill	Dust control		41	29	27	48	49
		Other	Multiple		17	18	19	13	15
Ennis	Ennis WWTP	Ennis Power	Cooling water	919	919	823	670	630	613
Fort Worth	Village Creek WWTP	Village Creek Reclaimed Water Delivery System: Waterchase Golf Course, Natural Gas Operators, City of Arlington, City of Euless, DFW Airport	Irrigation/ Mining	4,366	921	776	960	872	1,060
Gainesville	Gainesville WWTP	Keneteso Park	Irrigation	4	0	1	0	0	0
Garland	Duck Creek WWTP	Forney - Luminant Energy	Cooling water	9,196	8,736	7,658	8,591	9,238	9,326
Lewisville	Lewisville WWTP	UTRWD/Denton County FWSD #1A – Castle Hills Golf Course	Irrigation	897	358	260	327	288	129
Millsap	Millsap ISD WWTPs	Millsap ISD Reuse	Irrigation	2	n/a	n/a	n/a	n/a	n/a
NTMWD	Wilson Creek WWTP	Wilson Creek WWTP	Irrigation	100	n/a	n/a	n/a	n/a	n/a

Sponsor	Source WWTP	Project/Receiving Water	Use	2020 Estimate	Reported Reclaimed Water Use				
					2012	2013	2014	2015	2016
NTMWD	Stewart Creek West WWTP	Stewart Creek West WWTP	Irrigation	1,401	291	380	283	383	58
	Panther Creek WWTP	Panther Creek WWTP	Irrigation		0	0	0	120	370
	Buffalo Creek WWTP	Buffalo Creek WWTP	Irrigation	672	204	167	115	74	105
	Rowlett Creek WWTP	Los Rios Country Club	Irrigation	1,540	153	58	112	152	82
		Pecan Hollow Municipal GC	Irrigation		405	258	239	294	196
		Soccer Complex	Irrigation		48	44	47	49	36
Pinnacle Club	Pinnacle Club WWTP	Pinnacle Club	Irrigation	32	n/a	n/a	n/a	n/a	n/a
The Colony	The Colony WWTP	Stonebriar Country Club	Irrigation	457	n/a	n/a	n/a	n/a	n/a
TRA	Central RWS	DCURD – Las Colinas	Multiple	8,000	2,374	1,797	2,233	1,556	1,830
	Ten Mile Creek RWS	South Creek Ranch	Irrigation	125	56	38	67	27	47
Trophy Club	Trophy Club MUD No. 1 WWTP	Denton County Golf Reuse	Irrigation	800	n/a	n/a	n/a	n/a	n/a
Weatherford	Weatherford WTP	Parker County Golf Reuse	Irrigation	269	n/a	n/a	n/a	n/a	n/a
Direct Reuse Subtotal				**31,238**	**15,475**	**13,189**	**14,784**	**14,734**	**14,954**
Indirect Reuse									
Athens MWA	Athens Fish Hatchery	Lake Athens	Fish Hatchery	2,872	4,115	2,716	2,672	2,731	2,532
Dallas		Elm Fork Watershed	Municipal	43,451	11,819	9,382	11,529	18,476	18,128
DCPCMUD	Grapevine WWTP	Lake Grapevine	Municipal	3,295	595	1,085	904	854	781
Denton	Pecan Creek WWTP Clear Creek WWTP	Lewisville Lake	Municipal	5,740	n/a	n/a	n/a	n/a	n/a
Irving	TRA Central RWS	West Fork Trinity River	Irrigation	486	0	0	0	0	0

Sponsor	Source WWTP	Project/Receiving Water	Use	2020 Estimate	Reported Reclaimed Water Use				
					2012	2013	2014	2015	2016
NTMWD	Wilson Creek WWTP	Lake Lavon	Municipal	48,896	42,339	51,554	48,061	62,207	53,891
	East Fork Water Supply Project	Lake Lavon	Municipal	96,047	33,562	56,494	53,734	36,741	19,194
TRA	Waxahachie WWTP	Lake Waxahachie	Municipal	3,479	n/a	n/a	n/a	n/a	n/a
TRWD	Fort Worth Village Creek WRF	Richland-Chambers Reservoir	Municipal	100,465	959	19,159	62,998	29,882	9,836
UTRWD	Various WWTPs	Lewisville Lake	Municipal	3,970	4,451	2,156	2,602	4,154	4,236
Weatherford	Weatherford WWTP	Lake Weatherford	Municipal	2,242	n/a	n/a	n/a	n/a	n/a
Indirect Reuse Subtotal				**310,943**	**97,840**	**142,546**	**182,500**	**155,045**	**108,598**
Total Direct and Indirect Reuse				**342,181**	**113,315**	**155,735**	**197,284**	**169,779**	**123,552**

[a]Plan estimates are based on the full available supply during drought-of-record conditions. Reported reclaimed water use reflects actual demands and actual weather conditions. 2020 estimates for the 2021 Region C Water Plan are presented in Section 5B.7.
[b]"N/a" means no data were reported for the project.

The *2021 Region C Water Plan* estimates that the indirect reuse projects included in **Table 5B.3** will collectively be able to provide 282,500 acre-feet per year of water by the year 2020. Over the course of the period evaluated here (2012 to 2016), these projects collectively provided 97,839 to 182,500 acre-feet per year. (Note: some data was not available and is not included in these quantities.)

The primary obstacles hindering the growth of direct reuse systems in Region C are the initial capital costs required to build the necessary infrastructure and securing new customers. The primary obstacles hindering the growth of indirect reuse systems in Region C are the acquisition or amendment of water rights and development of reclaimed water conveyance systems, particularly within very urbanized areas. In order to continue advancing reuse systems within the region, emphasis will need to be placed on identifying means for financing these systems.

Historical Water Loss in Region C

Since 2003, retail public water utilities have been required to complete and submit a water loss audit form to the TWDB every five years. Since 2013, retail public utilities that supply potable water to more than 3,300 connections or receive financial assistance from the TWDB must file an annual water audit with the TWDB. The most recent available data were reported in 2018 for water loss during calendar year 2017. The TWDB compiled the data from these reports [12]. The water audit reporting requirements follow the International Water Association (IWA) and American Water Works Association (AWWA) Water Loss Control Committee methodology.

The primary purposes of a water loss audit are to account for all water being used and to identify potential areas where water can be saved. Water audits track multiple sources of water loss that are commonly described as apparent loss and real loss. Apparent loss is water that was used but for which the utility did not receive compensation. Apparent losses are associated with customer meters under-registering, billing adjustment and waivers, and unauthorized consumption. Real loss is water that was physically lost from the system before it could be used, including main breaks and leaks, customer service line breaks and leaks, and storage overflows. The sum of the apparent loss and the real loss make up the total water loss for a utility.

In Region C, 103 public water suppliers submitted a water loss audit to TWDB for the 2017 calendar year These water suppliers represent a retail service population of approximately 6.37 million, or about 88 percent of the regional population. Five more public water suppliers with a portion of their service areas in Region C also submitted water loss audits. **Table 5B.4** shows a summary of reported 2017 water loss accounting for the 108 public water suppliers that provide water in Region C. **Figure 5B.4** and **Figure 5B.5** compare losses in all Regional Water Planning Areas.

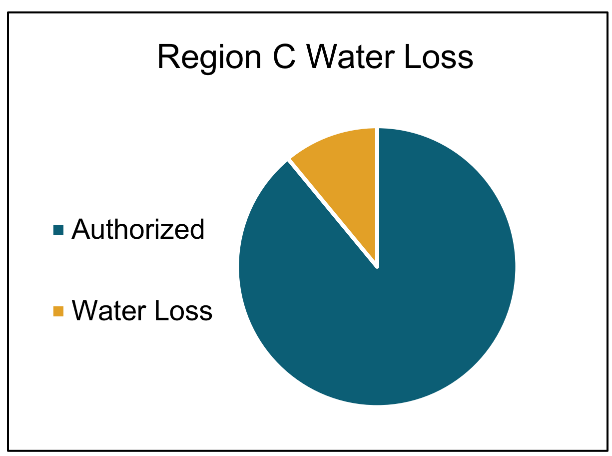


Table 5B.4 Reported 2017 Water Loss Accounting in Region C

<table>
<tr><td rowspan="9">System Input Volume
355,111,124,858
100.0%</td><td rowspan="4">Authorized Consumption
316,047,812,001
89.0%</td><td rowspan="2">Billed Consumption
297,819,676,183
83.9%</td><td>Billed Metered
297,726,407,120
83.8%</td><td rowspan="2">Revenue Water
297,819,676,183
83.9%</td></tr>
<tr><td>Billed Unmetered
93,269,063
0.03%</td></tr>
<tr><td rowspan="2">Unbilled Consumption
18,228,135,818
5.1%</td><td>Unbilled Metered
13,527,569,325
3.8%</td><td rowspan="7">Non-Revenue Water
57,291,448,675
16.1%</td></tr>
<tr><td>Unbilled Unmetered
4,700,566,493
1.3%</td></tr>
<tr><td rowspan="5">Water Loss
39,063,312,857
11.0%</td><td rowspan="3">Apparent Loss
6,481,553,296
1.8%</td><td>Unauthorized Consumption
883,305,353
0.2%</td></tr>
<tr><td>Customer Meter Accuracy Loss
5,066,596,234
1.4%</td></tr>
<tr><td>Systematic Data Handling Discrepancy
531,651,709
0.1%</td></tr>
<tr><td rowspan="2">Real Loss
32,581,759,562
9.2%</td><td>Reported Breaks and Leaks
2,694,418,785
0.8%</td></tr>
<tr><td>Unreported Loss
29,887,340,777
8.4%</td></tr>
</table>

[a]From [12]. Water volumes shown in gallons.

On a regional basis, the percentage of total water loss for Region C was 11 percent [(12)]. Extrapolating performance indicator guidelines [(13)] from individual utilities to entire regions, apparent losses should be normalized by the number of service connections, and real losses for regions with 32 or more service connections per mile of main should also be normalized by the number of service connections.

Based on the 2017 water loss data, Region C is performing better than the state average for apparent water loss and real water loss for regions with a high connection density. However, enhanced water loss control programs are still a potentially feasible water conservation strategy for Region C WUGs.

5B.4 **Existing Water Conservation and Reuse in Region C**

The next step in developing effective water conservation and reuse recommendations for Region C is to understand the current level of water conservation implementation. This section discusses existing water conservation measures and reuse projects in Region C.

5B.4.1 Existing Water Conservation in Region C

Water conservation measures and reuse strategies currently practiced in Region C were identified from reviewing submitted water conservation plans, from meetings with selected water suppliers, from a TWDB summary of 2017 annual water conservation reports, and from the *Statewide Water Conservation Quantification Project (SWCQP)*.

Sixty WUGs and seven WWPs submitted water conservation plans, 84 WUGs submitted annual water conservation reports in 2017, and 63 utilities reported their conservation activities in the SWCQP. There was some overlap between the different sources. Conservation activities for 118 unique entities are reported by the various sources, representing about 88 percent of the population of Region C.

Table 5B.5 shows the percentage of water conservation plans reporting implementation of different water conservation measures. The most widely implemented water conservation strategies in Region C include public and school education, water loss control, conservation rates, and water waste prohibition. Based on this information and the historical water use data, significant efforts have been made by water providers and water users to conserve water in Region C. Regional coordination is one tool that has been utilized by wholesale water providers in the region. The North Texas Municipal Water District, Dallas Water Utilities, and Tarrant Regional Water District cooperate to implement the "Water is Awesome" public awareness campaign and jointly sponsor the annual North Texas Regional Water Conservation Symposium. Outdoor water conservation practices, such as time-of-day and twice weekly watering restrictions, have become part of local ordinances in Fort Worth, Dallas, and many of the larger cities in the area. Cities and water utilities have begun allocating conservation staff and budgeting dollars as part of their permanent water management strategies. These individual conservation efforts are part of the ongoing Region C effort to promote conservation as a permanent, valuable water management strategy.

Water savings from existing water conservation measures are accounted for in this plan in two ways. Projected water demands are based on water usage during the base planning year, which was the most recent very dry year. For most Region C WUGs, the base planning year is 2011. Water usage during the base planning year is assumed to include water savings from all water conservation measures that were in effect at that time. Therefore, these historical water savings are built into the current water demand projections. Since the *2001 Region C Water Plan*, the baseline water demand projections (based on water usage during the base planning year without accounting for future water savings from low-flow plumbing fixture rules or other future conservation or reuse) for 2020-2050 have decreased by 38.7 to 40.5 gpcd, depending on the decade. **Table 5B.6** shows the demand reduction from existing water conservation measures implemented through the base planning year.

Since the base planning year, Region C WUGs have continued to implement active water conservation measures. The associated water savings has reduced water demand in Region C, but this demand reduction is not reflected in the Region C water demand projections. The projected demand reduction from existing water conservation measures implemented since the base planning year is quantified in **Table 5B.6.**

Methods for estimating demand reduction for water conservation measures implemented since the base planning year are described in **Appendix I**. No future costs are included in the plan for this demand reduction, because the costs have already been incurred. This is analogous to how existing water supplies are handled in the Region C Water Plan.

5B.4.2 Existing Reuse Projects

Reuse of treated wastewater effluent has been a source of water supply in Region C for a number of years. **Table 5B.7** lists currently operating reuse projects in Region C and the amount that can be used with existing infrastructure and current users (for direct reuse). Based on existing permitted reuse projects, Region C is expected to have more than 337,000 acre-feet per year of wastewater return flows available for use as water supplies in 2020. Under current permits and infrastructure, this existing supply is expected to increase to more than 411,000 acre-feet per year by 2070.

There are also several reuse projects that are permitted but that do not yet have the needed infrastructure. Others are not fully utilized due to infrastructure limitations. Development of the infrastructure for these projects is considered a water management strategy. Further discussion of current reuse projects is included in **Appendix E**.

Significant reuse projects implemented since the last plan include:

- **City of Irving:** water from the West Fork Trinity River is diverted for irrigation at the Twin Wells Golf Course. The water source is treated wastewater effluent from the TRA Central Regional Wastewater System.
- **NTMWD:** water from the Trinity River is diverted at the Main Stem Pump Station, receives water quality polishing at the East Fork Water Reuse Project, and is pumped to Lavon Lake for indirect reuse. The water source is treated wastewater effluent from the TRA Central Regional Wastewater System.

Figure 5B.4 Reported 2017 Apparent Losses by Region

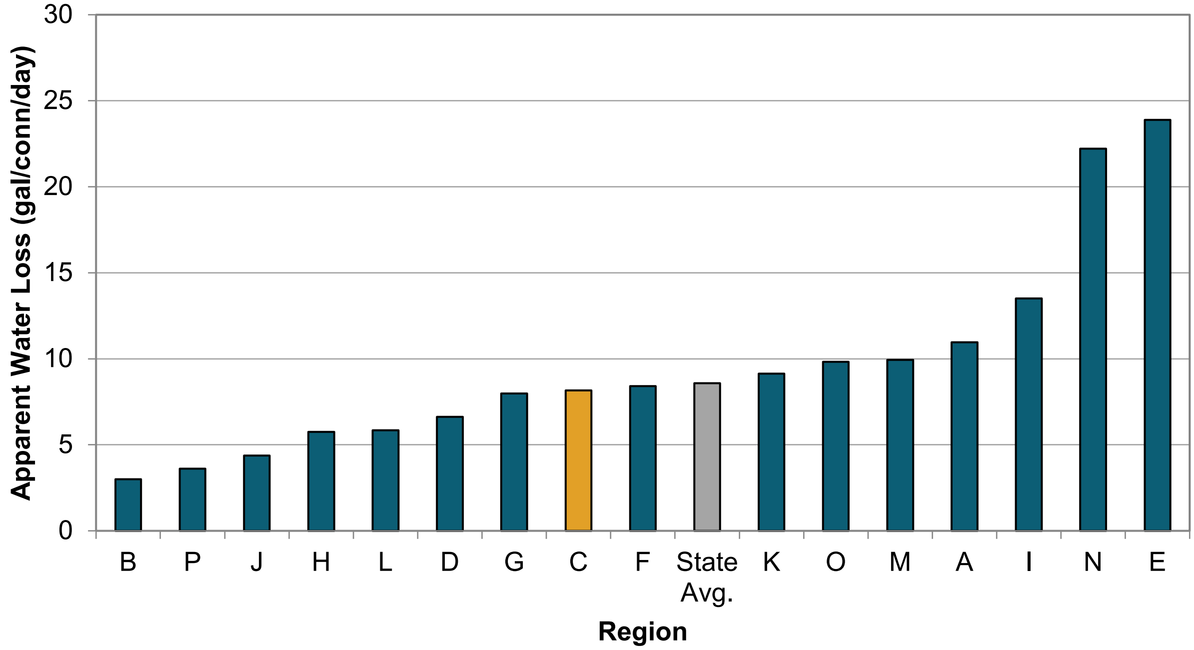


Figure 5B.5 Reported 2017 Real Losses in Regions with High Connection Density

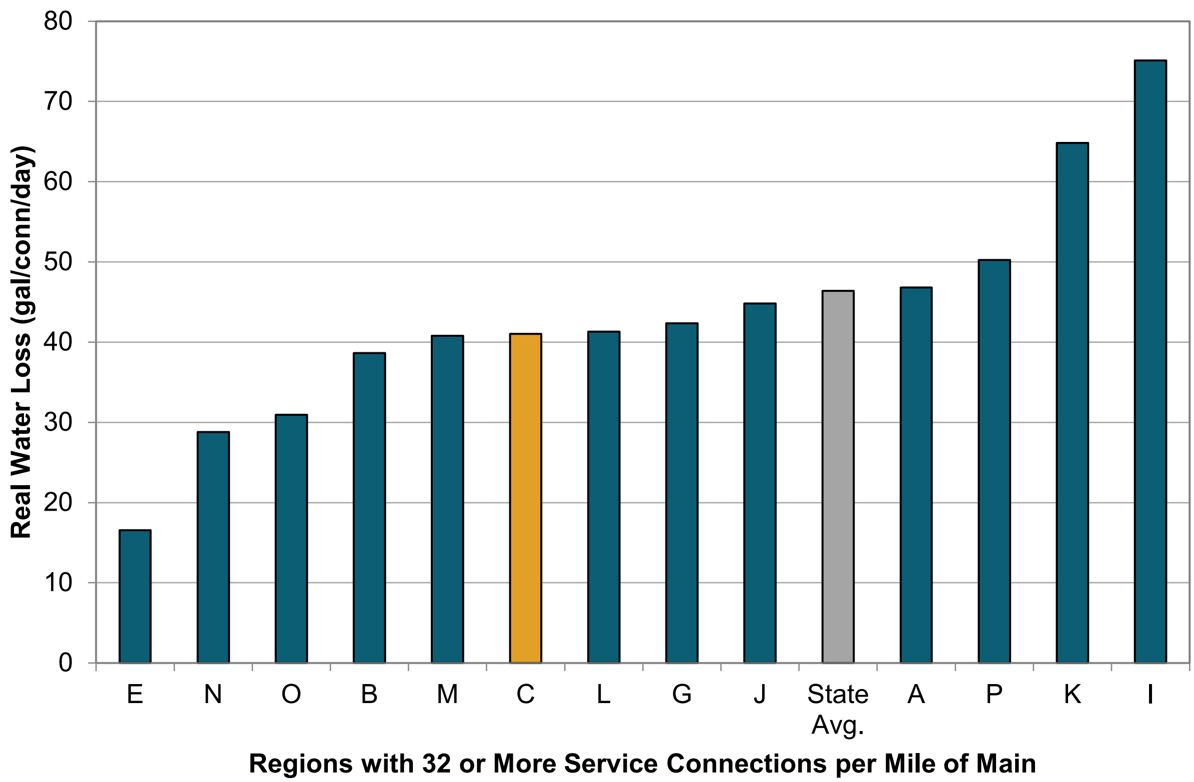


Table 5B.5 Existing Implementation of Water Conservation Measures in Region C

Measure	Percentage of WUGs/WWPs That Have Implemented the Measure	Minimum Percentage of Region C Population for which the Measure has been Implemented[a]
Public and school education programs	81%	83%
Water loss control programs	65%	75%
Conservation rate programs	56%	75%
Water waste prohibition	52%	75%
Twice weekly irrigation restrictions	38%	62%
Water conservation coordinator	31%	63%
Indirect reuse	31%	55%
Time-of-day irrigation restrictions	31%	67%
Residential water audits, irrigation checkups	25%	62%
Evapotranspiration irrigation recommendations	22%	19%
Waterwise landscape design program	19%	26%
Park/athletic field conservation	17%	47%
Landscape irrigation conservation/incentives	15%	47%
Toilet replacement and rebates	14%	53%
Showerhead/faucet retrofit program	11%	50%

[a]Based on projected 2020 population for reporting WUGs only. Since not all WUGs reported their conservation activities, and since there is overlap with conservation activities by WWPs, these percentages are an estimate of the minimum percentage of the Region C population for which each measure has been implemented.

Table 5B.6 Projected Water Demand Reduction from Existing Water Conservation Measures

Implementation Period	Projected Demand Reduction (Acre-Feet/Year) 2020	2030	2040	2050	2060	2070
Through Base Planning Year[a]	338,164	401,601	440,128	503,165	569,397	640,648
Since Base Planning Year	59,331	63,656	52,990	56,904	60,856	63,958

[a]These quantities were estimated based on a comparison of baseline water demand projections for the 2001 and 2021 Region C Water Plans. Since the 2001 Region C Water Plan only contains projections through 2050, the 2060 and 2070 quantities are based on the 2050 per capita water savings. The per capita water savings from existing water conservation measures implemented through the base planning year are presented later in this chapter as the blue-shaded area in Figure 5B.6.

Table 5B.7 Projected Available Supplies from Existing Reuse Projects in Region C

Provider	Project Name	Type	County	2020	2030	2040	2050	2060	2070
Annetta	Annetta Direct Reuse	direct	Parker	126	145	167	183	202	222
Azle	Azle Direct Reuse	direct	Tarrant	300	300	300	300	300	300
Bryson	Jack County Direct Reuse	direct	Jack	27	26	26	25	25	24
Crandall	Crandall Direct Reuse	direct	Kaufman	446	541	645	666	666	666
Dallas	Cedar Crest Golf Course Reuse	direct	Dallas	1,121	1,121	1,121	1,121	1,121	1,121
Dallas	Dallas Indirect Reuse	indirect	Denton	43,451	49,167	52,547	57,540	69,313	77,705
Denton	Denton Power Plant Direct Reuse	direct	Denton	173	173	173	173	173	173
Denton	Denton County Indirect Reuse	indirect	Denton	5,740	7,291	9,063	12,515	12,818	12,683
Denton	Denton County Direct Reuse	direct	Denton	265	265	265	265	265	265
Ennis	Ennis Direct Reuse	direct	Ellis	919	919	919	919	919	919
Fort Worth	Fort Worth Village Creek Direct Reuse	direct	Tarrant	3,469	3,526	3,526	3,526	3,526	3,526
Fort Worth	Waterchase Golf Course Direct Reuse	direct	Tarrant	897	897	897	897	897	897
Gainesville	Gainesville Direct Reuse	direct	Cooke	4	4	4	4	4	4
Garland/Forney	Garland Direct Reuse (sales through Forney)	direct	Kaufman	9,196	9,196	9,196	9,196	9,196	9,196
Grapevine	Grapevine Reuse (Lake Grapevine) DCPCMUD	indirect	Tarrant	3,2 95	3,659	3,698	3,683	3,680	3,679
Millsap ISD	Millsap WWTP Reuse	direct	Parker	2	2	2	2	2	2
NTMWD/Frisco	Stewart Creek West Reuse	direct	Collin	1,401	1,401	1,401	1,401	1,401	1,401
NTMWD	Rowlett Creek Reuse	direct	Collin	1,540	1,540	1,540	1,540	1,540	1,540
NTMWD	Wilson Creek Direct Reuse	direct	Collin	100	100	100	100	100	100
NTMWD	Buffalo Creek Reuse	direct	Rockwall	672	672	672	672	672	672

Provider	Project Name	Type	County	2020	2030	2040	2050	2060	2070
NTMWD	Lavon Watershed Reuse	indirect	Collin	48,896	58,626	69,999	73,014	73,014	73,014
NTMWD	East Fork Reuse	indirect	Kaufman	96,047	102,000	102,000	102,000	102,000	102,000
Pinnacle Club	Pinnacle Club Direct Reuse	direct	Henderson	32	32	32	32	32	32
The Colony	Stonebriar County Club (golf irrigation)	direct	Collin	457	457	457	457	457	457
TRA/DCURD	TRA/Las Colinas Indirect Reuse (Dallas County Irrigation)	indirect	Dallas	8,000	8,000	8,000	8,000	8,000	8,000
TRA	TRA/Waxahachie Indirect Reuse	indirect	Ellis	3,479	3,882	4,614	5,129	5,129	5,129
TRA	TRA Ten Mile Creek WWTP Reuse	direct	Dallas	125	125	125	125	125	125
TRA/Irving	Irving Indirect for Municipal Use	indirect	Dallas	486	486	486	486	486	486
TRWD	Richland-Chambers Reuse	indirect	Navarro	100,465	100,465	100,465	100,465	100,465	100,465
Trophy Club	Denton County Direct Reuse (Golf irrigation)	direct	Denton	800	800	800	800	800	800
Denton County FWSD#1/ UTRWD/Lewisville	UTRWD Direct Reuse	direct	Denton	897	897	897	897	897	897
UTRWD	UTRWD Lake Chapman Reuse	indirect	Denton	3,970	4,178	4,383	4,584	4,558	4,531
Weatherford	Weatherford Direct Reuse	direct	Parker	269	316	334	456	456	456
Total in Acre-Feet per Year				**337,067**	**361,209**	**378,854**	**391,173**	**403,239**	**411,487**
Total in MGD				**301**	**322**	**338**	**349**	**360**	**367**

5B.5 Recommended Water Conservation and Reuse in Region C

Water conservation has been a major component of the previous Region C Water Plans. The Region C Water Planning Group continues to place strong emphasis on water conservation and reuse as a means of meeting projected water needs in the region. After a discussion of conservation requirements for interbasin transfers of water, this section discusses new recommendations for water conservation and reuse strategies in Region C.

5B.5.1 Conservation Requirements for Interbasin Transfers of Water

Recommended water management strategies for many WUGs in Region C include a new interbasin transfer of surface water. Section 11.085 of the Texas Water Code includes permitting requirements for such interbasin transfers. Section 11.085(l)(2) defines the conservation standard for interbasin transfers, indicating that the Texas Commission on Environmental Quality (TCEQ) may grant a water right "to the extent that…the applicant for the interbasin transfer has prepared a drought contingency plan and has developed and implemented a water conservation plan that will result in the highest practicable levels of water conservation and efficiency achievable within the jurisdiction of the applicant."

Section 11.1271(e) of the Water Code indicates that the TWDB and the TCEQ should jointly "develop model water conservation programs for different types of water suppliers that suggest best management practices for achieving the highest practicable levels of water conservation and efficiency achievable for each specific type of water supplier." The TWDB and the TCEQ have addressed this requirement by preparing Best Management Practices Guides for agricultural, commercial and institutional, industrial, municipal, and wholesale water suppliers [3]. The TWDB, the TCEQ, and the WCAC have been working to update these BMPs.

5B.5.2 Recommended Conservation Strategies for Region C

For this report, the Region C Water Planning Group analyzed the applicability and appropriateness in Region C of the Best Management Practices (BMPs) suggested in the Best Management Practices Guides, considering cost, potential water savings, and opportunities for implementation and taking into account the current implementation levels.

Based on this analysis, the region recommends a Water Conservation Package that reflects practices that are:

- Practicable for implementation in Region C,
- Projected to provide long-term water savings, and
- Projected to provide a reasonable quantity of water savings at a reasonable cost for a wide range of water user groups.

The Water Conservation Package (shown in the blue sidebar) is recommended for implementation by each municipal water user group in the region. The Region C Water Conservation Package includes ten recommended practices. These practices are either required by state or federal law or a Best Management Practice [3] determined appropriate for Region C providers.

The first three water conservation practices included in the Water Conservation Package are state- and/or federally-mandated initiatives that will reduce water use over time simply through the natural replacement of high-water use fixtures and appliances.

The **first initiative** is the Water Saving Performance Standards for Plumbing Act, implemented by Texas in 1992. This act prohibits the sale, distribution, or importation of plumbing fixtures that do not meet certain low flow performance standards. The "low flow plumbing fixture rules" measure assumes that all new construction will be built with water saving plumbing fixtures and that existing plumbing fixtures will be replaced over time with low flow fixtures. House Bill 2667, implemented September 1, 2009, updated the water savings performance standards. For new fixtures, the average toilet flush volume is limited to 1.28 gallons, and the maximum showerhead flow is limited to 2.5 gallons per minute.

The **second initiative** is a federal requirement that new residential clothes washers must achieve the following levels of efficiency:

- Front-loading machines: maximum integrated water factor (total weighted per-cycle water consumption for all wash cycles divided by the clothes container capacity) of 4.5 gallons per cubic foot.
- Top-loading machines: maximum integrated water factor of 6.5 gallons per cubic foot.

The **third initiative** is a federal requirement that new residential dishwashers must achieve water consumption of 5 gallons per cycle or less.

2021 Region C Water Conservation Package:

- Low flow plumbing fixture rules
- Efficient new residential clothes washer standards
- Efficient new residential dishwasher standards
- Enhanced public and school education
- Price elasticity/rate structure impacts
- Enhanced water loss control program
- Water waste prohibition
- Water conservation coordinator
- Time-of-day irrigation restriction
- Twice weekly irrigation restriction **(NEW)**

The "efficient new residential clothes washer standards" and "efficient new residential dishwasher standards" measures assume that all new construction will be built with efficient clothes washers and dishwashers and that existing clothes washers and dishwashers will be replaced over time with efficient appliances.

The three state- and/or federally-mandated initiatives are projected to produce significant water conservation savings, and the Region C Water Planning Group has built these savings into its water demand projections. The projected 2070 municipal water demand in Region C is about 8.5 percent less than it would be without this "built-in" water conservation.

The remaining measures in the Water Conservation Package are recommended for implementation by each municipal water user group in the region that meets the following eligibility criteria:

- The projected water demand is greater than the existing water supply.
- The projected total water demand is greater than 140 gpcd. The 140 gpcd goal was introduced as a recommended total gpcd utility goal by the Water Conservation Implementation Task Force (14) and utilized as a threshold for recommendation of conservation measures in the *2021 Region C Water Plan*. This is a suggested goal and not a planning or regulatory requirement.
- The measure is not already implemented, and the measure is applicable to the WUG.
- A sponsor can be identified to implement the water conservation measure.
- The cost of water from the measure is less than $5.85 per thousand gallons for that WUG.

The development of the recommended Water Conservation Package included several assumptions related to measure adoption rates and realization of full benefits over time. For most measures it was assumed that full benefits would be realized by the second decade of implementation (e.g., 2030 for a measure implemented in 2020). Methods for estimating costs and water savings for the Water Conservation Package are described in **Appendix I**.

The recommended water conservation strategies for non-municipal WUGs are as follows:

- A general rebate program for irrigation demands. It is anticipated that municipal WUGs would offer rebates for golf course water conservation measures implemented within their service areas.
- Additional on-site recycling for mining WUGs.

For WUGs that are projected to receive water in the future from a new interbasin transfer, the water savings associated with the recommended municipal and non-municipal water conservation strategies represent the highest practicable level of water conservation and efficiency achievable in the region. With respect to projected water savings and costs, the Water Conservation Package is expected to have similar reliability to the other recommended water management strategies in the plan.

5B.5.3 Recommended Reuse Projects in Region C

Discussions with the regional and local water providers identified several potential reuse projects that could be used to help meet the projected shortages in Region C.

Table 5B.8 lists recommended reuse strategies for Region C. More detailed descriptions of the recommended reuse projects are included in **Appendix E**.

5B.5.4 Summary of Recommended Water Conservation and Reuse in Region C

Cities and utilities in Region C have made significant strides in the implementation of water conservation efforts in Region C. It is important that suppliers in the region build on this momentum with continued conservation efforts, and this plan suggests areas of emphasis for that effort. **Table 5B.9** shows a regional summary of estimated water savings from recommended water conservation and reuse strategies. It also shows the amount of conservation that is included in the approved water demands for the region.

The projected 2070 Region C water demand with no conservation is over 3,100,000 acre-feet per year. This amount includes the TWDB-approved 2070 demand plus 249,646 acre-feet per year of conservation from low flow plumbing fixtures, efficient residential clothes washer standards, and efficient residential dishwasher standards. The existing and recommended 2070 water conservation and reuse strategies, including those that are assumed in the demands, will meet more than 1.34 million acre-feet per year (or 42.8 percent) of the pre-conservation demand. Estimated costs for these strategies by entity are included in **Appendix H**.

5B.5.5 Other Recommendations

Although specific water conservation measures (or BMPs) are identified as part of the Water Conservation Package, these are suggested methods to achieve the projected water savings. However, WUGs and WWPs should not be restricted to these specific measures in their approach to achieving the projected water savings associated with the Water Conservation Package. The recommended measures were studied at a regional level, and more detailed studies conducted for individual suppliers may indicate that some of these measures are not practicable for individual suppliers or that alternate measures should be implemented. Each WUG and WWP should tailor its water conservation implementation to its particular service area characteristics, considering not only the measures in the Region C Water Plan but also measures determined appropriate for the user based on service area composition and other factors.

5B.6 Per Capita Water Use in Region C

Policy Recommendations

- Support legislative and state agency findings regarding water use evaluation
- Support more state funding for water conservation efforts
- Support research to advance reuse and desalination
- Funding assistance for desalination and water reuse projects
- Revise Federal Section 316(b) regulations on power plant cooling water

The *Report to the 79th Legislature* [14] from the Water Conservation Implementation Task Force suggested that when establishing conservation targets and goals, a municipal water supplier should consider "a minimum annual reduction of one percent in total gpcd, based upon a five-year rolling average, until such time as the entity achieves a total gpcd of 140 or less." The gpcd values used for Region C projections are dry year estimates, whereas the 140 gpcd recommendation is based on a five-year rolling average. The five-year average gpcd is typically 10-15% less than a dry year gpcd.

The 140 gpcd goal has no specific regulatory basis, and it may not be appropriate for all entities based on differences in climatic conditions and other water use characteristics. However, since this number has been used in previous plans and is recognized statewide, it is used to provide a baseline for comparison.

5B.6.1 Per Capita Water Use with Implementation of the Recommended Plan

This plan recommends significant conservation efforts and development of substantial new supplies from reuse that will result in a demand for conventional water supplies of less than 140 gpcd.

Table 5B.8 Recommended Reuse Projects in Region C

Provider	User	Project Name	Type	County [a]	2020	2030	2040	2050	2060	2070
Athens MWA	Athens Fish Hatchery	Athens Fish Hatchery	Indirect	Henderson	2,872	2,872	2,872	2,872	2,872	2,872
Athens	Athens MWA	Lake Athens Indirect Reuse	Indirect	Henderson	0	1,455	1,557	1,708	2,677	2,677
Gainesville	Cooke County Irrigation	Direct Reuse for Irrigation	Direct	Cooke	70	70	70	70	70	70
NTMWD	DWU	Elm Fork Swap to NTWMD	Indirect	Dallas	7,591	8,617	10,645	13,975	15,806	16,880
DWU	DWU	Main Stem Balancing Reservoir	Indirect	Ellis	0	0	0	78,447	89,741	95,829
UTRWD	DWU	Additional Indirect Reuse Lewisville Lake	Indirect	Denton	1,166	4,351	6,575	11,395	16,195	16,901
Ennis	Ennis	Indirect Reuse	Indirect	Ellis	0	0	2,026	3,109	3,696	3,696
Flower Mound	Flower Mound	Long Prairie/Lakeside Business District Service Areas	Direct	Denton	0	569	693	845	900	900
Fort Worth	Fort Worth	Village Creek WRF Future Direct Reuse	Direct	Tarrant	2,442	2,442	2,442	2,442	2,442	2,442
Fort Worth	Fort Worth	Mary's Creek WRF Future Direct Reuse	Direct	Parker/ Tarrant	0	4,245	4,245	4,245	4,245	4,245
Gainesville	Gainesville	Cooke County Mining Reuse	Direct	Cooke	99	67	71	74	77	80
Jacksboro	Jack County Mining	Indirect Reuse (Jack County Mining)	Indirect	Jack	330	342	348	351	356	359
NTWMD	Frisco	Collin County Direct Reuse, Expanded	Direct	Collin	325	594	856	1,118	1,379	1,379
TRA	NTWMD	Additional East Fork Reuse	Indirect	Collin	0	547	7,610	10,581	15,441	20,630
DWU	NTMWD	Elm Fork Swap/Lake Lewisville	Indirect	Collin	7,591	8,617	10,645	13,975	15,806	16,880
NTMWD	DWU	Ray Hubbard Exchange	Indirect	Dallas	20,477	22,783	24,899	25,483	26,931	28,778

Provider	User	Project Name	Type	County [a]	2020	2030	2040	2050	2060	2070
NWTMD	NWTMD	Additional Lavon Watershed	Indirect	Collin	0	0	0	11,826	26,140	38,780
TRA	Tarrant County Irrigation, Denton County Irrigation	Alliance Corridor Direct Reuse	Direct	Tarrant/Denton	2,800	3,356	8,396	8,396	8,396	8,396
TRA	Midlothian	Midlothian Joe Pool Lake Indirect Reuse	Indirect	Dallas	2,107	9,203	10,100	10,224	10,324	10,470
TRA	TRWD	TRA Central to TRWD	Indirect	Dallas	0	20,000	30,000	40,000	50,000	60,000
TRA	Irving	Irving Indirect for Municipal Use	Indirect	Dallas	0	27,539	27,539	27,539	27,539	27,539
Fort Worth/TRA	TRWD	Trinity River Indirect Reuse - Cedar Creek	Indirect	Henderson/ Kaufman	0	38,323	55,807	70,819	83,870	88,058
Fort Worth	Tarrant County Steam Electric Power	Tarrant County SEP Future Reuse	Direct	Tarrant	0	1,528	2,360	2,360	2,360	2,360
UTRWD	UTRWD	Indirect Reuse of Sulphur Basin Supplies (Marvin Nichols 328 and Wright Patman Reallocation)	Indirect	Denton	0	0	0	10,340	10,340	13,838
UTRWD	UTRWD	Indirect Reuse of Lake Ralph Hall Water	Indirect	Denton	0	13,944	14,689	15,428	15,390	15,391
UTRWD	Denton County Irrigation	Direct Reuse	Direct	Denton	0	560	1,121	2,240	2,240	2,240
Weatherford	Weatherford	Lake Weatherford Indirect Reuse	Indirect	Parker	2,242	2,803	3,363	3,363	3,363	3,363
Total Reuse in Acre-Feet per Year					**50,112**	**174,827**	**228,928**	**373,225**	**438,596**	**485,054**
Total Reuse in MGD					**45**	**156**	**204**	**333**	**391**	**433**

[a]*County reflects location of reuse project.*

Table 5B.9 Summary of Existing and Recommended Conservation (Including Reuse) for Region C

Strategy	2020	2030	2040	2050	2060	2070
Municipal Conservation						
State/Federal Initiatives[a]	75,085	119,881	160,677	193,278	221,329	249,646
Demand Reduction Since Base Planning Year	59,331	63,656	52,990	56,904	60,856	63,958
Municipal Recommended Conservation	34,732	63,273	81,510	97,106	112,412	128,447
Non-Municipal Conservation						
Demand Reduction Since Base Planning Year	6,261	6,261	6,261	6,261	6,076	6,076
Non-Municipal Recommended Conservation[b]	2	38	161	1,328	2,535	4,196
Reuse Strategies						
Existing Reuse	337,067	361,209	378,854	391,173	403,239	411,487
Recommended Reuse Strategies	50,112	174,827	228,928	373,225	438,596	485,054
Total Conservation and Reuse	**562,590**	**789,145**	**909,381**	**1,119,275**	**1,245,043**	**1,348,864**
Total Region C Water Demand[c]	1,733,893	1,936,605	2,151,925	2,390,623	2,641,476	2,898,540
Total Water Demand without Conservation	1,808,978	2,056,486	2,312,602	2,583,901	2,862,805	3,148,186
Total Conservation and Reuse	31.1%	38.4%	39.3%	43.3%	43.5%	42.8%

[a]State/federal initiatives include low flow plumbing fixtures, efficient residential clothes washer standards, and efficient residential dishwasher standards. These values were provided by the TWDB.

[b]Non-municipal water conservation measures include estimated conservation savings from irrigation rebates.

[c]Total Region C Water Demand includes projected conservation savings from low flow plumbing fixtures, efficient residential clothes washer standards, and efficient residential dishwasher standards. These savings were added to the Total Region C Water Demand to obtain the Total Water Demand without Conservation, a projection of Region C water demands if no conservation occurred.

Table 5B.10 summarizes the projected per capita municipal water use for Region C with the implementation of the plan. **Figure 5B.6** is a graph of the data from **Table 5B.10.** The figure and the table show the following:

- With no conservation or reuse at all, the projected dry-year per capita municipal water use in Region C is 178 gpcd in 2070.
- Implementation of the plumbing code requiring the use of low flow plumbing fixtures is expected to reduce the 2070 per capita municipal use by a total of about 15 to 163 gpcd.
- Accounting for demand reduction since the base planning year due to existing water conservation measures will reduce the projected 2070 per capita municipal use by an additional 4 to 159 gpcd.
- The recommended water conservation measures in the *2021 Region C Water Plan* will reduce the projected 2070 per capita municipal use by an additional 8 to 151 gpcd.
- The existing and recommended municipal water reuse projects will reduce the projected per capita municipal water use well under the suggested voluntary goal of 140 gpcd in each decade (**Figure 5B.6**). These projects will reduce the 2070 per capita municipal use by an additional 55 to 96 gpcd.
- The projected normal year per capita use is 10-15 percent lower than dry-year use and is also well under the suggested voluntary goal of 140 gpcd.

Figure 5B.6 also shows historical water demand projections. The differences between historical water demands and water demands in this plan represent water conservation savings from measures that have already been implemented. Region C has greatly reduced its water demand since the beginning of the regional planning process and is poised to make significant additional reductions in water demand.

Figure 5B.6 Projected Municipal Per Capita Water Use in Region C

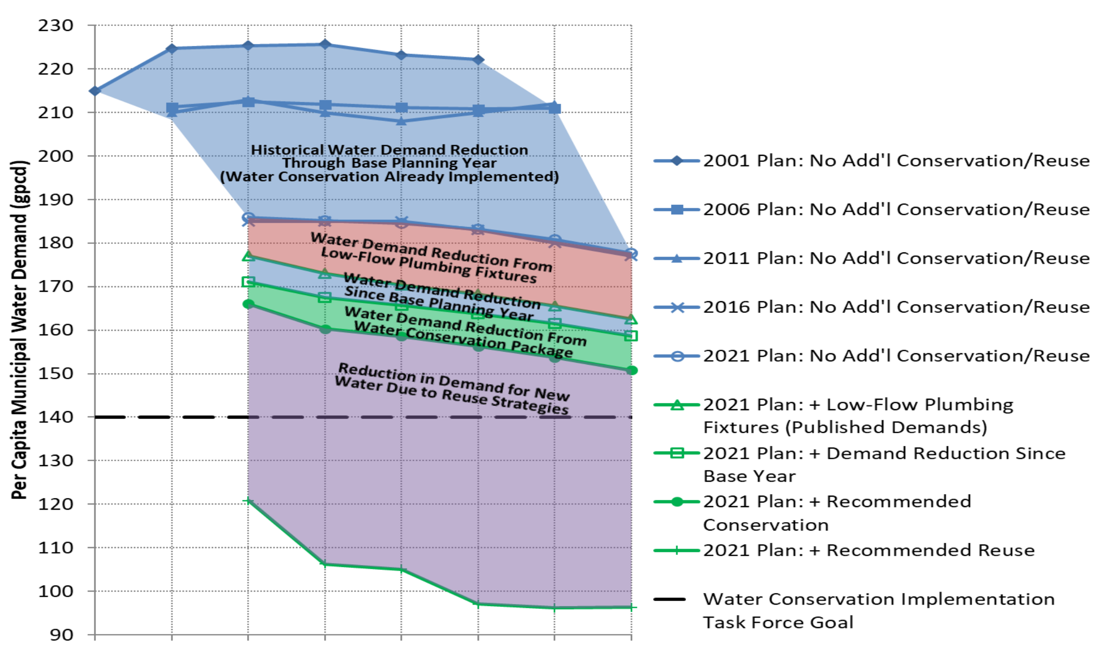


Table 5B.10 Projected Municipal Per Capita Use in Region C(Acre-Feet)

	2020	2030	2040	2050	2060	2070
Basic Data						
Population	7,637,764	8,857,957	10,150,077	11,533,432	13,051,603	14,684,790
Municipal Demand without Add'l Low Flow Fixtures	1,589,740	1,837,167	2,097,956	2,366,431	2,642,515	2,923,475
Municipal Demand with Add'l Low Flow Fixtures	1,514,655	1,717,286	1,937,279	2,173,153	2,421,186	2,673,829
Municipal Demand Reduction Since Base Planning Year	59,331	63,656	52,990	56,904	60,856	63,958
Recommended Municipal Water Conservation	34,732	63,273	81,510	97,106	112,412	128,447
Current Municipal Reuse	337,067	361,209	378,854	391,173	403,239	411,487
Recommended Municipal Reuse	50,112	174,827	228,928	373,225	438,596	485,054
Municipal Per Capita Use (Gallons per Capita per Day)						
No Additional Conservation or Reuse	186	185	185	183	181	178
With Full Implementation of Low Flow Fixtures	177	173	170	168	166	163
With Demand Reduction from Measures Implemented Since Base Planning Year	170	167	166	164	161	159
With Recommended Conservation	166	160	159	156	154	151
With Recommended Reuse	121	106	105	97	96	96
Normal-Year Use (Assumed Dry-Year Use 12 Percent Higher)	108	95	94	87	86	86

5B.6.2 Municipal Per Capita Goals

House Bill 807 was passed by the 86th Texas Legislature and signed by the Governor on June 10, 2019 and became effective immediately, meaning that the requirements of the Bill would apply to the current round of planning and must be included in the 2021 Regional Water Plans. The Bill amended Section 16.053 of the Texas Water Code to include, among others, the requirement that RWPGs "set one or more specific goals for gallons of water use per capita per day in each decade of the period covered by the plan for the municipal water user groups in the RWPA." (TWC §16.053(e)(11)).

TWDB provided the following guidance regarding this requirement. "TWDB will provide a list of municipal WUGs as well as supporting information. GPCD goals may be a specific GPCD, or ranges of GPCD; may be based on specific municipal WUGs, or groupings of municipal WUGs as determined appropriate by the RWPG. To be included in Subchapter 5B of the RWP."

GPCD Goal = *(Projected Water Demand minus Demand Reduction Since the Base Planning Year minus Recommended Water Conservation) divided by WUG population*

This is analogous to the "With Recommended Conservation" line in **Table 5B.10** for Region C as a whole. The GPCD goal by decade for each municipal WUG is provided in **Appendix I**.

5B.7 Water Conservation Plans and Reporting Requirements

The TCEQ requires water conservation plans for the following entities [15]:

- All municipal, industrial, and other non-irrigation water users with surface water rights of 1,000 acre-feet per year or more,
- All irrigation water users with surface water rights of 10,000 acre-feet per year or more, and
- All retail public water suppliers providing water service to 3,300 connections or more.

Water conservation plans are also required for all water users applying for a new or amended state water right and for entities seeking state funding of more than $500,000 for water supply projects. Updated water conservation plans were required to be submitted to the TCEQ and/or the TWDB by May 1, 2019 [15].

Table 5B.11 lists estimated Region C entities that are required by TCEQ to develop a water conservation plan based on having 3,300 or more retail water connections, irrigation water rights of 10,000 acre-feet per year or more, and/or non-irrigation water rights of 1,000 acre-feet per year or more. Connections for each WUG were identified from the population projections with an assumption of 3 people per connection, and applicable water rights were identified from TCEQ's Water Rights Database [16]. **Table 5B.11** may not include Region C entities required to develop water conservation plans based on a water right application or a state funding application.

5B.7.1 Municipal Water Conservation Plan Requirements

The TCEQ requires the following content in a municipal water conservation plan:

- Utility profile
- Record management system
- Specific, quantified five-year and ten-year targets for water savings
- Accurate metering
- Universal metering
- Determination and control of water loss
- Public education and information program
- Non-promotional water rate structure
- Reservoir system operation plan
- Means of implementation and enforcement
- Coordination with regional water planning group.
- Implementation report detailing progress toward implementing the water conservation plan and whether water savings targets are being met.

In addition, the TCEQ requires additional minimum content for municipal entities that are projected to supply 5,000 people or more in the following 10 years:

- Leak detection, repair, and water loss accounting
- Requirement for water conservation plans by wholesale customers.

The TCEQ also suggests optional content for municipal water conservation plans:

- Conservation-oriented water rates
- Ordinances, plumbing codes, or rules about water-conserving fixtures
- Programs for the replacement or retrofit of water-conserving plumbing fixtures in existing structures
- Reuse and recycling of wastewater and/or graywater
- Pressure control and/or reduction
- Landscape water management ordinance or program
- Method for monitoring the effectiveness and efficiency of the water conservation plan
- Other conservation methods
- Review and update of the plan

In addition, the TCEQ requires additional minimum content for municipal entities that are projected to supply 5,000 people or more in the following 10 years:

- Leak detection, repair, and water loss accounting
- Requirement for water conservation plans by wholesale customers.

The TCEQ also suggests optional content for municipal water conservation plans:

- Conservation-oriented water rates
- Ordinances, plumbing codes, or rules about water-conserving fixtures
- Programs for the replacement or retrofit of water-conserving plumbing fixtures in existing structures
- Reuse and recycling of wastewater and/or graywater
- Pressure control and/or reduction
- Landscape water management ordinance or program
- Method for monitoring the effectiveness and efficiency of the water conservation plan
- Other conservation methods
- Review and update of the plan

Table 5B.11 Region C Water Users Required to Develop Water Conservation Plans

Addison	Allen	Anna
Arcosa LWS, LLC	Arlington	Athens
Athens MWA	Azle	Balch Springs
Beall Concrete Enterprises, Ltd.	Bedford	Benbrook Water Authority
Bethesda WSC	Big Brown Power Company LLC	Bolivar WSC
Bonham	Boyd	Burleson
Carrollton	Cedar Hill	Celina
Colleyville	Community WSC	Coppell
Corinth	Corsicana	Crowley
CSR Golf Group, Inc.	Dallas	Dallas County Park Cities MUD
Dallas County Utility & Reclamation District	Denison	Denton
Denton County FWSD 1-A	Denton County FWSD 7	Desoto
Duncanville	East Cedar Creek FWSD	East Fork SUD
Ellis County WCID 1	Ennis	Euless
ExGen Handley Power, LLC	Fairview	Farmers Branch
Fate	Flower Mound	Forest Hill
Forney	Fort Worth	Frisco
Gainesville	Garland	Glenn Heights
Grand Prairie	Grapevine	Greater Texoma Utility Authority
Haltom City	Hanson Aggregates, Inc.	Heath
Highland Village	Honey Grove	Hurst
Irving	Jacksboro	J-M Manufacturing, Inc.
Justin	Keller	Ladonia
Lafarge North America Inc.	Lake Cities MUA	Lancaster
Lewisville	Little Elm	Luminant Generation LLC
Mabank	Mansfield	McKinney
Melissa	Mesquite	Midlothian
Mineral Wells	Mountain Creek Power, LLC	Murphy
Mustang SUD	North Richland Hills	North Texas Municipal Water District
Plano	Princeton	Prosper
Red River Authority of Texas	Richardson	River Oaks
Rockett SUD	Rockwall	Rowlett
Royse City	Sachse	Saginaw
Sardis Lone Elm WSC	Seagoville	Sherman
Southlake	Tarrant Regional Water District	Terrell
The Colony	Trinidad	Trinity River Authority of Texas
Trophy Club MUD 1	University Park	Upper Trinity Regional Water District
Walnut Creek SUD	Watauga	Waxahachie
Weatherford	West Cedar Creek MUD	White Settlement
Wise County WSD	Wylie	

[a]The table shows Region C entities with 3,300 or more retail water connections, irrigation water rights of 10,000 acre-feet per year or more, and/or non-irrigation water rights of 1,000 acre-feet per year or more. It may not include Region C entities required to develop water conservation plans based on a water right application or a state funding application.

5B.7.2 Irrigation Water Conservation Plan Requirements

The TCEQ requires the following minimum content in an irrigation water conservation plan:

- Description of the irrigation production process
- Description of the irrigation method or system and equipment
- Accurate metering
- Specific, quantified five-year and ten-year targets for water savings
- Description of water-conserving irrigation equipment and application system
- Leak detection, repair, and water-loss control
- Irrigation timing and/or measuring the amount of water applied
- Land improvements for retaining or reducing runoff and increasing the infiltration of rain and irrigation water
- Tailwater recovery and reuse
- Other conservation practices, methods, or techniques.
- Review and update of the plan.
- Implementation report detailing progress toward implementing the water conservation plan and whether water savings targets are being met.

5B.7.3 Manufacturing and Steam Electric Power Water Conservation Plan Requirements

The TCEQ requires the following minimum content in manufacturing or steam electric power water conservation plans:

- Description of water use in the production process
- Specific, quantified five-year and ten-year targets for water savings
- Accurate metering
- Leak detection, repair, and water-loss accounting
- Water use efficiency process and/or equipment upgrades
- Other conservation practices
- Review and update of plan.
- Implementation report detailing progress toward implementing the water conservation plan and whether water savings targets are being met.

5B.7.4 Model Water Conservation Plans

Model water conservation plans for Region C have been developed for four different water user types: municipal, irrigation, manufacturing, and steam electric power.

The model water conservation plans are available online at regioncwater.org.

The model plans are designed to show the content required by the TCEQ, optional content suggested by the TCEQ, and optional content suggested by the Region C Water Planning Group (e.g., potentially feasible water conservation strategies).

The model plans are intended to be a template that Region C water user groups can use as a starting point and customize to develop their own situation-specific water conservation plans.

5B.7.5 Other Water Conservation Reporting Requirements

Each entity that is required to submit a water conservation plan to the TWDB or the TCEQ must file a report by May 1 each year on the entity's progress in implementing its water conservation plan. These reports document system information, water use accounting, water conservation programs and activities data, leak detection and water loss, program effectiveness, and drought plan implementation.

Retail public utilities that supply potable water to more than 3,300 connections or receive financial assistance from the TWDB must file a system water loss audit with the TWDB by May 1 each year. Other retail public utilities that supply potable water must file a system water loss audit with the TWDB every five years (the next due date is May 1, 2021) (17).

Water use surveys: Each year, the TWDB surveys persons and/or entities using groundwater and surface water for municipal, industrial, power generation, or mining purposes to gather data to be used for long-term water supply planning. Entities that receive a water use survey are required to respond within 60 days. (17)

Other Conservation Reporting

- Annual Reports
- Water Loss Audits
- Water Use Surveys

5B.8 Evaluation of Water Conservation Planning Requirements

TWDB regional water planning rules (2) require consideration of water conservation for various water user groups. **Table 5B.12** shows each requirement and documents that the requirements have been fulfilled.

Table 5B.12 Evaluation of Water Conservation Planning Requirements

Requirement	Evaluation	Fulfilled?
Conservation measures shall be considered by RWPGs when developing the regional plans, particularly during the process of identifying, evaluating, and recommending water management strategies. RWPs shall incorporate water conservation planning in the regional water planning area. [31 TAC 357.34(g)]	Water conservation practices were considered for each water user group. Existing water conservation plans and other water conservation planning information were considered during development of the Water Conservation Package for municipal water suppliers, as described in Section 5B.7.	Yes
RWPGs must consider water conservation practices, including potentially applicable best management practices, for each identified water need. [31 TAC 357.34(g)(2)]	Water conservation practices, including potentially applicable best management practices, were considered for each identified water need, as described in Section 5B.7.	Yes
RWPGs shall include water conservation practices for each user group to which Texas Water Code §11.1271 and §13.146 (relating to Water Conservation Plans) apply. The impact of these water conservation practices on water needs must be consistent with requirements in appropriate Commission administrative rules related to Texas Water Code §11.1271 and §13.146. [31 TAC 357.34(g)(2)(A)]	The Water Conservation Package was recommended for each municipal WUG, as described in Section 5B.7. In addition, it is recommended that municipal WUGs offer rebates for water conservation by irrigation WUGs. The impact of these recommendations is consistent with the water conservation plan requirements.	Yes
RWPGs shall consider water conservation practices for each WUG beyond the minimum requirements of subparagraph (A) of this paragraph, whether or not the WUG is subject to Texas Water Code §11.1271 and §13.146. If RWPGs do not adopt a water conservation strategy to meet an identified need, they shall document the reason in the RWP. [31 TAC 357.34(g)(2)(B)]	As described in Section 5B.7, water conservation practices were considered for each water user group. Where water conservation measures have not been recommended, the reason is one or more of the following conditions: There is no identified water need. Total demand is 140 gpcd or less. The measure has already been implemented. The measure is not applicable to the WUG. There is not an identified sponsor that will implement the water conservation measure.	Yes
For each WUG or WWP that is to obtain water from a proposed interbasin transfer to which Texas Water Code §11.085 (relating to Interbasin Transfers) applies, RWPGs will include a water conservation strategy, pursuant to Texas Water Code §11.085(1), that will result in the highest practicable level of water conservation and efficiency achievable. For these strategies, RWPGs shall determine and report projected water use savings in gallons per capita per day based on its determination of the highest practicable level of water conservation and efficiency achievable. RWPGs shall develop conservation strategies based	Water conservation strategies were included for each WUG or WWP that is to obtain water from a proposed interbasin transfer to which Texas Water Code §11.085 applies. Recommended water conservation strategies were developed based on review of water conservation plans, analysis of existing conservation practices in the region, and best management practices. The	Yes

Requirement	Evaluation	Fulfilled?
on this determination. In preparing this evaluation, RWPGs shall seek the input of WUGs and WWPs as to what is the highest practicable level of conservation and efficiency achievable, in their opinion, and take that input into consideration. RWPGs shall develop water conservation strategies consistent with guidance provided by the Commission in its administrative rules that implement Texas Water Code §11.085. When developing water conservation strategies, the RWPGs must consider potentially applicable best management practices. Strategy evaluation in accordance with this section shall include a quantitative description of the quantity, cost, and reliability of the water estimated to be conserved under the highest practicable level of water conservation and efficiency achievable. [31 TAC 357.34(g)(2)(C)]	recommendations reflect practices that are practicable for implementation in Region C, projected to provide long-term water savings, and projected to provide a reasonable quantity of water savings at a reasonable cost for a wide range of water user groups. Descriptions of the quantity, cost, and reliability of the projected water savings are presented in Section 5B.5 and Appendix I.	
RWPGs shall consider strategies to address any issues identified in the information compiled by the Board from the water loss audits performed by retail public utilities pursuant to §358.6 of this title (relating to Water Loss Audits). [31 TAC 357.34(g)(2)(D)]	An enhanced water loss control program is part of the Water Conservation Package recommended for each municipal WUG.	Yes
RWPs shall include a subchapter consolidating the RWPG's recommendations regarding water conservation. RWPGs shall include in the RWPs model water conservation plans pursuant to Texas Water Code §11.1271. [31 TAC 357.34(h)]	The RWPG recommendations on water conservation are consolidated in Chapter 5B. Model water conservation plans for municipal, manufacturing, irrigation, and steam electric power WUGs are presented online at http://www.regioncwater.org/Documents/Model_Drought_Plan.pdf.	Yes
RWPGs shall perform a secondary water needs analysis for all WUGs and WWPs for which conservation water management strategies or direct reuse water management strategies are recommended. This secondary water needs analysis shall calculate the water needs that would remain after assuming all recommended conservation and direct reuse water management strategies are fully implemented. The resulting secondary water needs volumes shall be presented in the RWP by WUG and MWP and decade. [31 TAC 357.33(e)]	The secondary water needs analysis is presented in Section 4.5.	Yes
RWPGs shall describe the level of implementation of previously recommended water management strategies and associated impediments to implementation in accordance with guidance provided by the board. Information on the progress of implementation of all water management strategies that were recommended in the previous RWP, including conservation and drought management water management strategies; and the implementation of projects that have affected progress in meeting the state's future water needs. [31 TAC 357.45(a)]	The level of implementation of previously recommended water conservation strategies in Region C is summarized in Tables 5B.6 and 5B.7.	Yes
The Board shall consider approval of an RWP that includes unmet municipal Water Needs provided that the RWPG includes adequate justification, including	No unmet municipal water needs in Region C	Not applicable

Requirement	Evaluation	Fulfilled?
that the RWP documents that the RWPG considered all potentially feasible WMSs, including Drought Management WMSs and contains an explanation why additional conservation and/or Drought Management WMSs were not recommended to address the need. [31 TAC 357.50(j)(1)]		

5B.9 **Chapter 5B List of References**

(1) Freese and Nichols, Inc., Alan Plummer Associates, Inc., CP&Y, Inc., and Cooksey Communications, Inc: *2016 Region C Water Plan*, prepared for the Region C Water Planning Group, Fort Worth, December 2015.

(2) Texas Administrative Code Title 31, Part 10, Chapter 357, [Online], Available URL: http://texreg.sos.state.tx.us/public/readtac$ext.ViewTAC?tac_view=4&ti=31&pt=10&ch=357&rl=Y, accessed August 2019.

(3) Texas Water Development Board: "Water Conservation Best Management Practices,", [Online], Available URL: www.twdb.texas.gov/conservation/bmps/index.asp, accessed August 2019.

(4) Water Conservation Advisory Committee: *Progress Made in Water Conservation in Texas, Report and Recommendations to the 86th Texas Legislature*, Austin, [Online] Available URL: http://www.savetexaswater.org/resources/doc/2018_WCAC_Lege_Report.pdf, December 1, 2018.

(5) Texas Water Development Board: *Water Use of Texas Water Utilities*, prepared for the 86th Texas Legislature, Austin, [Online], Available URL: http://www.twdb.texas.gov/publications/reports/special_legislative_reports/doc/Water-Use-of-Texas-Water-Utilities-86th-Legislative.pdf?d=1564158420138, January 1, 2019.

(6) Alliance for Water Efficiency, M.Cubed, Freese and Nichols, Inc., Texas State University, and Watearth, Inc.: *Municipal Water Conservation Planning Tool*, prepared for the Texas Water Development Board, [Online], Available URL: http://www.twdb.texas.gov/conservation/municipal/plans/doc/TWDB_MWCPT_v1.xlsm, accessed August 2019.

(7) Averitt & Associates, Inc.: *Statewide Water Conservation Quantification Project*, prepared for the Texas Water Development Board, Austin, [Online], Available URL: http://www.twdb.texas.gov/publications/reports/contracted_reports/doc/1600012030_Water%20Conservation.pdf, August 2017.

(8) Alan Plummer Associates, Inc. et al: *Direct Potable Reuse Resource Document Final Report*, prepared for the Texas Water Development Board, Austin, [Online], Available URLs: http://www.twdb.texas.gov/publications/reports/contracted_reports/doc/1248321508_Vol1.pdf and

http://www.twdb.texas.gov/publications/reports/contracted_reports/doc/1248321508_Vol2.pdf, April 2015.

(9) Lone Star Chapter Sierra Club and National Wildlife Federation: *Water Conservation by the Yard*, Austin, [Online], Available URL: https://texaslivingwaters.org/wp-content/uploads/2018/03/WCBTY-II_Final_031918.pdf?pdf=WCBTY-2018, March 2018.

(10) Texas Water Development Board: Water Use Survey Historical Summary Estimates by Region, [Online] Available URLs: http://www2.twdb.texas.gov/ReportServerExt/Pages/ReportViewer.aspx?%2fWU%2fSumFinal_RegionReport&rs:Command=Render and http://www2.twdb.texas.gov/ReportServerExt/Pages/ReportViewer.aspx?%2fWU%2fSumFinal_RegionReportWithReuse&rs:Command=Render.

(11) Texas Water Development Board and Texas Commission on Environmental Quality in consultation with Water Conservation Advisory Council: *Guidance and Methodology for Reporting on Water Conservation and Water Use*. [Online] Available URL: http://www.twdb.texas.gov/conservation/doc/SB181Guidance.pdf, December 2012.

(12) Texas Water Development Board: 2017 Water Loss Audit Data by Region, Austin, [Online] Available URL: https://www.twdb.texas.gov/waterplanning/rwp/planningdocu/2021/doc/current_docs/project_docs/conservation/2017_WLA_Data_Region_20180918.xlsx, accessed August 2019.

(13) Mathis, M., Kunkel, G., and Chastain Howley, A.: Water Loss Audit Manual for Texas Utilities, Report 367, prepared for the Texas Water Development Board, Austin, March 2008.

(14) Texas Water Development Board and Water Conservation Implementation Task Force: *Special Report, Report to the 79th Legislature*, Austin, [Online] Available URL: http://savetexaswater.org/resources/doc/WCITF_Report_2004.pdf, November 2004.

(15) Texas Administrative Code, Title 30, Part 1, Chapter 288, [Online], Available URL: https://texreg.sos.state.tx.us/public/readtac$ext.ViewTAC?tac_view=4&ti=30&pt=1&ch=288, effective August 16, 2018.

(16) Texas Commission on Environmental Quality, Water Rights Data File, [Online], Available URL: https://www.tceq.texas.gov/assets/public/permitting/watersupply/water_rights/applications/wractive.xlsx, accessed August 2019.

(17) Texas Administrative Code Title 31, Part 10, Chapter 358, [Online], Available URL: https://texreg.sos.state.tx.us/public/readtac$ext.ViewTAC?tac_view=4&ti=31&pt=10&ch=358, effective February 14, 2018.

5C Evaluation of Major Water Management Strategies

The total water needs for Region C increase to almost 1.3 million acre-feet by 2070. To meet these large needs, the region has identified a diverse list of potential water management strategies.

Each of these strategies is described in detail and evaluated further in **Appendix G** with detailed costs included in **Appendix H**.

This chapter of the report summarizes the major potentially feasible water management strategies. Major strategies are those that would supply a substantial amount of water, typically around 30,000 acre-feet per year or more. These major water management strategies are generally sponsored by the Region C major and regional wholesale water providers and account for most of the new water supplies. Region C has identified seven new major reservoirs of which six are designated as unique reservoir sites or are recommended for designation.

Chapter Outline

Section 5C.1 – New Surface Water

Section 5C.2 – Connection of Existing Supplies

Section 5C.3 – New Groundwater

Section 5C.4 – Reuse Strategies

Section 5C.5 – Desalination

Section 5C.6 – Aquifer Storage and Recovery

Section 5C.7 – Summary of Recommended Major Water Management Strategies

Related Appendices

Appendix F – Potentially Feasible Water Management Strategies

Appendix G – Water Management Strategy Evaluations

Appendix H – Cost Estimates

Appendix J - Updated Quantitative Marvin Nichols Analysis

5C.1 New Surface Water

Region C has identified multiple new surface water strategies for potential future supplies, including seven new major reservoirs, two river diversions with off-channel storage, and reallocation of flood storage in Wright Patman Reservoir. The new reservoirs include Bois d'Arc Lake in the Red River Basin, four potential reservoir sites in the Sulphur River Basin, Lake Tehuacana in the Trinity River Basin, and Lake Columbia in the Neches River Basin. Each of these sites have been previously studied by Region C and six are designated as unique reservoir sites or are recommended for designation.

5C.1.1 Bois d'Arc Lake

Bois d'Arc Lake, formerly known as Lower Bois d'Arc Creek Reservoir, was a recommended strategy for the North Texas Municipal Water District (NTMWD) in the past four Region C Water Plans.

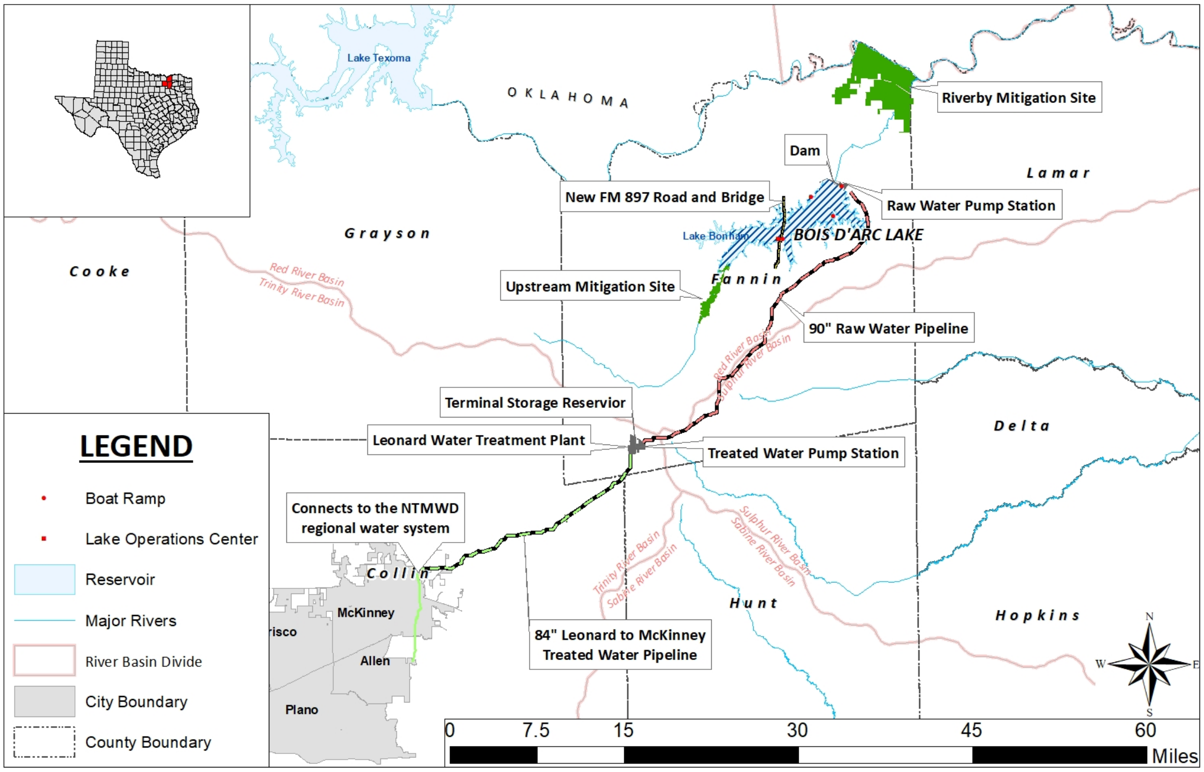
The project is located in Region C on Bois d'Arc Creek in Fannin County, northeast of the City of Bonham. At the conservation pool elevation of 534 feet MSL, the lake will have a surface area of 16,641 acres and a storage capacity of 367,609 acre-feet.

This project is currently under construction and includes the dam and lake, raw water intake, a 35-mile transmission pipeline to the Leonard Water Plant (also currently under construction), and approximately 19,000 acres of mitigation. Mitigation construction has also begun. Impoundment of water is expected to begin in 2021 with initial operation beginning in 2022.

Bois d'Arc Lake will provide NTMWD with 120,200 acre-feet per year of firm supply. It also provides a new fresh water source that NTMWD intends to use to blend with its existing Lake Texoma supplies.

The Bois d'Arc Lake project is a recommended strategy for NTMWD and has an associated capital cost of over $939 million. Water from Bois d'Arc Lake will be used as part of NTMWD's system and will meet the needs of NTMWD customers.

Additional details for this strategy can be found in the corresponding technical memorandum in **Appendix G**.



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5C.1.2 Dredging or Reallocation

While increasing the capacities of existing lakes does not qualify as a major strategy (> 30,000 acre-feet per year of supply), this concept has been raised by the public as an alternative to new reservoir development. Region C evaluated the potential for increased water supply and associated costs to increase the storage capacities at 4 lakes in the greater Metroplex area through dredging or reallocation of flood storage for water supply. The quantity of reliable supply gained through dredging to the permitted conservation storage ranged from 1,700 to 3,360 acre-feet per year for the lakes evaluated. Consideration of reallocation provided new supplies of only 7,200 acre-feet per year due to the lack of unappropriated water in the Trinity River Basin. The costs for these strategies averaged $143.64 per 1,000 gallons of supply for dredging, and no costs were developed for the reallocation. Reallocation was considered not potentially feasible due to the permitting obstacles and uncertainty of impacts on flooding.

Dredging a large major reservoir is a massive technical and financial undertaking with only small gains in water supply. While reallocating water to water supply at area lakes does not provide reliable water of the quantity needed for the Metroplex, it also potentially places an increasingly urban area at risk for flooding. Dredging and reallocation are not recommended or alternative strategies for Region C. Additional details for these strategies can be found in the corresponding technical memorandum in **Appendix G.**

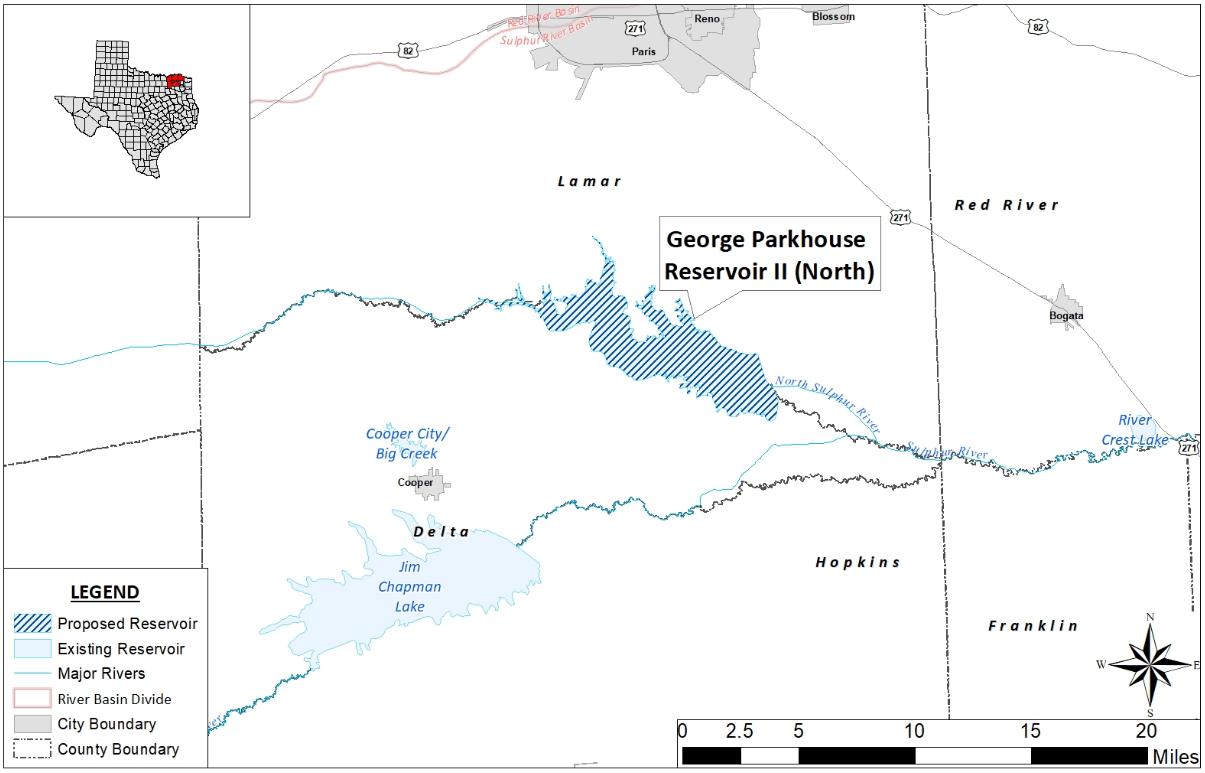
5C.1.3 George Parkhouse Reservoir (North)

George Parkhouse Reservoir (North), also known as Parkhouse II, is a potential reservoir located on the North Sulphur River in Lamar and Delta Counties, about 15 miles southeast of the City of Paris. This reservoir site was originally proposed as the second phase of the larger George Parkhouse Reservoir, also known as Sulphur Bluff Reservoir. At a proposed conservation elevation of 410.0 feet MSL, the reservoir would store approximately 331,000 acre-feet of water and inundate 14,400 acres. It is assumed that the project will either be pursued solely by NTMWD or as a joint strategy with UTRWD.

The firm yield of George Parkhouse (North) with Consensus Criteria Environmental Flow Needs instream releases is estimated to be 106,500 acre-feet per year. As adopted for Marvin Nichols, it is assumed that the total amount of supply assumed available to Region C users is approximately 80 percent of the project yield and 20 percent would remain within Region D for local use; however, the amount to remain for local use would likely be determined at the time of development. This yield considers new drought of record conditions in the Sulphur River Basin and assumes senior priority over other potential future Sulphur Basin projects (excluding Lake Ralph Hall). If other proposed projects in the Sulphur River Basin are permitted as senior to George Parkhouse (North), this could have a significant impact to the quantity of available supply. Previous studies have shown that the reduction in yield could be more than 70 percent [1].

Facilities included in this strategy include both the proposed reservoir and the infrastructure needed to transport raw water to the Leonard Water Treatment Plant in Fannin County for NTMWD. For UTRWD, the transmission system delivers water to the Tom Harpool Water Treatment Plant and Lake Lewisville. Of the approximate 15,000 acres of impacted land at the reservoir site, there are less than 1,250 acres of wetlands and 2,000 acres of bottomland hardwoods.

This project has the potential to produce a reliable supply for Region C only if other potential reservoirs are not permitted senior to George Parkhouse (North). It is located near Lake Jim Chapman and Lake Ralph Hall, so it could be operated as a system with those sources. As a stand-alone strategy for NTMWD, there is an associated capital cost of $905.6 million. As a joint strategy between NTMWD and UTRWD, this is an associated capital cost of $613.6 million for NTMWD and $457 million for UTRWD. This is an alternative strategy for NTMWD and UTRWD. Additional details for this strategy can be found in the corresponding technical memorandum in **Appendix G**.



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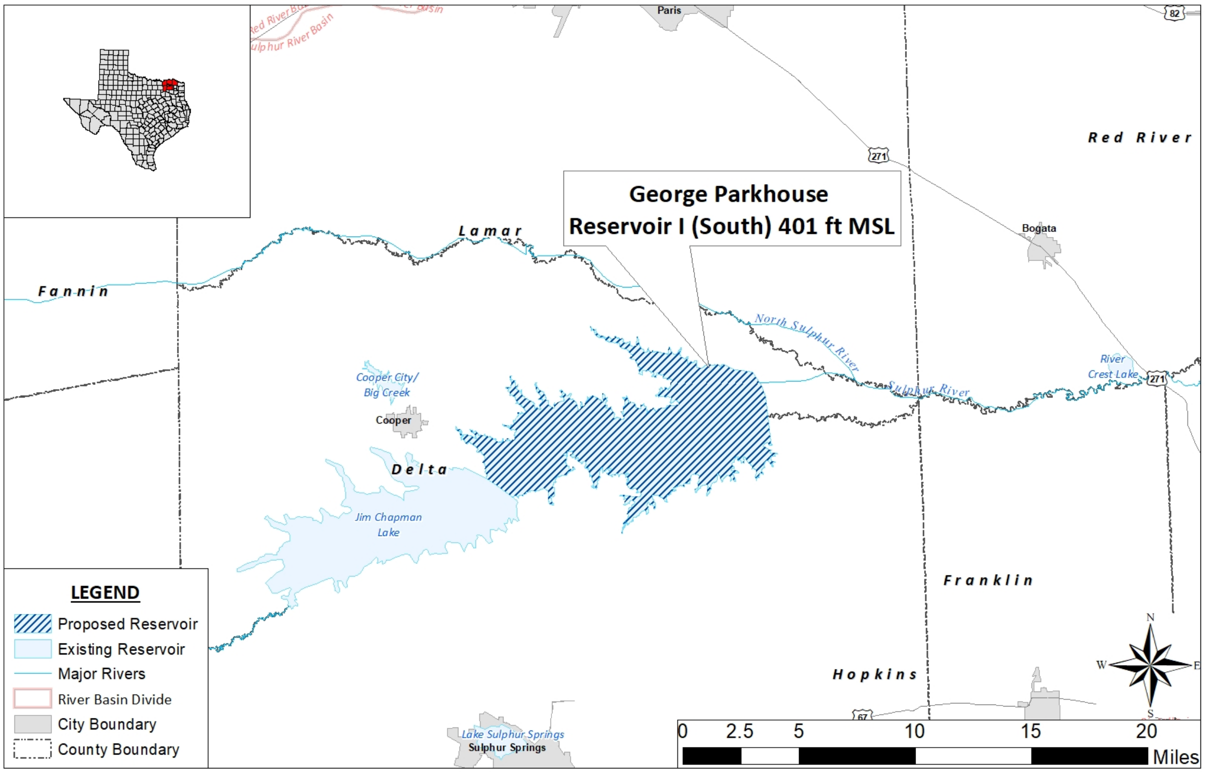
5C.1.4 George Parkhouse Lake (South)

George Parkhouse Lake (South) is a potential reservoir located in Region D on the South Sulphur River in Hopkins and Delta Counties. This reservoir site was originally proposed as the first phase of the larger George Parkhouse Reservoir, also known as Sulphur Bluff Reservoir. It is located downstream from Jim Chapman Lake and would yield 116,000 acre-feet per year (with 80 percent available for Region C). At conservation elevation 401 feet MSL, George Parkhouse Lake (South) would inundate approximately 29,000 acres and store 652,000 acre-feet. The yield of George Parkhouse (South) is contingent upon other water development in the Sulphur River Basin. If other downstream projects are permitted with a senior priority to George Parkhouse (South), then the yield would decrease. Previous studies have indicated the reduction in yield could be up to 60 percent of the stand-alone firm yield[2]. This would likely make this project not economically viable for Region C providers. This project could be developed in conjunction with George Parkhouse (North). The yield of the combined projects has not been assessed.

The lake, as currently configured, would abut the dam for Jim Chapman Lake and over fifty percent of the land impacted would be bottomland hardwood forest or marsh[1]. This reservoir site has over 10,000 acres of bottomland hardwood forest and potential wetlands (marsh and seasonally flooded shrubland). The impacts to these resources would require mitigation, which is included in the cost estimate.

This project is considered a potential strategy for NTMWD and UTRWD. It is assumed that the project will either be pursued solely by NTMWD or as a joint strategy with UTRWD. As a stand-alone strategy for NTMWD, there is an associated capital cost of $1.15 billion. As a joint strategy between NTMWD and UTRWD, this is an associated capital cost of $776 million for NTMWD and $535 million for UTRWD. This is an alternative strategy for NTMWD and UTRWD.

Additional details for this strategy can be found in the corresponding technical memorandum in **Appendix G.**



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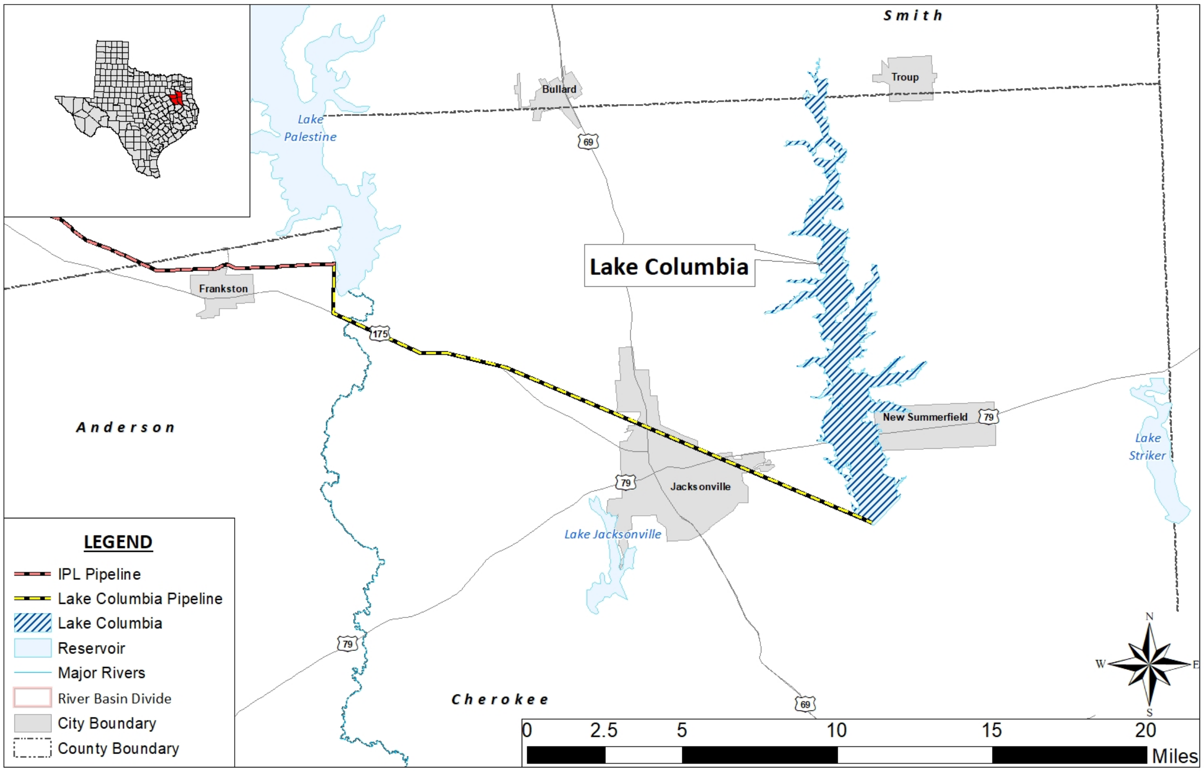
5C.1.5 Lake Columbia

Lake Columbia is a proposed new reservoir in the Neches River Basin on Mud Creek in Cherokee County in Region I. Angelina and Neches River Authority (ANRA) is the sponsor for the Lake Columbia project. ANRA has been granted a water right permit by the TCEQ to impound 195,500 acre-feet and to divert 85,507 acre-feet per year (76.3 MGD) for municipal and industrial purposes. Based on discussions between ANRA and DWU, Dallas would contract for supplies from ANRA and participate in the development of this project. The projected share of the proposed Lake Columbia project for DWU is 56,000 acre-feet per year. Lake Columbia would be connected to Dallas' western system via a pipeline from the reservoir to the IPL pump station at Lake Palestine. Supplies would then be transported to the Lake Joe Pool area via a new pipeline parallel to the IPL.

Currently, the Lake Columbia project is subject to completion of the NEPA process and issuance of a 404 permit from the USACE. If Dallas were to participate in the Lake Columbia project, the current water right permit would be amended for an interbasin transfer from the Neches to the Trinity basin.

Lake Columbia would provide a new water source near existing water resources for DWU. This makes it easier to operate and maintain as part of the overall DWU system. Dallas' share of the capital cost is estimated at $313 million. This strategy is recommended for DWU for implementation in 2070. This strategy is also recommended for other users located in Region I. Additional details for this strategy can be found in the corresponding technical memorandum in **Appendix G.**



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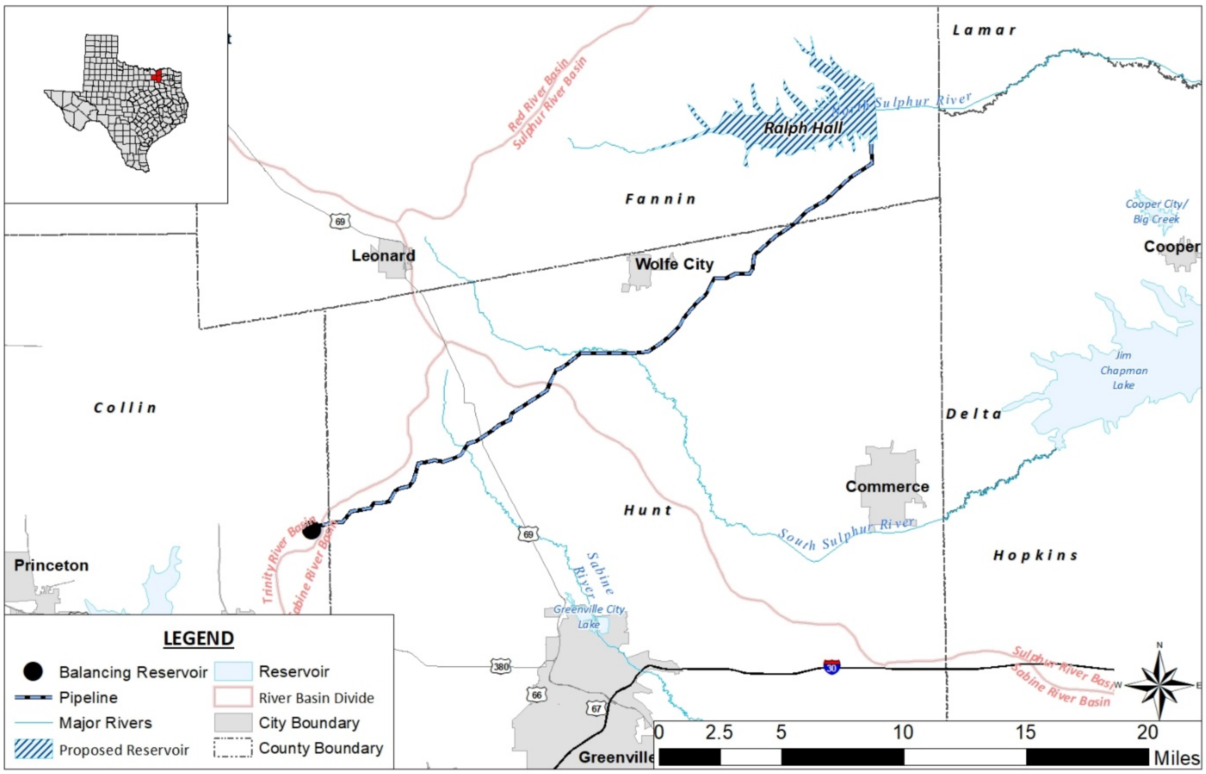
5C.1.6 Lake Ralph Hall and Reuse

Lake Ralph Hall is a proposed new reservoir on the North Fork of the Sulphur River in Fannin County in Region C. The lake would store 160,235 acre-feet of water and inundate 7,568 acres at the normal pool elevation of 551 feet MSL. This project is sponsored by the Upper Trinity Regional Water District (UTRWD), which has a water right permit to impound Lake Ralph Hall and divert 45,000 acre-feet per year. Of this amount, 39,220 acre-feet per year is firm supply.

UTRWD intends to reuse the water originating from Lake Ralph Hall. The source of reuse water will be various UTRWD WWTPs in the Lewisville Lake Basin, based on the percentage of effluent that originates from Lake Ralph Hall. This reuse will augment UTRWD's supply at no additional capital cost to UTRWD.

The strategy includes construction of the Lake Ralph Hall, a transmission pipeline from the reservoir to a new balancing reservoir, a lake intake pump station (intake is sized for full permitted amount), roadway and utility relocations, mitigation, reservoir and administration/support facilities and land acquisition of the reservoir site and transmission system easements. The Lake Ralph Hall Dam would be constructed across the valley of the North Fork Sulphur River near the City of Ladonia. The North Fork of the Sulphur River is a highly eroded channel that continues to erode during high flow events. Lake Ralph Hall Dam and Lake would slow down erosive flows, reduce continued degradation of the downstream channel, and provide storage for water supply.

Environmental considerations were analyzed as part of the Lake Ralph Hall Environmental Impact Statement. There are 8 acres of wetlands within the reservoir site. Most of the site consists of grasslands, pastures and cropland. A mitigation plan has been developed for this project, and it has been accepted by TCEQ for the water right and the USACE for the federal Section 404 permit. The project is expected to be constructed and supplying water by 2030. The development of the reuse supplies from Lake Ralph Hall source water will occur over time beginning as early as 2030. Capital costs to construct this project are estimated at $443 million. This is a recommended project for UTRWD. Additional details for this strategy can be found in the corresponding technical memorandum in **Appendix G**.



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5C.1.7 Marvin Nichols Reservoir

The Marvin Nichols Reservoir has been included in the previous four Region C Water Plans (2001, 2006, 2011, and 2016) and is being retained as a potentially feasible strategy for the 2021 Region C Water Plan. Marvin Nichols Reservoir is a potential reservoir located on the Sulphur River in Titus, Red River, and Franklin Counties, about 45 miles west of Texarkana. The reservoir, if constructed, would be approximately 100 miles from the Metroplex. This strategy has historically been pursued as a joint strategy by several Metroplex water providers.

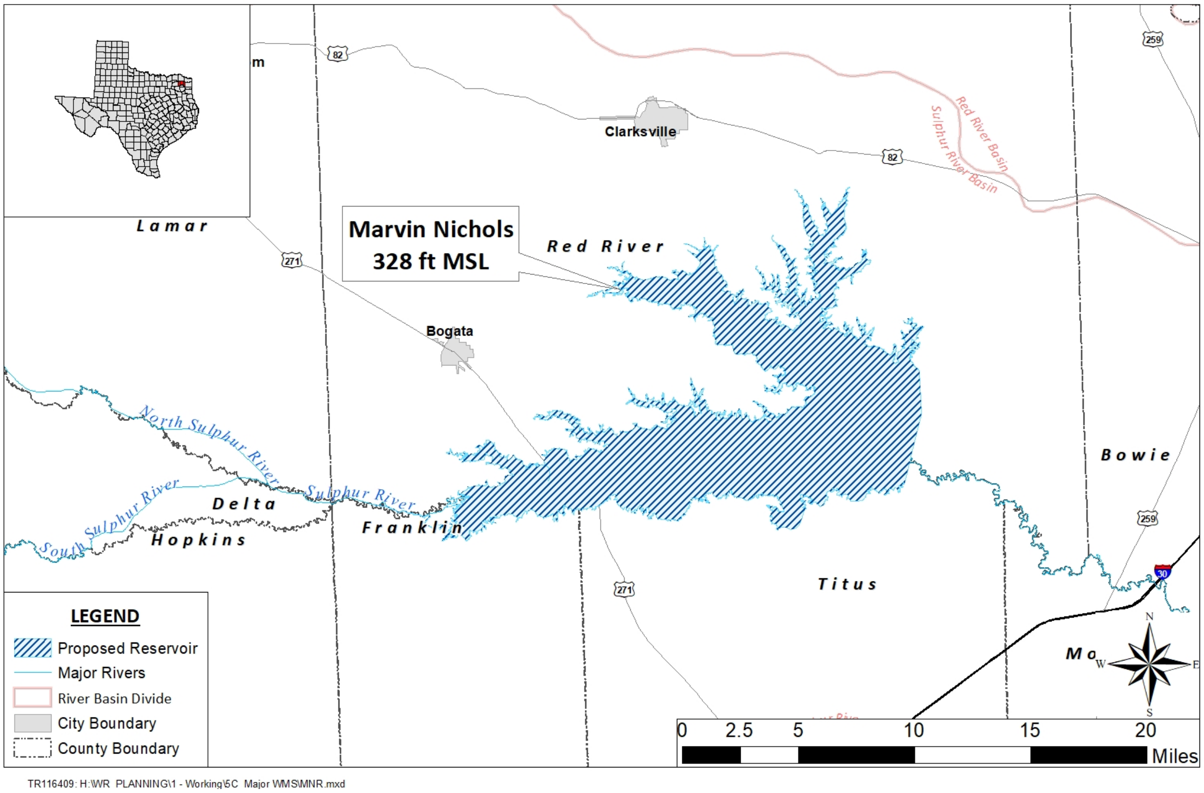
At a proposed conservation elevation of 328 feet MSL, the reservoir would store 1,532,000 acre-feet of water with a water surface area of 66,103 acres. A smaller version of this project with a conservation elevation of 313.5 feet MSL was also analyzed (see Technical Memorandum for Marvin Nichols Reservoir, 313.5 feet MSL, in **Appendix G**).

The firm yield of Marvin Nichols at 328 feet MSL is estimated to be 451,500 acre-feet per year. Of this amount, it is assumed that 361,200 acre-feet per year would be available to water providers in Region C, and the remaining 20 percent of the yield would remain in the Sulphur Basin for local use. This yield considers new drought of record conditions in the Sulphur River Basin and assumes senior priority over other potential future Sulphur Basin projects (excluding Lake Ralph Hall, which is already permitted). If other proposed projects in the Sulphur River Basin are permitted as senior to the Marvin Nichols Reservoir, this could have an impact on available supply.

Feasibility studies have been conducted for the Marvin Nichols Reservoir, but no detailed field studies or permit applications have been submitted. Environmental studies indicate there are approximately 24,000 acres of existing wetlands and 10,000 acres of bottomland hardwood forests within the reservoir footprint. Impacts to these resources and associated streams would be mitigated as part of the strategy implementation and are included in the cost. Capital costs to construct the Marvin Nichols Reservoir and deliver water to the sponsors are estimated at $4.4 billion. This equates to approximately $2.80/1,000 gallons of raw water during debt service and $0.73/1,000 gallons after debt service.

This strategy provides a reliable new source of fresh water supplies for Region C water providers at a reasonable cost. It is located near other existing water sources that could potentially be operated as a system. The challenges to this strategy are permitting and the current political opposition. Economic studies conducted as part of the Sulphur River Basin Feasibility Study show that the construction and operation of the reservoir would induce economic benefit to the local communities[(2)]. The construction of the reservoir would provide nearly $1.5 billion economic benefit over the 3-year construction period and $52 million annually during operation[(2)].

Appendix J of the *2021 Region C Water Plan* contains additional information on the quantitative evaluation of this strategy. This strategy is a recommended strategy for NTMWD, TRWD, and UTRWD. It is an alternative strategy for DWU and Irving. Additional details for this strategy can be found in the corresponding technical memorandum in **Appendix G**.



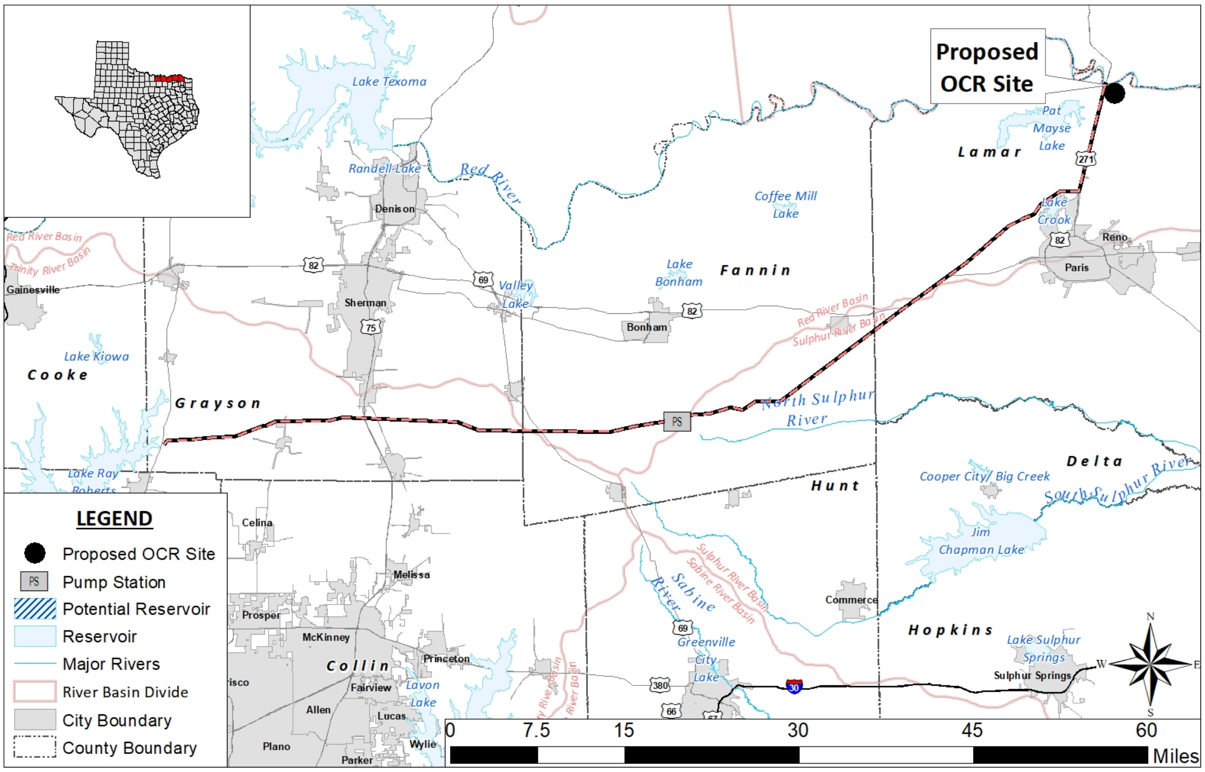
5C.1.8 Red River Off-Channel Reservoir

This strategy would develop new water supplies from the Red River, downstream of Lake Texoma. Dallas proposes to permit a portion of Texas' share of the flow in the Red River for diversion and impoundment in a series of off-channel reservoirs (OCR). The water would then be transported to Lake Ray Roberts for subsequent diversion and use.

This project includes an intake and pump station on the Red River at Arthur City, Texas, immediately downstream of the Highway 271 Bridge. Diversions from the Red River would be pumped approximately 2 miles to three off-channel reservoirs in series. The first OCR would consist of a 2,500-acre-foot basin for initial sediment settling and removal. The next OCR in the series would have a capacity of 5,300 acre-feet and would provide additional sediment removal and water quality improvement. The third and final OCR would consist of a 32,000-acre-foot storage basin to allow for extended pumping when the flow in the Red River is extremely low or water quality is impaired. Water would be diverted from the third OCR by an intake and pump station that would transport supplies via a transmission pipeline to Lake Ray Roberts for subsequent blending and use by Dallas. The total area of the reservoirs is 803 acres with a total capacity of 39,800 acre-feet. The reliable supply from the reservoir would be 114,000 acre-feet per year. Capital costs for this project are $937 million.

The Red River OCR project has the potential to provide DWU with significant new water supplies. Potential issues with this project include bank stability for the intake structure along the Red River, water quality, sediment control and invasive species. Other risks include permitting and potential future upstream diversions and impoundments. A significant portion of the available flow to the project originates in the Blue and Muddy Boggy River watershed in Oklahoma. If large reservoirs are constructed in these watersheds, the available flow could be reduced.

The Red River OCR project is an alternative strategy for DWU and UTRWD in the *Region C Regional Water Plan*. There is a possibility that BRA would also participate in the implementation of this strategy. More information on BRA's potential involvement is detailed in the *Region G Regional Water Plan*. Additional details for this strategy can be found in the corresponding technical memorandum in **Appendix G.**



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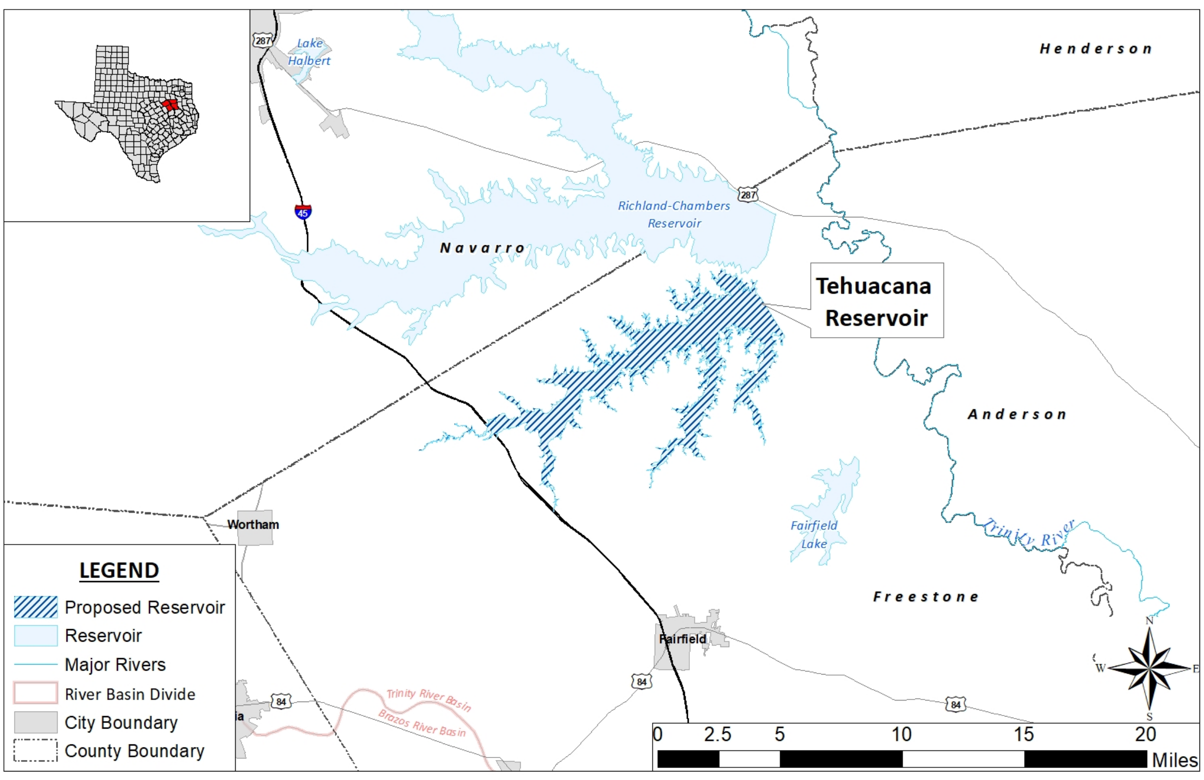
5C.1.9 Tehuacana Reservoir

Tehuacana Reservoir is a proposed reservoir on Tehuacana Creek within the Trinity River Basin in Freestone County in Region C. Tehuacana Creek is a tributary of the Trinity River and lies immediately south and adjacent to Richland Creek on which the existing Richland-Chambers Reservoir is located. Tehuacana Reservoir would connect to Richland-Chambers Reservoir by a 9,000-foot channel and be operated as an integrated extension of that reservoir. The project would have a firm yield of 25,400 acre-feet per year. The reservoir would store approximately 338,000 acre-feet and inundate approximately 15,000 acres. Supplies derived from Tehuacana would be transported from the expanded

reservoir utilizing existing and proposed TRWD transmission facilities.

Most of the reservoir site is classified as upland deciduous forest and grassland. Less than 3 percent is presently classified as marsh or open water. There are about 1,200 acres of bottomland hardwood forest that are concentrated near the dam site. Further, part of the Tehuacana Reservoir site is underlain by lignite.

Lake Tehuacana is a recommended strategy for TRWD and has an associated capital cost of $309 million. The reservoir would provide a new water source near existing water resources for TRWD, which makes it easier to operate and maintain as part of the TRWD East Texas Reservoir System. Additional details for this strategy can be found in the corresponding technical memorandum in **Appendix G.**



5C.1.10 Wright Patman Reallocation

This strategy is the reallocation of flood storage in Wright Patman Lake to elevation 235 feet MSL. The USACE selected an increase of Lake Wright Patman water supply pool to an elevation of 235.0 to be the Tentatively Selected Plan (TSP) in February 2019. This reallocation would provide an additional amount of approximately 200,000 acre-feet per year. The USACE-sponsored study evaluated a total of sixty combinations of alternative scales and locations of new surface water development in the Sulphur Basin.

Wright Patman Lake is an existing reservoir on the Sulphur River, about 150 miles from the Metroplex. It is owned and operated by the USACE. The City of Texarkana has contracted with the Corps of Engineers for storage in the lake and holds a Texas water right to use up to 180,000 acre-feet per year from the lake. Presently, the available supply from Wright Patman Lake is limited due to the USACE "Interim Rule" operating curve. The reallocation of flood storage along with changes in operation would result in the full water right of 180,000 acre-feet per year being available to Texarkana and 122,200 acre-feet per year available to Region C.

The higher conservation pool at Wright Patman Lake would inundate an additional 14,372 acres above the permitted conservation pool elevation (ultimate rule curve). This recommendation provides the desired quantity of water for Region C, while minimizing impacts to the White Oak Mitigation Area.

Reallocation at Wright Patman Lake on the scale envisioned in this strategy would require approval of the U.S. Congress. A new State water right and inter-basin transfer approval would be required from TCEQ.

This strategy provides a reliable new source of fresh water supplies for Region C water providers at a reasonable cost. It is located near other existing and proposed water sources that could potentially be operated as a system. The challenges to this strategy are permitting and the current political opposition. This is a recommended strategy for NTMWD, TRWD and UTRWD. It is an alternative strategy for DWU and Irving.

Additional details for this strategy can be found in the corresponding technical memorandum in **Appendix G**.

5C.2 Connection of Existing Supplies

There are several existing water sources in Region C and surrounding areas that can potentially provide water supplies to Region C. Some of these sources have been developed by or have existing contracts with Region C providers, and simply need infrastructure to move the water to these providers (such as Lake Palestine). Others require new contracts with the owner of the water source. Connection of existing supplies is an important part of the Region C water supply plan. There are seven major potentially feasible strategies that consider connections to existing supplies. Some of these strategies would be developed by a single water provider, while others would be developed jointly.

5C.2.1 Cypress Basin Supplies (Lake O' the Pines)

Lake O' the Pines is an existing Corps of Engineers reservoir, about 120 miles from the Metroplex, with Texas water rights held by the Northeast Texas Municipal Water District (NETMWD). The lake is on Cypress Creek in the Cypress Basin in Senate Bill One water planning Region D, the North East Texas Region. Some Metroplex water suppliers have explored the possibility of purchasing supplies in excess of local needs from the Cypress Basin for use in the Metroplex. However, based on the most recent information available from Region D, there is no available water from the Lake O' the Pines Reservoir(3). This information on availability is based on contracted amounts rather than projected use. The strategy is therefore maintained as a potentially feasible strategy, as water could potentially be purchased by Region C water providers. For planning purpose, the strategy is evaluated for 50,000 acre-feet per year.

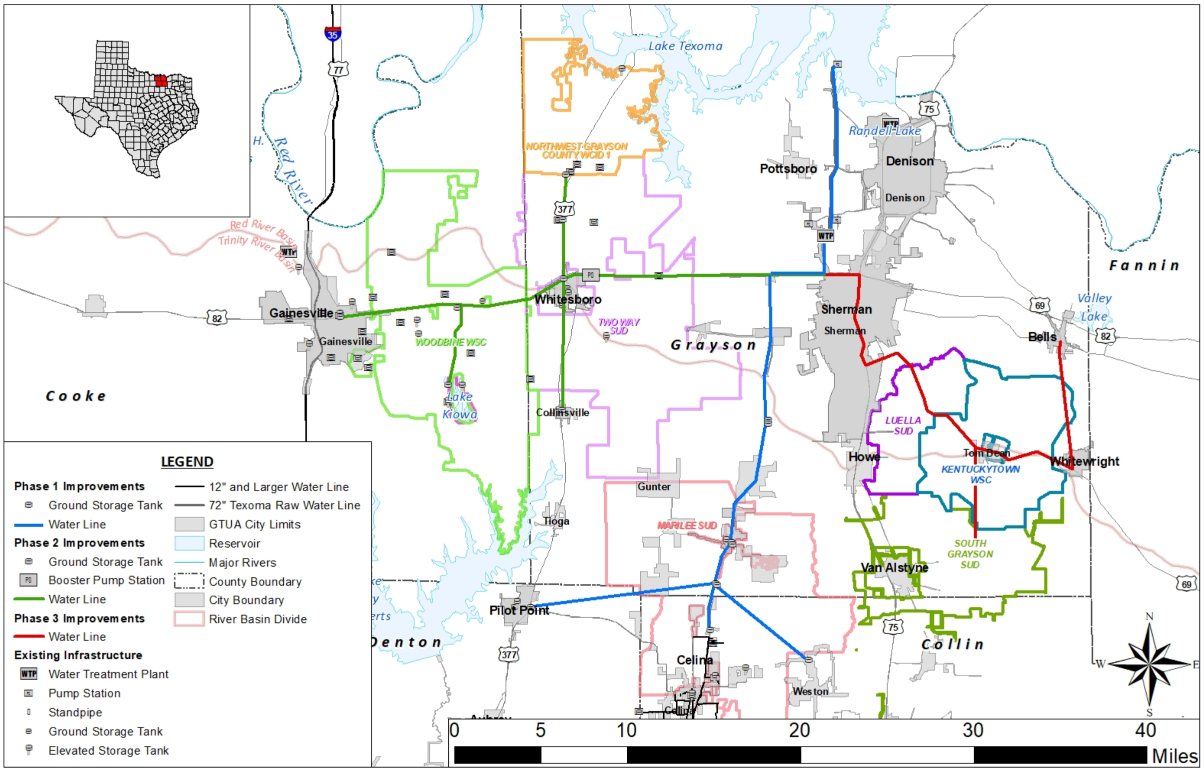
The Cypress Basin Supplies (Lake O' the Pines) strategy was evaluated for NTWMD and customers. This is an alternative strategy for NTMWD. Additional details for this strategy can be found in **Appendix G.**

5C.2.2 GTUA Regional System with Treatment Expansion at Sherman

A regional water system strategy was developed for communities in northern Collin, Cooke, northern Denton and Grayson counties. Several of the entities in this area hold water rights in Lake Texoma but currently do not have access to this resource. The amount of water available from this strategy is 33,106 acre-feet per year to be developed in two phases. This strategy focuses on treating and connecting these entities to Lake Texoma supplies. The Lake Texoma supplies would be transported to and then treated at the site of the existing Sherman Water Treatment Plant. Due to the higher level of TDS of the supplies from Lake Texoma, advanced treatment is necessary to achieve drinking water level standards.

For siting of physical transmission infrastructure, delivery points are located at existing water system infrastructure where possible and transmission pipelines generally follow existing highways or county roads to minimize right-of-way impacts. This strategy includes expansion at Sherman Desalination Plant, expansion of the existing Lake Texoma Intake Pump Station, a new transmission line providing additional capacity between the intake pump station and the water treatment plant, and other transmission infrastructure such as pipeline and booster pump stations.

Since the reservoir is existing, these strategies provide a reliable source of additional supplies with limited impacts. This strategy would utilize water that is already developed and permitted, and it will enable several of the participating entities to begin using water that has been contracted. However, this strategy would provide water that is more expensive than current supplies. Unit costs of water range from $6.82 during debt service to $3.96 after debt service for Phase I and $5.07 during debt service to $3.73 after debt service for Phase II. The strategy is costly mainly because of the advanced treatment required and the length of transmission pipeline required to connect the treated supplies to the end-users. Due to the transmission distance and relatively small quantities of water for each entity, this strategy would be best developed as a regional concept. To make the regional system effective, it requires commitment from the participants and a sponsor for the operation, maintenance, and administration of the system. For purposes of this study, it is assumed that GTUA will be the sponsor, and this is a recommended strategy for GTUA by the Region C Regional Water Planning Group. Additional details for this strategy can be found in the corresponding technical memorandum in **Appendix G.**



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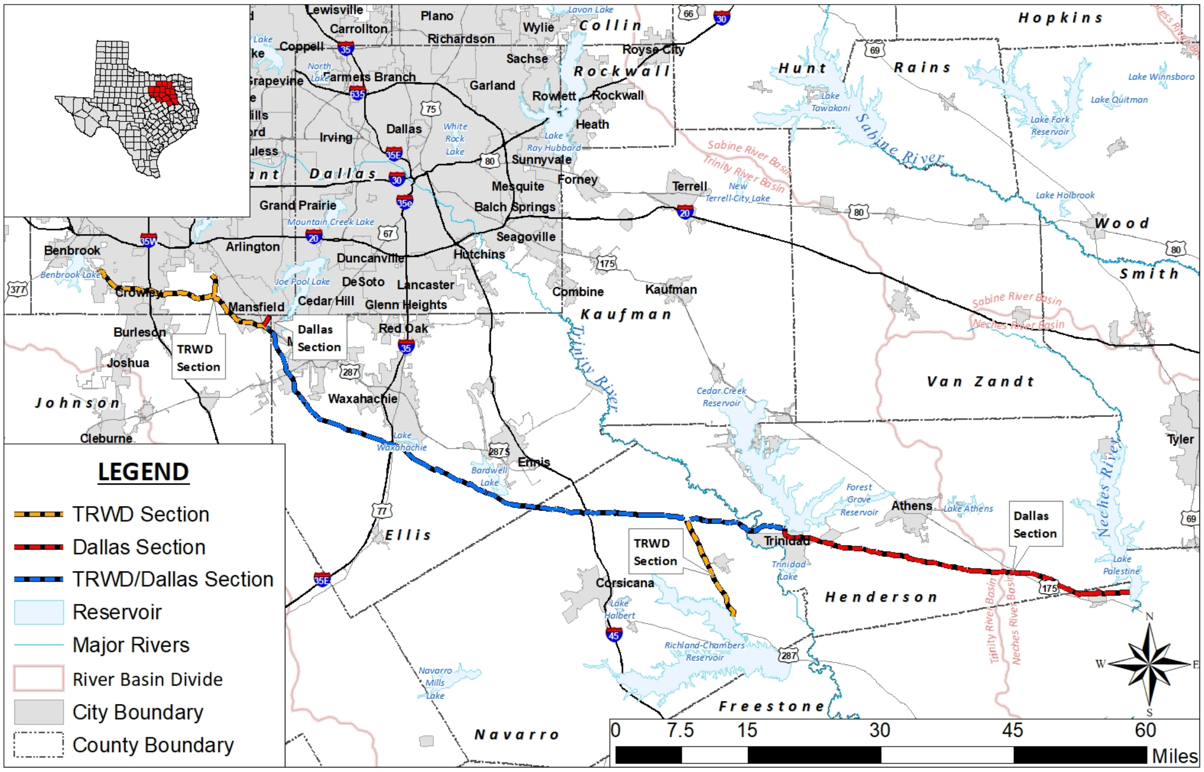
5C.2.3 Integrated Pipeline (Tarrant Regional Water District and Dallas Water Utilities)

The Tarrant Regional Water District (TRWD) and Dallas Water Utilities (DWU) have partnered to construct and operate the Integrated Pipeline (IPL) Project. The IPL project is an integrated water delivery transmission system that extends from Lake Palestine to Benbrook Lake with connections to Cedar Creek and Richland-Chambers Reservoirs. The pipeline will have an ultimate capacity of approximately 350 MGD (200 MGD for TRWD and 150 MGD for DWU). Dallas's share of the project will deliver water from Lake Palestine and is discussed in **Section 5C.2.4**. TRWD's share will deliver surface water and reuse supplies from Cedar Creek and Richland-Chambers Reservoirs. A portion of the IPL has been constructed and is currently delivering raw water to TRWD customers from the Richland-Chambers Reservoir. However, there is no infrastructure currently in place to transport DWU's supplies from Lake Palestine. Similarly, the Cedar Creek wetlands have not yet been constructed although supplies from the wetlands will eventually be transported via the IPL as well.

The IPL provides the means to use existing water supplies that are currently not available to TRWD or DWU because of infrastructure limitations. The IPL also provides a means to share water resources between TRWD and DWU during emergencies or on an interim basis. The flexibility in operations provided by the IPL increases the resiliency of the water supplies. The IPL Project is recommended by the Region C Regional Water Planning Group, and the total capital cost is approximately $1 billion. The IPL Project is sponsored by TRWD and DWU and will serve the customers of both. Additional details for this strategy can be found in the corresponding technical memorandum in **Appendix G**.



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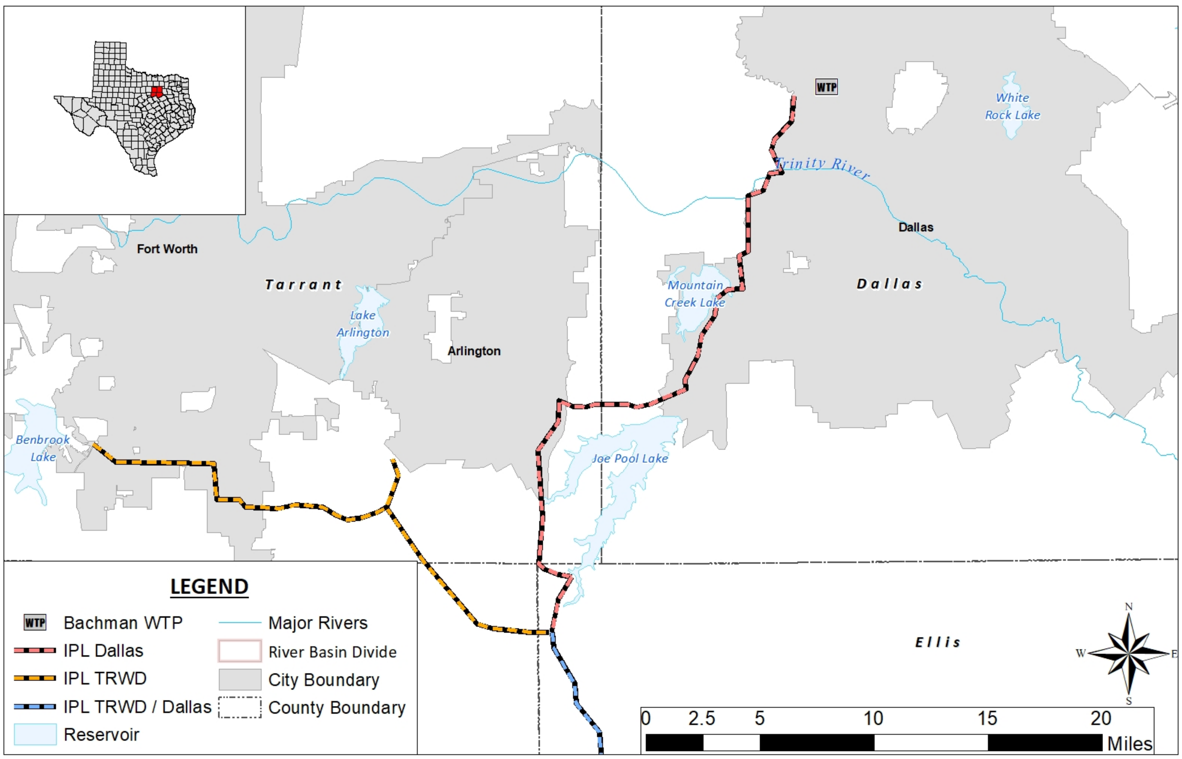
5C.2.4 Lake Palestine

Lake Palestine is an existing reservoir located in the East Texas Region (Region I) on the Neches River. The lake is owned and operated by the Upper Neches River Municipal Water Authority (UNRMWA). The permitted diversion is 238,110 acre-feet per year. Dallas Water Utilities (DWU) has a contract with UNRMWA for 53.73% of the yield of the reservoir up to a maximum of 114,337 acre-feet per year (102 MGD). The contract includes an interbasin transfer permit allowing the use of water from the lake in the Trinity River Basin.

To date, DWU has not used water from Lake Palestine because there is no infrastructure to transport the water to the Dallas area. DWU is working with TRWD to build the Integrated Pipeline (IPL), which would include a segment to move DWU's share of Lake Palestine to Dallas County. The infrastructure necessary to move the water from Lake Palestine to a location near the upper end of Joe Pool Lake for this strategy is discussed in **Section 5C.2.3**. There will be a separate project to move the water from the IPL delivery point to the Bachman Water Treatment Plant. It is assumed that the water from the IPL will be delivered directly to the Bachman WTP by pipeline.

Permits to use the water from Lake Palestine have already been obtained. Any permits associated with the transmission system to Joe Pool Lake are discussed under the IPL Project. Associated permits for the pipeline from the IPL delivery point to the Bachman WTP are discussed in the corresponding technical memorandum in **Appendix G**. The Lake Palestine strategy is sponsored by DWU and the strategy is recommended for DWU by the Region C Regional Water Planning Group. The total capital cost is approximately $297 million. Additional details for this strategy can be found in the corresponding technical memorandum in **Appendix G.**



5C.2.5 Lake Texoma

Lake Texoma is an existing Corps of Engineers reservoir on the Red River on the border between Texas and Oklahoma. The reservoir is about 50 miles from the Metroplex. Under the terms of the Red River Compact, the yield of Lake Texoma is divided equally between Texas and Oklahoma. In Texas, the North Texas Municipal Water District (NTMWD), the Greater Texoma Utility Authority (GTUA), the City of Denison, Luminant (previously TXU), and the Red River Authority (RRA) have contracts with the Corps of Engineers and Texas water rights allowing them to use water from Lake Texoma. Dallas (DWU) and Upper Trinity Regional Water District (UTRWD) have expressed interest in developing supplies from Lake Texoma. However, all of the currently authorized storage in the lake is contracted with other users.

Water from Lake Texoma is brackish, which means that the use of Texoma water requires the water to be blended with a freshwater source or desalinated for municipal use. The amount of water available to the entities listed above, by blending, ranges from 25,000 to 120,386 acre-feet per year. For NTMWD, there are four potential sources of water for blending: Bois d'Arc Lake, Toledo Bend, Marvin Nichols Reservoir, and Wright Patman Reallocation. NTWMD already blends Texoma water with its current supplies (up to 76,614 acre-feet per year by

2070). NTMWD would blend additional Texoma water (120,386 acre-feet per year by 2070) with the three new sources of water listed above. This new blending will bring NTWMD to the limit of their current water right from Texoma, 197,000 acre-feet per year. The blending source for UTRWD is also supplies from Marvin Nichols Reservoir and the Wright Patman Reallocation.

Desalination provides treated water but is a more expensive strategy, and there are uncertainties in the long-term costs. There is some uncertainty regarding the ability to desalinate and dispose of the large quantities of reject water. Lake Texoma desalination is discussed in **Section 5C.5.2**.

Lake Texoma supplies requires an interbasin transfer permit, state water rights, possible Congressional authorization, and a contract with USACE. The State of Oklahoma does retain the right to a significant portion of unpermitted water that is allocated to municipal and industrial use. However, Oklahoma has a moratorium on exporting water. Development of this supply will require agreement between the water rights stakeholders in Texas, the state of Oklahoma and the Corps of Engineers.

Lake Texoma is a recommended source of additional water supply by blending for the NTMWD (blending with Bois d'Arc Lake, Marvin Nichols Reservoir and Wright Patman Reallocation). It is an alternative strategy by blending for UTRWD. The total capital cost ranges from approximately $228 million to $345 million. Additional details for this strategy can be found in the corresponding technical memorandum in **Appendix G.**

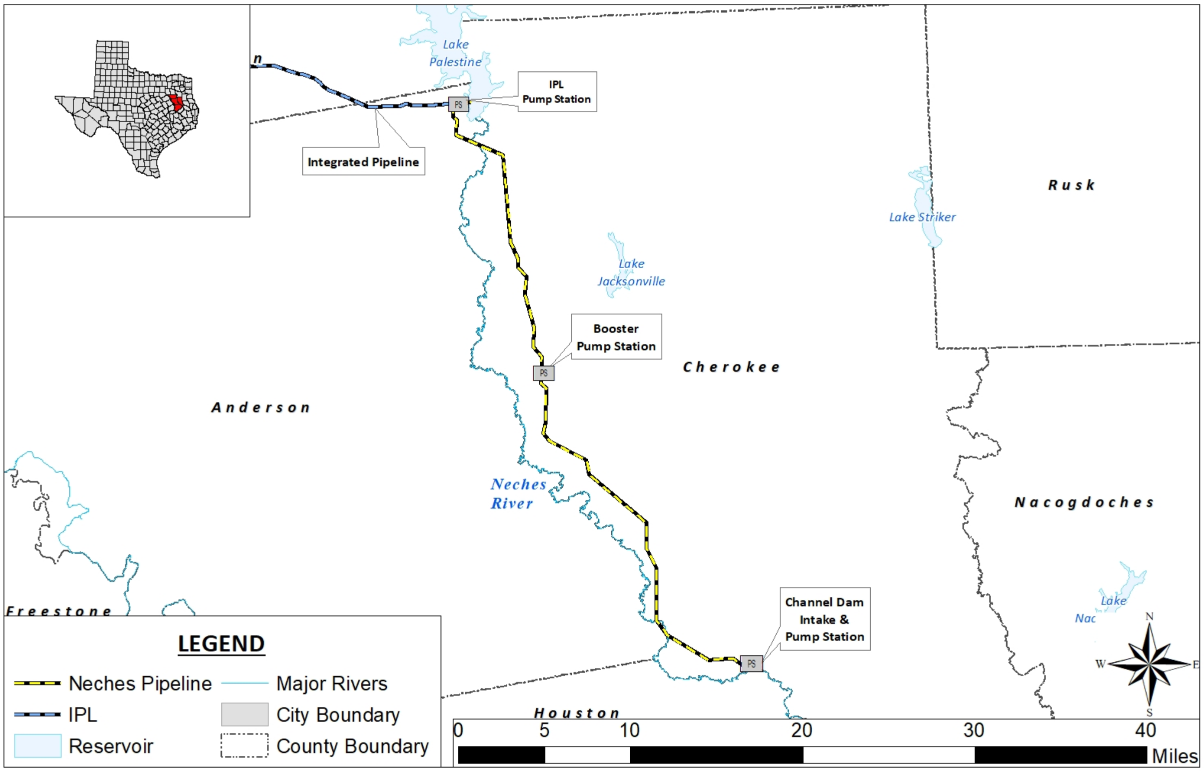
5C.2.6 Neches River Run-of-River Diversion

The Neches River Run-of-River Diversion Strategy was originally developed as an alternative to the Lake Fastrill project after the development of the reservoir was determined unlikely due to the designation of Neches River National Wildlife Refuge (NRNWR) within the reservoir site. This project would be sponsored by the Upper Neches River Municipal Water Authority (UNRMWA) with water supplies contracted to Dallas Water Utilities (DWU).

The Neches River Run-of-River Diversion Strategy would include a new river intake and pump station on the Neches River near the State Highway 21 crossing. Water would be delivered through a 42-mile pipeline to DWU's pump station at Lake Palestine for delivery to DWU through the Integrated Pipeline (see **Section 5C.2.3**). The run-of-river diversions would be operated as a system with Lake Palestine to supplement existing water supplies. Dallas' existing contract with UNRMWA for Lake Palestine water is for an annual quantity of 114,337 acre-feet per year (102 MGD). The IPL will have a capacity of 150 MGD, so there is a remaining infrastructure capacity of approximately 48 MGD available for this strategy. The new run-of-river diversion will be interruptible, so the quantity available with this strategy is the incremental increase in the firm yield of Lake Palestine resulting from system operations of the new diversion and the existing reservoir. If other new water rights are granted in the Neches River Basin before the water right for this project, the yield could be affected.

The Neches Run-of-River strategy provides supplemental water for DWU that is located near existing DWU water sources. This strategy assumes that existing and planned (IPL) infrastructure can be used to transport this water to the DWU service area, which minimizes transmission costs. Also, the use of a small river diversion structure provides fewer environmental impacts than a new reservoir, and the operations with Lake Palestine provide the necessary reliability for the river diversion. It is anticipated that this project will be online by 2060 and will provide 42 MGD (47,250 acre-feet per year) of supply.

This is a recommended strategy for DWU and the estimated capital cost is $254 million. Additional details for this strategy can be found in the corresponding technical memorandum in **Appendix G.**



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5C.2.7 Oklahoma Water

Several wholesale water providers in the Metroplex have been pursuing the purchase of water from Oklahoma. At the present time, the Oklahoma Legislature has established a moratorium on the export of water from the state. Previously, the Tarrant Regional Water District (TRWD) pursued a case in Federal Court to determine whether this moratorium could be overturned, and the Supreme Court ruled in favor of Oklahoma. For the long term, Oklahoma remains a potential source of water supply for Region C. Since this strategy would not be implemented for several decades, the source of water is simply defined as Oklahoma water. For planning purposes, the strategy is evaluated for 50,000 acre-feet per year.

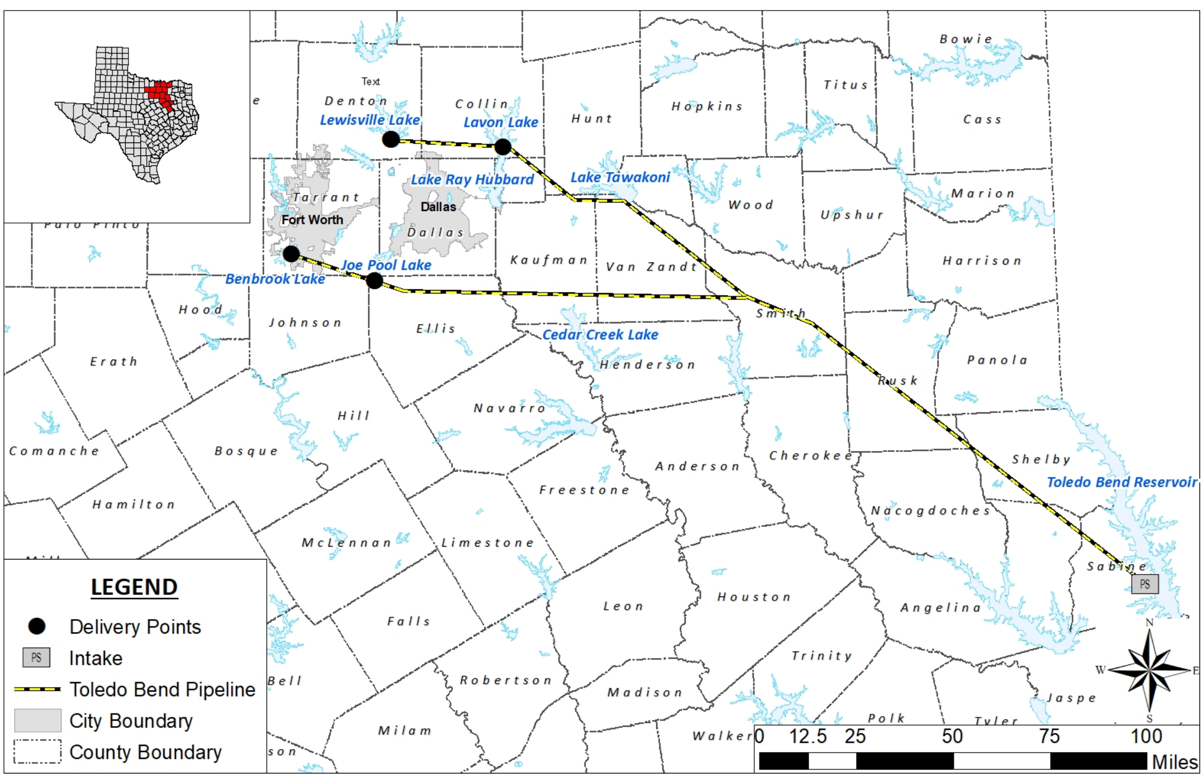
The public and political opposition to this strategy limit development opportunities in the near future. Additional information on these challenges can be found in the corresponding technical memorandum in **Appendix G**. It is expected that this opposition will subside over time. Raw water from Oklahoma would have relatively low environmental impacts because of the use of existing sources. Water from Oklahoma is a recommended strategy for NTMWD (50,000 acre-feet per year). It is identified as an alternative strategy for UTRWD (15,000 acre-feet per year), and Irving (25,000 acre-feet per year). Additional details for this strategy can be found in the corresponding technical memorandum in **Appendix G**.

5C.2.8 Toledo Bend Reservoir

Toledo Bend Reservoir is an existing impoundment located in the Sabine River Basin on the border of Texas and Louisiana. It was built in the 1960s by the Sabine River Authority of Texas (SRA) and the Sabine River Authority of Louisiana. The yield of the project is split equally between the two states, and Texas' share of the yield is slightly over 1,000,000 acre-feet per year[(4)]. The SRA currently holds a Texas water right to divert 970,067 acre-feet per year from Toledo Bend for municipal, industrial, and irrigation purposes.

Several Region C Metroplex water suppliers have been investigating the possibility of developing substantial water supplies from Toledo Bend Reservoir, with up to 650,000 acre-feet per year delivered to Region C. Toledo Bend Reservoir is located in Region I, the East Texas Region. The development of this supply will require an agreement among the SRA and Metroplex suppliers, an interbasin transfer permit from the Sabine River Basin to the Trinity River Basin, and possibly other basins, and development of water transmission facilities. Supply from Toledo Bend is identified as an alternative joint strategy for NTMWD, TRWD, DWU, and UTRWD. The strategy would be constructed in two phases. Phase 1 and 2 would supply the same amounts of water to each entity. However, Phase 2 of this strategy would likely not occur until after the end of this planning cycle and is not included in this strategy evaluation.

Phase 1 would transport 350,000 acre-feet per year. This is a relatively expensive source of supply because Toledo Bend Reservoir is approximately 200 miles from Region C. In addition to costs, the length of the pipelines increases concerns over line breakage or pump failure. However, this strategy does offer substantial water supply and environmental impacts will be limited since it is an existing source. Additional details can be found in **Appendix G.**



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5C.3 New Groundwater

There are limited groundwater resources within Region C. Much of the groundwater has been developed and the amount available for future development is approximately 55,000 acre-feet per year. About a third of this unallocated groundwater (17,800 acre-feet per year) is in Denton County. Some of this supply will be developed by smaller WUGs, but suppliers in this county have begun to move toward surface supplies as population has become denser. Another 22 percent of the unallocated groundwater (11,800 acre-feet per year) is in Cooke County. About 12 percent of the unallocated groundwater (6,700 acre-feet per year) is in Henderson County. The City of Athens plans to use over 2,000 acre-feet per year of this supply. The remaining unallocated groundwater supplies (18,700 acre-feet per year) are scattered through the remaining 13 counties of the region. Any major new groundwater development (over 50,000 acre-feet per year) is likely to occur outside Region C.

The Carrizo-Wilcox aquifer is a large aquifer system that spans from the East Texas-Louisiana border across northeast and central Texas to the border of Mexico. Three new groundwater development projects were identified in the Carrizo-Wilcox aquifer, two in east Texas and one partially in east Texas and partially in Region C.

5C.3.1 Carrizo-Wilcox Aquifer Groundwater in Anderson County

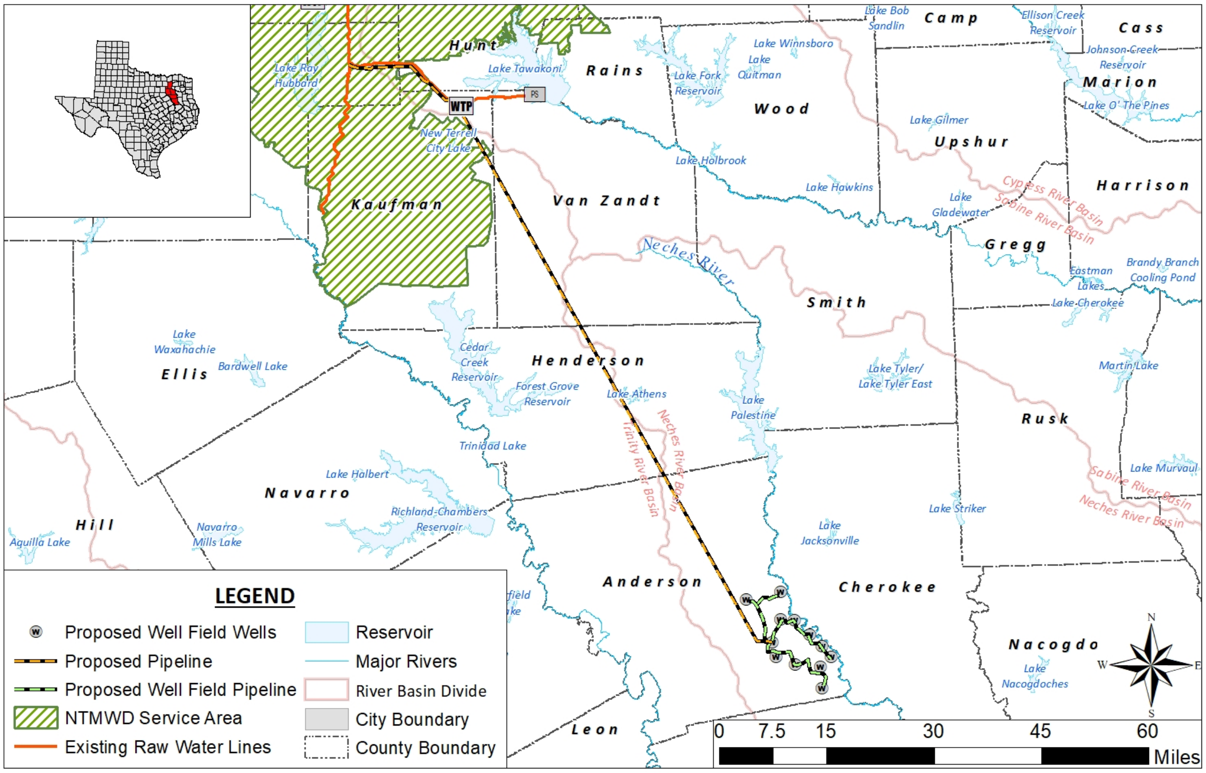
A local water marketer has groundwater holdings in multiple counties in east Texas south of Lake Palestine. A portion of these holdings lie in the eastern part of Anderson County. Additionally, there are groundwater supplies available in Wood, Upshur and Smith counties. This strategy would develop a well field and pump the water to existing infrastructure near Lake Tawakoni. This strategy is evaluated for the North Texas Municipal Water District. Much of NTMWD's Sabine Basin supply is transported to Lake Lavon for subsequent diversion and treatment, but an interim contract with SRA for 40,000 acre-feet expires in 2025. The proposed groundwater supplies would provide up to 42,000 acre-feet per year of supply. This could replace the current interim supplies from SRA for NTMWD.

The additional infrastructure for this project includes a new well field, pump station and transmission pipeline from the well field to the Lake Tawakoni water treatment plant, and a new pump station and 60-inch pipeline from the water plant to the existing 84-inch East Fork Wetlands Project pipeline.

This strategy can provide additional supplies, but the reliability is uncertain. Changes in groundwater conservation district (GCD) operating rules and Desired Future Conditions (DFCs), as well as the Modeled Available Groundwater (MAG), for this source of groundwater would likely be needed in order to permit the well field. There is uncertainty as to whether the quantities as specified in this alternative can actually be permitted. Supply amounts can change based on changes in rules. This can impact the long-term reliability of this source.

There also may be political opposition to a large export of local groundwater. This could delay the project and increase costs. The total capital cost is approximately $496 million. The Carrizo Groundwater Project for NTMWD is recommended to remain as an alternative strategy by the Region C Regional Water Planning Group.

Additional details for this strategy can be found in the corresponding technical memorandum in **Appendix G**.



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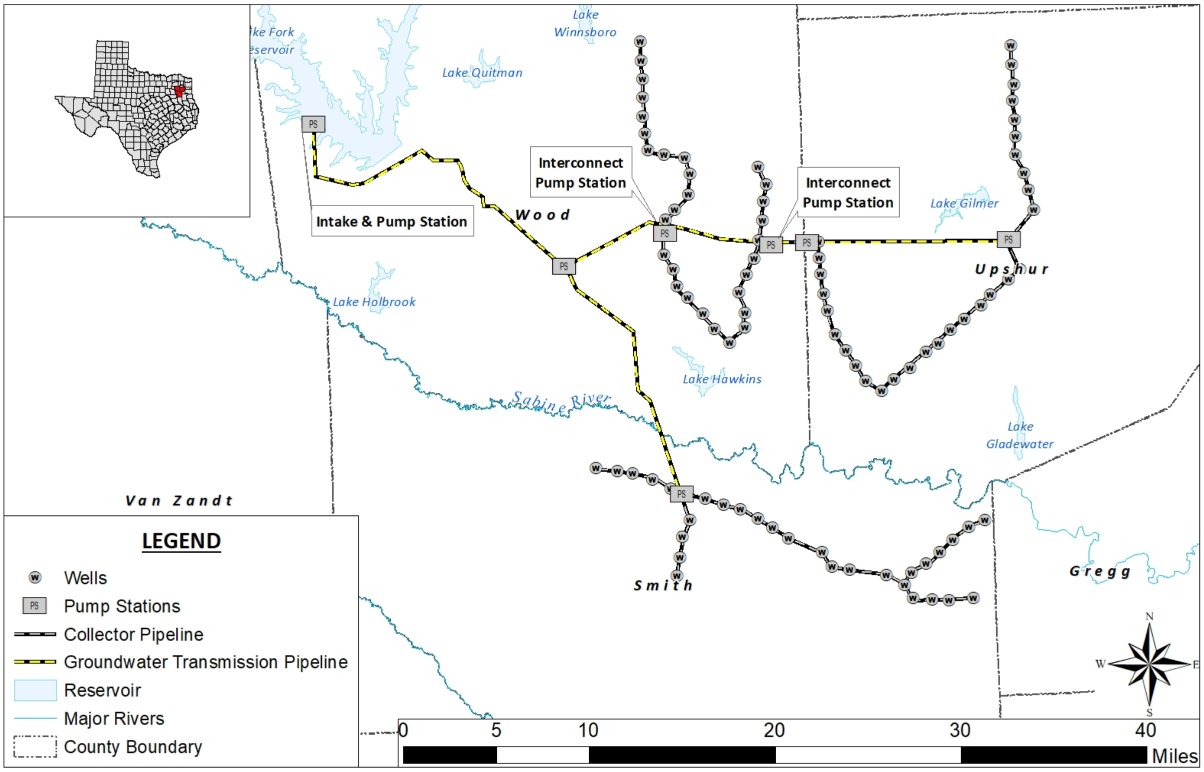
5C.3.2 Carrizo-Wilcox Aquifer Groundwater in Wood, Upshur, and Smith Counties

The Carrizo-Wilcox and Queen City aquifers cover a large portion of northeast Texas. This strategy evaluates the potential for groundwater development in Smith, Wood, and Upshur Counties in Region D for DWU. Use of these aquifers for other major water providers is discussed separately.

Where appropriate, the wells would be co-screened in both the Carrizo-Wilcox and Queen City aquifers to provide the greatest amount of available supply. A series of wellfields and pump stations would be strategically located to transport the water 58 miles to the Lake Fork intake and pump station. From this location the groundwater would be transported to DWU Eastside water treatment plant via existing infrastructure.

The quantity of water for this strategy is 30,000 acre-feet per year. This is less than half of the potentially available supply from the two aquifers within the target counties. Most of this supply would be from the Queen City aquifer. With no GCDs in the targeted counties, there are no pumping regulations or limitations. The amount of available water is limited to the economically sustainable production from specific well fields. Securing sufficient groundwater rights would help protect the long-term productivity of the well fields, since groundwater is a property right and there could be competing development that may impact supplies. While there are few regulatory requirements with this strategy, there may be public opposition to a large groundwater project that exports the water outside of the county and region. This strategy could take 5 to 10 years to develop, considering acquisition of water rights, pilot tests, and final design and construction.

Groundwater provides a reliable water supply to DWU's portfolio of water resources. This source is less susceptible to drought-related impacts, such as evaporation. The source of water is relatively near existing infrastructure and other DWU resources and there are few development concerns. Additional details for this strategy can be found in the corresponding technical memorandum in **Appendix G**. The Carrizo-Wilcox/Queen City (Region D) Groundwater strategy was evaluated for DWU. The total capital cost is approximately $180 million. It is recommended to remain an alternative strategy by the Region C Regional Water Planning Group.



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5C.3.3 Carrizo-Wilcox Aquifer Groundwater – Tarrant Regional Water District

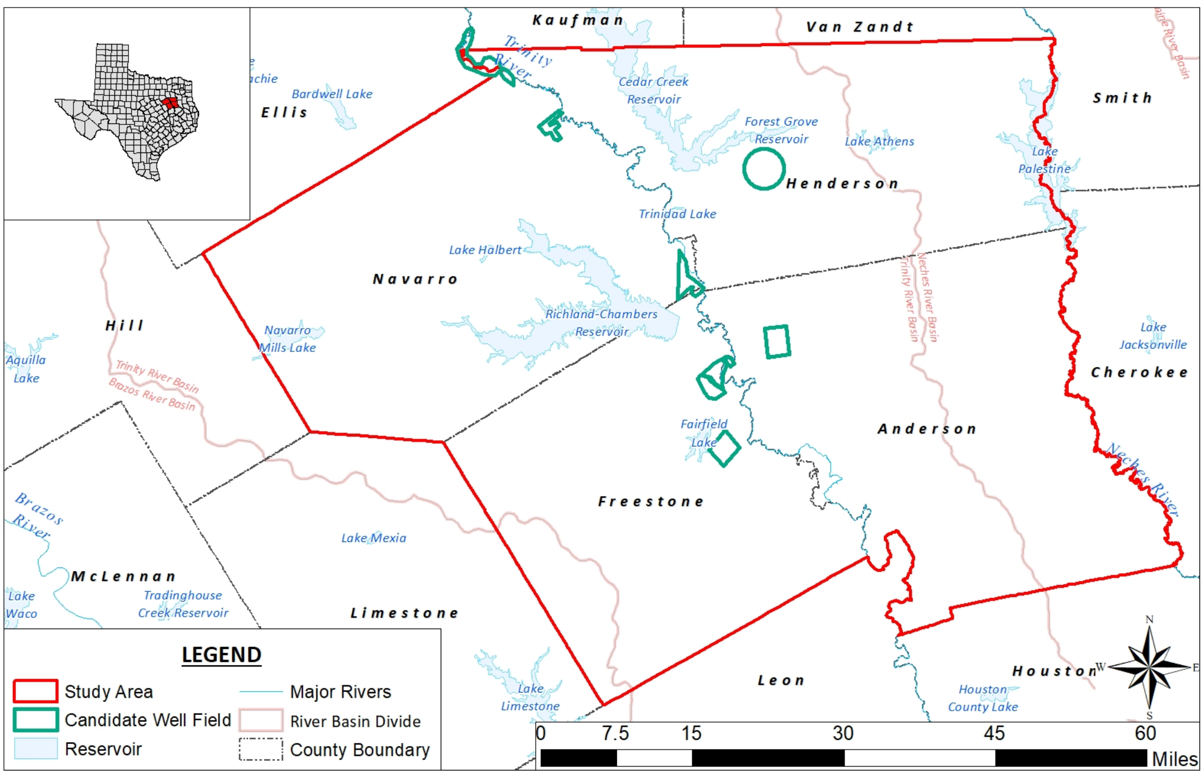
This strategy proposes to develop groundwater from the Carrizo-Wilcox and Queen City aquifers in Freestone and Anderson Counties. (Wells fields in Navarro and Henderson Counties were initially considered but ruled out in TRWD's preliminary feasibility studies.) The groundwater would be transported approximately 28 miles to the Integrated Pipeline (IPL) near Cedar Creek Reservoir. The IPL would then be used to move the groundwater to TRWD's service area. This strategy assumes the groundwater is mixed directly in the IPL with surface water and/or reuse water.

This groundwater supply would supplement TRWD's existing water sources and provide diversity to its existing portfolio. As a supplemental supply, TRWD may choose to operate the well system on a continual basis or seasonally to provide water during the higher demand periods. This strategy assumes the wells are operated continuously on an average annual basis. The Average Scenario assumes that up to 32,000 acre-feet per year could be developed from the targeted area, with the project operating year-round at a fairly steady level of production. Peak Scenario details can be found in the corresponding Technical Memorandum in **Appendix G**.

The infrastructure required for this strategy includes 39 wells (most likely distributed over multiple well fields), well field piping, ground storage, pump station, and 28 miles of 36- to 54-inch diameter transmission pipeline. The proposed water management strategy includes costs for sites E1A, E4, and E1B.

Development of a well field would require groundwater permits. The amount of water that could be permitted under the current Modeled Available Groundwater (MAG) value is near the proposed total quantity for this strategy. Additionally, large-scale groundwater export proposals could face public opposition, especially if perceived to affect neighboring wells. Further study is likely to address these potential concerns.

This strategy provides a new water source that provides a higher level of resistance to future droughts than current surface water sources. The proposed groundwater well fields are located near TRWD's existing water sources, and existing infrastructure can be used to transport the water to TRWD's service area. The quality of the water is generally good and likely would not require extensive treatment. The total capital cost is approximately $191 million. This strategy is recommended for TRWD by the Region C Regional Water Planning Group. Additional details for this strategy can be found in the corresponding technical memorandum in **Appendix G**.



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5C.4 Reuse Strategies

Region C has identified multiple reuse strategies to more efficiently utilize water supplies within the Region. Many entities have permitted their return flows and developed strategies to either temporarily store and/or further treat this water, including wetlands and off-channel storage reservoirs which can provided fewer environmental concerns in comparison to other strategies. Reuse water is generally a reliable supply.

5C.4.1 Wetland Project – Tarrant Regional Water District

The Tarrant Regional Water District (TRWD) has water rights allowing the diversion of return flows of treated wastewater from the Trinity River. To utilize these flows, TRWD has developed a reuse project at Richland-Chambers Reservoir. Treated wastewater is discharged to the Trinity River and its tributaries, flows downstream, is pumped from the Trinity River into the constructed George W. Shannon Wetlands and then pumped into Richland-Chambers Reservoir. The reuse water is then diverted from Richland-Chambers Reservoir and transported to the TRWD service area. However, this project can only divert and treat a portion of the permitted reuse supplies. To fully utilize the available reuse, TRWD will develop a similar reuse project at Cedar Creek Reservoir. The amount of permitted reuse supply at Cedar Creek Reservoir is 88,059 acre-feet per year.

This strategy addresses the development of a reuse project at Cedar Creek Reservoir, which includes a new diversion structure, constructed wetlands, and infrastructure necessary to discharge the treated return flows into Cedar Creek Reservoir. The wetlands will be constructed adjacent to the Trinity River, east of the City of Ennis. The reuse supply would then be diverted from the lake and transported by the Integrated Pipeline (see Integrated Pipeline Technical Memorandum, **Appendix G**).

Tarrant Regional Water District has already secured water right permits to develop the wetlands on Cedar Creek. A federal Section 404 permit would be needed to construct the intake pump station, pipelines, and wetlands because of possible impacts to waters of the U.S. TRWD acquired the property for the Cedar Creek Wetlands in 2014 and is in the process of acquiring the site and right-of-way for the finished water pipeline and pump station facilities. The total capital cost is approximately $226 million. The Cedar Creek Wetland Reuse Project is sponsored by TRWD and the strategy is recommended for TRWD by the Region C Regional Water Planning Group. The water provided from the Cedar Creek Wetlands Reuse Project will be used by TRWD customers. Additional details for this strategy can be found in the corresponding technical memorandum in **Appendix G.**

5C.4.2 Indirect Reuse Implementation by DWU and NTMWD

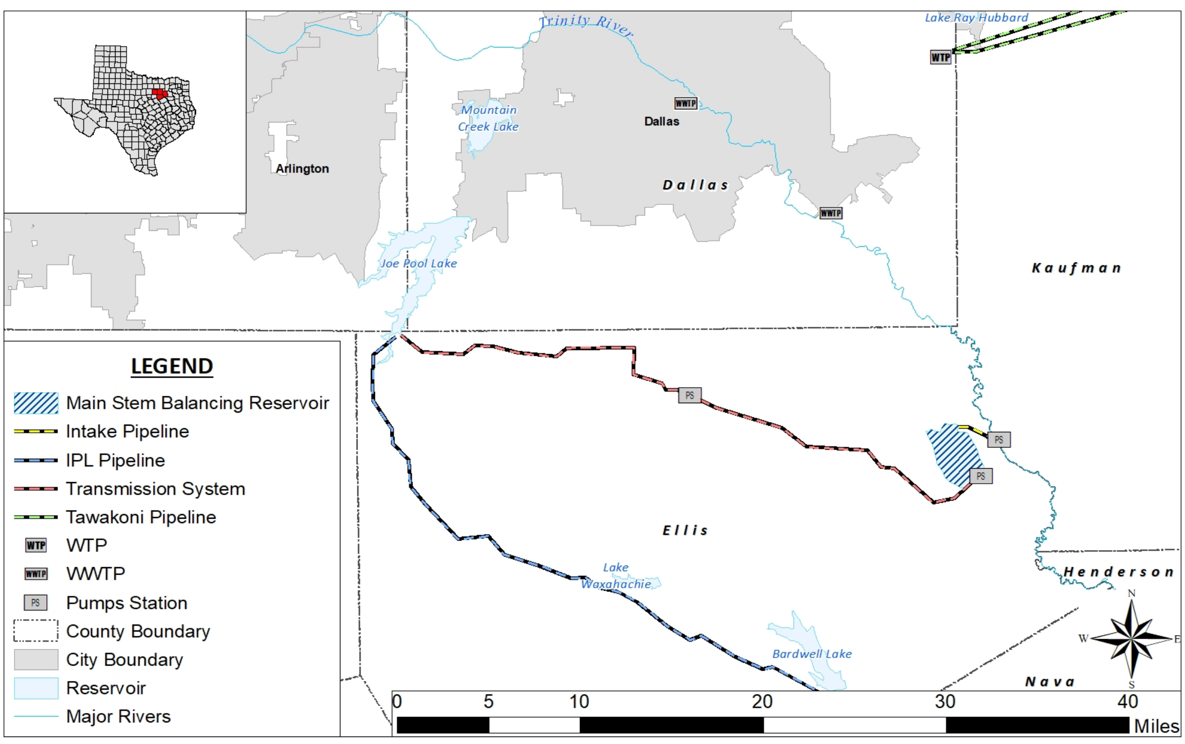
Dallas has rights to the return flow for much of its water supply and plans to utilize those return flows through two projects on the Main Stem of the Trinity River. Those projects are the Main Stem Balancing Reservoir and the Expanded Wetland Reuse. The Expanded Wetland Reuse is a recommended strategy for North Texas Municipal Water District (NTMWD) that allows for a swap of return flows between NTMWD and DWU. More detail is provided on these two specific projects in **Section 5C.4.3** and **5C.4.4**. The Expanded Wetland Reuse is anticipated to be online in 2030 and provide 69,980 acre-feet per year of supply. The Main Stem Balancing Reservoir is anticipated to be online in 2050 and provide as much as 92,111 acre-feet per year of supply by 2070. Additional details for these strategies can be found in the corresponding technical memoranda in **Appendix G.**

5C.4.3 Main Stem Balancing Reservoir

The project description for the Main Stem Balancing Reservoir is based on the information provided by the Dallas Long Range Plan[6]. Dallas would store return flows from the Central and Southside wastewater treatment plants in an off-channel reservoir, the Main Stem Balancing Reservoir. The Main Stem Balancing Reservoir would be located in Ellis County southeast of Bristol, Texas, and would divert water from the Trinity River. This project has a good amount of flexibility and different potential configurations require additional evaluation. For the configuration selected for Region C, reuse water is delivered from the balancing reservoir to Joe Pool Lake through a 36.5 mile transmission system.

The source of water for the Main Stem Balancing Reservoir is return flows from Dallas' Central and Southside wastewater treatment plants. However, total return flows available to be stored in the reservoir consider other commitments and an amendment to instream flow requirements. Other commitments are the proposed Elm Fork and Lake Ray Hubbard Swap, an agreement between Dallas Water Utilities (DWU) and the North Texas Municipal Water District (NTMWD). DWU will provide NTMWD with water from the Central and Southside WWTP in equal exchange for NTMWD's reuse flows into Lake Lewisville (above agreed upon historical amounts) and Lake Ray Hubbard. The return flows available for the Main Stem Balancing Reservoir considering the agreement and amended instream flow requirements total 95,829 acre-feet per year by 2070. More details can be found in the corresponding technical memorandum in **Appendix G**.

The Main Stem Balancing Reservoir would provide a means to store reuse water and manage water supplies across the DWU system. With the diversion pump station located downstream of the confluence of the Trinity River and East Fork of the Trinity River, water could be released from DWU's eastern supplies and moved to the western areas of its service area. Reuse water is a reliable supply, and this project does not require additional appropriation of state water. An off-channel reservoir is expected to have fewer environmental concerns than an on-channel reservoir. The Main Stem Balancing Reservoir strategy was evaluated for DWU and its customers. The total capital cost is approximately $773 million. It is a recommended strategy in Dallas' Long-Range Water Supply Plan. This strategy is recommended for DWU by the Region C Regional Water Planning Group. Additional details for this strategy can be found in the corresponding technical memorandum in **Appendix G.**



5C.4.4 Expanded Wetland Reuse (NTMWD)

The proposed Expanded Wetland Reuse project will treat return flows from wastewater treatment plants owned and operated by NTMWD and the City of Dallas. The return flows will be pumped from a pump station on the Trinity River and delivered to a new constructed wetlands facility for nutrient removal before being blended with other raw water sources from the NTMWD system. A new water treatment facility is included as part of the conceptual design of this project. At this time specific locations for the pumping facility, the new wetlands and the water treatment plant have not been identified. Water would be delivered for blending with other sources at a new treatment plant near the existing Tawakoni Water Treatment Plant.

The return flows for this project come from two sources. The first is through growth in return flows from plants owned and operated by NTMWD that discharge into the East Fork of the Trinity River. It is expected that the quantity of return flows available from this source will exceed the treatment capacity of the existing East Fork Wetlands by the year 2030. The second source of water for the project are return flows from Dallas' (DWU) Central and Southside wastewater treatment plants, provided through a swap agreement between DWU and NTMWD. This agreement provides NTMWD return flow from DWU's Central and Southside WWTP's in equal exchange for NTMWD's return flows into DWU's reservoirs. The total amount of water expected to be produced by the project is 59,483 acre-feet per year by 2070.

The reliability of the reuse supplies is high. There is the potential for the reuse supplies to develop at a faster or slower rate, depending on the volume of return flows. The water quality is expected to be good, as the wetlands will filter out excess nutrients and pollutants and trap natural sediment and organic matter, providing higher quality water than diverted from the Trinity River. The proposed project would require an amendment to the existing NTMWD reuse water rights for the additional return flows and the expanded wetlands.

The Expanded Wetland Reuse strategy provides NTMWD with water supply in an ecologically sustainable manner. The total capital costs are approximately $626 million. The Expanded Wetland Reuse strategy will provide water to NTMWD customers. This strategy is recommended for NTMWD by the Region C Regional Water Planning Group. Additional details for this strategy can be found in the corresponding technical memorandum in **Appendix G.**

5C.4.5 Irving Reuse

Irving has contracted with TRA for 25 MGD from the TRA Central Plant discharge effluent. The strategy consists of infrastructure for pre-treatment of the TRA Central discharge (25 MGD) and transmission to the Dallas Bachman Treatment Plant. The total capital cost is approximately $39 million. This reuse project is a recommended strategy for City of Irving by the Region C Regional Water Planning Group.

5C.5 Desalination

Region C has evaluated desalination as a potential strategy for potential future supplies, including the desalinization of sea water and brackish lake water. The desalinization of seawater from the Gulf of Mexico is evaluated in response to public comment during the Region C planning process. The desalinization of brackish water from Lake Texoma is evaluated as an alternative to blending Lake Texoma water with a freshwater source.

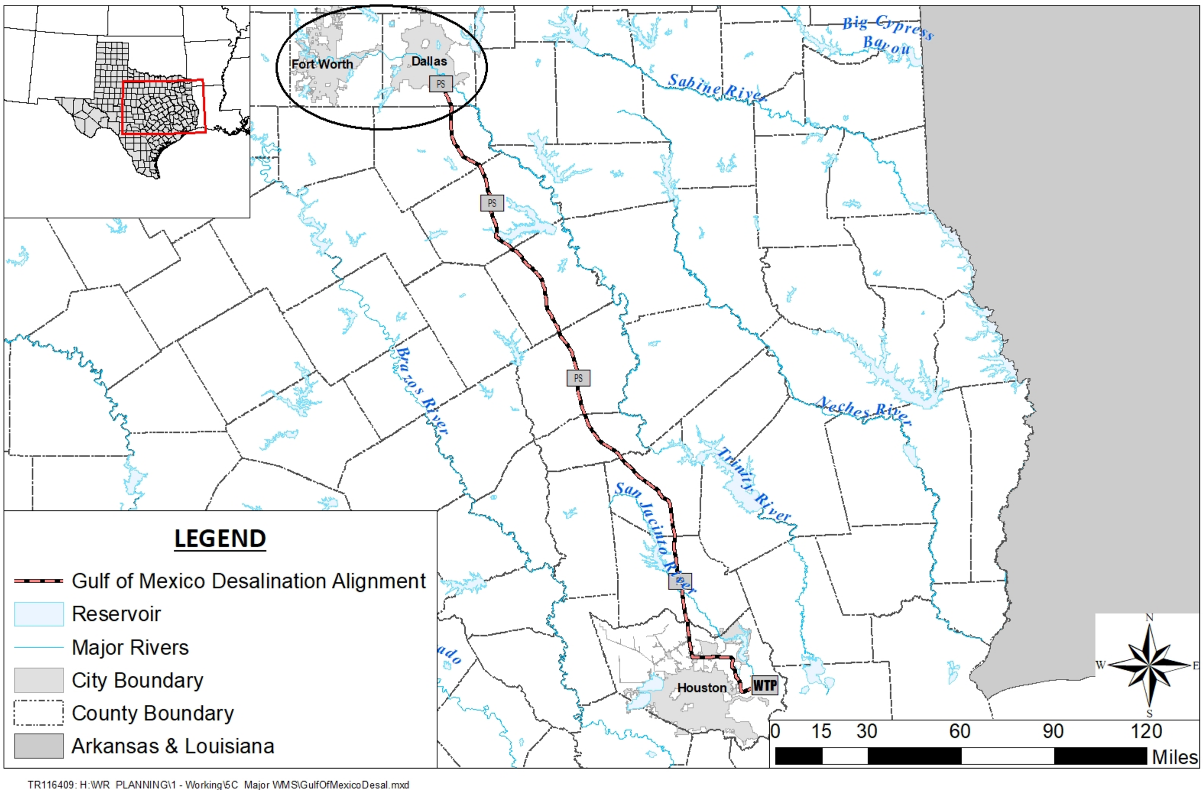
5C.5.1 Gulf of Mexico with Desalination

The cost of desalination has been decreasing in recent years, and some municipalities in Florida and California have been developing desalinated seawater as a supply source. The

State of Texas has sponsored initial studies of potential seawater desalination projects[7], and this is seen as a potential future supply source for the state. Seawater desalination has been mentioned through public input during the Region C planning process, and it was evaluated in response to that input. However, because of the cost of desalination and the distance to the Gulf of Mexico, seawater desalination is not currently a practical source of supply for Region C. This strategy assumes seawater would be taken from the Gulf of Mexico near Baytown, Texas, and desalinated near the diversion location. The water would be desalinated by reverse osmosis and the reject stream from the treatment process would be discharged back to the Gulf of Mexico. The treated water would be transported to the Metroplex generally following the I-45 corridor.

The supply from seawater desalination is essentially unlimited, but the cost is a great deal higher than the cost of other water management strategies for Region C. For this strategy evaluation, it is assumed that 200,000 acre-feet per year would be delivered to the Metroplex via one 132-inch pipeline (could alternatively use two parallel pipelines). Since this water would require desalination, the amount of source water would need to be 300,000 acre-feet per year and 100,000 acre-feet per year would be discharged as waste. The total capital cost is approximately $9 billion.

The major challenges for this strategy are the technical developments for a desalination project of this scale. Maintaining and operating a remote desalination water treatment plant and a 300-mile transmission system is costly and difficult for the water providers. Additionally, there are mixed views on seawater desalination and the project could face public opposition. Developing water from the Gulf of Mexico with desalination is not a recommended or alternative strategy for any water supplier in Region C. Additional details for this strategy can be found in the corresponding technical memorandum in **Appendix G.**



5C.5.2 Lake Texoma with Desalination

Lake Texoma is an existing Corps of Engineers reservoir on the Red River on the border between Texas and Oklahoma. The reservoir is about 50 miles from the Metroplex. Under the terms of the Red River Compact, the yield of Lake Texoma is divided equally between Texas and Oklahoma. In Texas, the North Texas Municipal Water District (NTMWD), the Greater Texoma Utility Authority (GTUA), the City of Denison, Luminant (previously TXU), and the Red River Authority (RRA) have contracts with the Corps of Engineers and Texas water rights allowing them to use water from Lake Texoma. Dallas (DWU) and Upper Trinity Regional Water District (UTRWD) have expressed interest in developing supplies from Lake Texoma. However, all of the currently authorized storage in the lake is contracted with other users.

Water from Lake Texoma is brackish, which means that the use of Texoma water requires the water to be blended with a freshwater source or desalinated for municipal use. The amount of water available to the entities listed above, by desalination, ranges from 8,500 to 146,000 acre-feet per year. For desalination strategies, a portion of the Texoma source water would be discharged as waste. Loss amounts from the desalination process could range from 15 to 25 percent, depending on the quality of the incoming water. For this analysis, the loss from the treatment process is assumed to be 20 percent.

Desalination provides treated water but is a more expensive strategy, and there are uncertainties in the long-term costs. There is some uncertainty regarding the ability to desalinate and dispose of the large quantities of reject water. Lake Texoma is a recommended source of additional water supply by desalination for the GTUA and Denison. It is an alternative strategy by desalination for NTMWD and DWU. The total capital cost ranges from approximately $1.2

billion to $1.8 billion. Additional details for this strategy can be found in the corresponding technical memorandum in **Appendix G.**

5C.6 Aquifer Storage and Recovery

Aquifer Storage and Recovery (ASR) is a water management solution that allows for storing surplus water in local aquifers during periods of high or surplus surface flows and withdrawing the stored water later during periods of drought or peak demands. It also can be used to temporarily store treated brackish groundwater or treated wastewater for use during high demand periods. ASR can provide a cost-effective and reliable alternative to the construction of above-ground storage reservoirs; however, identifying and securing suitable aquifer formations for storage and the geochemical evaluation of the mixed waters can be challenging. ASR in Texas is currently being studied to assess if it is a reliable and cost-effective technology that should be considered as part of a diversified portfolio of water supply options.

5C.6.1 Large-Scale Aquifer Storage and Recovery (ASR)

In Region C, the most likely application of ASR would be to store surplus surface water when lakes are full and spilling, store reuse water, increase operational flexibility of multiple sources, and serve as a short-term source to meet peak demands. ASR could reduce evaporative losses, store water that would have spilled downstream, maximize use of water rights, and possibly delay infrastructure improvements that would be needed to meet peak demands.

Detailed hydrogeological studies are needed to identify an appropriate receiving formation and size the infrastructure of the recharge system. There have been several recent studies conducted to define the storage and migration potential of the Trinity aquifer, and some regional water providers are currently in the process of confirming the information from the hydrogeological models by means of a pilot study. For these reasons, a generic ASR strategy for 50,000 acre-feet per year was developed for the purpose of this study.

Based on the available literature, this strategy assumes that an appropriate receiving site can be identified in the Trinity aquifer within 50 miles of the major water providers. The depth of this formation is about 2,000 feet below ground surface and the migration potential is minimal to retain the stored water bubble. It is also assumed that there is existing infrastructure capacity to move water to within 50 miles of the ASR site. Additional infrastructure would be needed to move the water to the recharge site. For this strategy, it is assumed that the recharge wells will also serve as recovery wells.

The WMS discussed is a region-wide strategy that benefits multiple major water providers in Region C. It is not a recommended strategy. Specific ASR strategies are considered for individual water users. The total capital cost associated with this strategy is $2.3 billion. Additional details for this strategy can be found in the corresponding technical memorandum in **Appendix G.**

5C.7 Summary of Recommended Major Water Management Strategies

Table 5C.1 is a summary of the recommended major water management strategies for Region C. These projects represent the majority of the total supply from strategies. Much of the remaining cost of projects is associated with infrastructure projects to treat and/or deliver these supplies to water user groups.

Table 5C.1 Recommended Major Water Management Strategies for Region C

Strategy	Supplier	Supply (Ac-Ft/Yr)	Supplier Capital Cost	Supplier Unit Cost ($/1000 gallon)	
				With Debt Service	After Debt Paid
New Surface Water					
Bois d'Arc Lake	NTMWD	120,200	$939,638,000	$1.49	$0.25
Lake Columbia[a]	DWU	56,000	$322,267,000	$1.77	$0.86
Lake Ralph Hall and Reuse[b]	UTRWD	60,399	$469,158,000	$1.40	$0.25
Marvin Nichols Reservoir	TRWD, NTMWD, and UTRWD	361,200	$4,467,478,000	$2.67	$0.57
Neches River Run-of-the-River[c]	DWU	47,250	$261,616,000	$1.89	$0.97
Tehuacana Reservoir	TRWD	21,070	$325,468,000	$3.28	$0.96
Wright Patman Reallocation	TRWD, NTMWD, and UTRWD	122,200	$1,645,711,000	$2.73	$0.71
Connection of Existing Supplies					
GTUA Regional System	GTUA – Phase I	15,332	$243,986,000	$5.72	$3.06
	GTUA – Phase II	20,540	$224,083,000	$4.75	$2.93
Integrated Pipeline (IPL)	TRWD	60,263	$507,733,000	$0.95	$0.48
	DWU	-	$419,835,000	$0.93	$0.41
Lake Palestine (Connect to Bachman)	DWU	105,370	$297,546,000	$0.52	$0.05
Lake Texoma	NTMWD – Phase I (Blending)	39,733	$228,206,000	$1.23	$0.28
	NTMWD – Phase II (Blending)	74,733	$346,367,000	$1.04	$0.32
Oklahoma Water	NTMWD	50,000	$259,924,000	$1.30	$0.43
New Groundwater					
Carrizo – Wilcox Aquifer Groundwater Eastern Study Area	TRWD	32,000 (average)	$191,469,000	$2.45	$1.15

Strategy	Supplier	Supply (Ac-Ft/Yr)	Supplier Capital Cost	Supplier Unit Cost ($/1000 gallon)	
				With Debt Service	After Debt Paid
Reuse Strategies					
Cedar Creek Wetland Reuse	TRWD	88,059	$226,318,000	$0.94	$0.51
Reuse from TRA Central RWS	TRWD	60,000	$154,205,000	$1.99	$1.57
Indirect Reuse Implementation	DWU	62,559	TBD	TBD	TBD
Main Stem Balancing Reservoir	DWU	95,829	$772,904,000	$1.89	$0.63
Expanded Wetland Reuse	NTMWD	37,510	$625,891,000	$5.03	$2.30
Region C Total[d]		**1,871,845**	**$30,438,919,000**		

[a] *Lake Columbia cost reflects transmission to Lake Palestine. Additional infrastructure to move the water to DWU is discussed under DWU infrastructure expansion.*

[b] *UTRWD will be seeking a state water right for return flows out of Lake Ralph Hall for up to 21,179 ac-ft/yr and cost estimates were developed based on this amount. However, for regional planning purposes the dry-year projected return flow value of 15,391 ac-ft/yr by 2070 is used.*

[c] *The Neches River Run-of-the-River unit costs do not include the cost to transport water from Palestine to DWU through the IPL.*

[d] *This is the total in the whole region for all strategies, not the total of strategies in this table.*

5C.8 Chapter 5C List of References

(1) HDR, Freese and Nichols, Brandes, Texas Water Development Board. *Report 370 Reservoir Site Protection Study*. Prepared for the Texas Water Development Board. 2008.

(2) Freese and Nichols, Inc*. Sulphur River Basin: Socio-Economic Assessment.* Prepared for the Fort Worth U.S. Army Corps of Engineers, January 2014.

(3) "U.S. Army Corps of Engineers Makes Major Announcement in Lake Wright Patman Water Supply Study." SRBA, 2019.

(4) Brown and Root, Inc., Yield Study Toledo Bend Reservoir, prepared for the Sabine River Authority of Texas and the Sabine River Authority of Louisiana, Houston, July 1991.

(5) Carollo, Inc., Hayes Engineering, Inc., WSP, Inc., RPS, Inc.: *2021 Initially Prepared Region D Regional Water Plan*, prepared for the Northeast Texas Water Planning Group, March 2019.

(6) HDR Engineering, Inc., Webb & Webb, CDM-Smith, Todd Groundwater, JQ Infrastructure, AZB Engineers & Surveyors, K Strategies, Inc., TAS & Associates, and MS Dallas: *2014 Dallas Long Range Water Supply Plan to 2070 and Beyond*, prepared for Dallas Water Utilities, City of Dallas, April 2015.

5D Recommended Water Management Strategies for Major Water Providers and Regional Water Providers

The purpose of this chapter is to discuss the recommended water management strategies for both major and regional water providers. Major water provider strategies are discussed in **Section 5D.1** and regional water provider strategies are discussed in **Section 5D.2.** Evaluations of specific water management strategies are included in **Appendix G** and detailed costs are shown in **Appendix H**. Cost estimates for conservation strategies were developed for individual water user groups and are discussed in **Chapter 5B** and shown in **Appendix H.**

Most of the water supplied in Region C is provided by the major and regional water providers. Collectively, these entities meet over 90 percent of the total water needs in the region. These entities are expected to continue to provide over 90 percent of the water supply for Region C through 2070, and they will also develop most of the new supplies for the region during that time period.

As part of the preparation of this regional water plan, consultants met with the major and regional water providers to develop the plans outlined in this chapter. In addition, published plans of these entities were considered in the preparation of this adopted initially prepared regional plan.

Many of the strategies included in this section are infrastructure projects needed to deliver and/or treat water included in another strategy. Quantities for these infrastructure projects have been shown in *gray italics* so they can be easily identified. To avoid double-counting quantities of supply, the quantities in gray italics are ***not*** included in the totals.

Chapter Outline

Related Appendices

Appendix G – Water Management Strategy Evaluations

Appendix H – Cost Estimates

Six Major Water Providers

- **Dallas Water Utilities**
- **City of Fort Worth**
- **North Texas Municipal Water District**
- **Tarrant Regional Water District**
- **Trinity River Authority**
- **Upper Trinity Regional Water District**

Two Regional Water Providers

- **City of Corsicana**
- **Greater Texoma Utility Authority**

Management Supply Factor

Based on TWDB Regional Planning Guidance, a management supply factor has been listed for each major and regional water provider. This management supply factor, commonly referred to as a safety factor, is calculated as the existing water supply plus supply from strategies, divided by total demand.

In general, the Region C Water Planning Group has adopted strategies that will develop a total supply for water providers some amount greater than the projected demands. This policy was adopted for several reasons:

- The additional supply provides a margin of safety in case climate change reduces the supply available from existing sources.
- The additional supply provides a margin of safety in case of a drought more severe than the previous drought of record, which would reduce the supply available.
- The additional supply provides a margin of safety in case of unanticipated population growth or industrial growth within the region. This is in response to the November 2014 Drought Preparedness Council recommendation to all regional water planning groups.
- The additional supply provides a margin of safety in case some proposed management strategies cannot be developed or are developed more slowly than anticipated.
- The additional supply provides a margin of safety in case problems with facilities or contamination of sources by invasive species or other contamination makes specific supplies unusable.

The recommended strategies for the major and regional wholesale water providers include conservation, new surface water, connections to existing supplies, new groundwater, reuse strategies, desalination, and aquifer storage and recovery. These strategies are described in greater detail below.

5D.1 Recommended Strategies for Major Water Providers

5D.1.1 Dallas Water Utilities

Dallas Water Utilities (DWU) provides treated and raw water for most of Dallas County as well as several surrounding counties.

Table 5D.1 summarizes the projected demands for DWU and all existing and potential future customers. DWU is under no obligation to provide supplies for the potential future customers listed within the Region C Water Plan.

Dallas' supply is composed of several reservoirs and run-of-river diversions from the Elm Fork of the Trinity River. The system is divided into western and eastern subsystems. The western subsystem supplies Dallas' Elm Fork and Bachman water treatment plants and the eastern subsystem supplies the Eastside water treatment plant.

The City of Dallas completed an update to its Long Range Water Supply Plan[5] which was reviewed and adopted by the Dallas City Council on October 8, 2014. At the direction of Dallas, all of the recommended and alternative water management strategies identified in Dallas' Long Range Plan have been incorporated into this Region C Plan. Descriptions of projects below that are in quotations and italics have been taken directly from Dallas' Long Range Plan without revision. In addition, the Long Range Plan evaluated multiple potentially feasible water management strategies which were not selected. Those potentially feasible water management strategies have not been repeated in this Region C Plan.

The recommended water management strategies for DWU are:

- **Conservation**
- **Additional Indirect Reuse**
- **Connect Lake Palestine (Dallas Portion of IPL and IPL to Bachman)**
- **Neches Run-of-River**
- **Lake Columbia**
- **Infrastructure to Treat and Deliver to Customers**

The alternative water management strategies for DWU are:

- **Direct Reuse**
- **Carrizo-Wilcox Groundwater**
- **Sabine Conjunctive System Operation (Off Channel Reservoir and Groundwater)**
- **Red River Off Channel Reservoir**
- **Marvin Nichols Reservoir (328)**
- **Wright Patman Reallocation**
- **Toledo Bend**
- **Lake Texoma Desalination**

These strategies are discussed individually below.

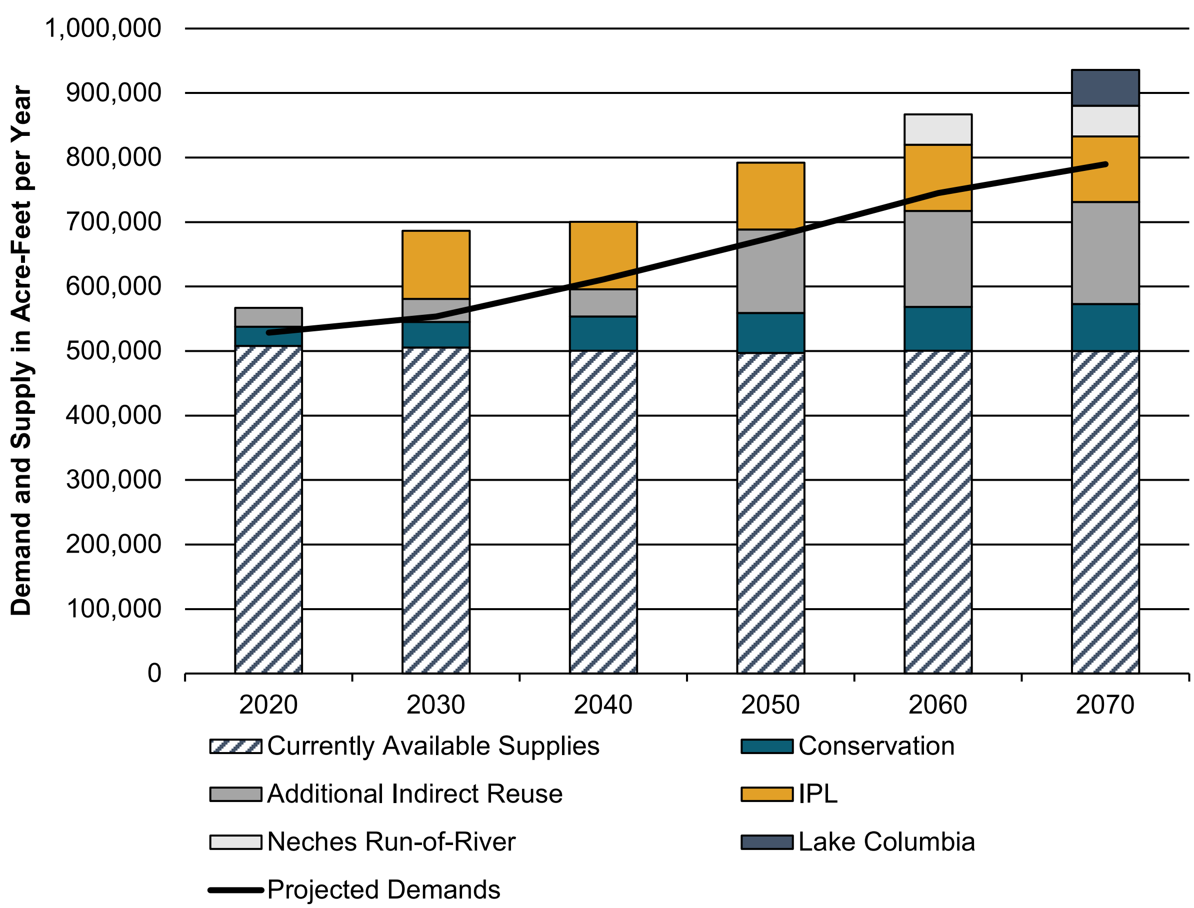
Conservation. The conservation savings for DWU's retail and wholesale customers are based on the Region C recommended water conservation program. Not including savings from low-flow plumbing fixtures (which are built into the demand projections) and not including reuse, conservation by DWU retail and wholesale customers is projected to reach 72,884 acre-feet per year by 2070.

Additional Indirect Reuse

Share of Additional Discharges to Lewisville Lake DWU's water right in Lewisville is larger than the yield which grants them access to additional discharges into the Lake.

Elm Fork Swap and Ray Hubbard Exchange DWU and NTMWD are in discussions to swap reuse water from several wastewater treatment plants. DWU will receive NTMWD treated wastewater discharges into the Lewisville watershed and in return DWU will provide discharges from their WWTPs on the Main Stem of the Trinity River to NTMWD. (The amount provided to NTMWD from Dallas will equal the increase in discharges from NTMWD's Lewisville watershed above historical levels.) NTMWD will divert the water provided by DWU to Lake Lavon using the Main Stem Pump Station. The projected supply from the Elm Fork Swap is based on wastewater flow projections for the purposes of regional and state planning – actual supplies are contingent on what is actually discharged. Capital costs are to be determined.

Figure 5D.1 Recommended Water Management Strategies for Dallas Water Utilities



Main Stem Balancing Reservoir DWU's recent Long Range Water Supply Plan identified a 300,000 acre-foot off channel reservoir in Ellis County southeast of Bristol Texas as the Main Stem Balancing Reservoir.

"*This site…could store Dallas' (and potentially other entities') return flows as well as stormwater runoff originating in the upstream Trinity River watershed. Additionally, because the diversion location for this strategy is downstream of the confluence with the East Fork of the Trinity River (East Fork), the Main Stem Balancing Reservoir could also be used to transfer water from Dallas' eastern system to Dallas' western system by storing water released from either Lake Ray Hubbard or from Dallas' eastern raw water transmission pipelines where they cross the East Fork. Dallas has secured water rights to use return flows from their Central and Southside wastewater treatment plants. This reuse water is a valuable asset that can be utilized by Dallas and does not require additional appropriation of state water. The storage of return flows in the balancing reservoir provides several benefits including water quality benefits and the benefit of being able to store the water during times of plenty and diverting it for subsequent use during times of drought….Water supplies will be delivered to the Joe Pool area through a 36.5 mile transmission system*."

The quantity of supplies available from this strategy is decreased from the previous round of planning. This is due in part to a portion of the DWU Central and Southside discharges now being allocated to NTMWD through the Elm Fork/Ray Hubbard Exchange strategy.

Connect Lake Palestine. DWU is currently working with Tarrant Regional Water District (TRWD) to develop integrated transmission facilities (Integrated Pipeline, or IPL) to connect Lake Palestine with the DWU system by 2030. DWU has a contract for 114,337 acre-feet per year of water from Lake Palestine but cannot currently access this supply due to lack of infrastructure. The firm yield of Lake Palestine is estimated to be 197,710 acre-feet per year in 2020. This represents a decrease from the authorized diversion, which is attributed to the reduction in storage capacity of the lake due to sedimentation and to releases for senior water rights downstream. The infrastructure necessary to move the water from Lake Palestine to a location near Joe Pool Lake for this strategy is discussed in the IPL Project Technical Memorandum located in **Appendix G**.

There will be a separate project to move the water from the IPL delivery point to the Bachman Water Treatment Plant where the supplies will be treated before being distributed to customers. It is assumed that the water from the IPL will be delivered directly to the Bachman WTP by pipeline.

Both capital costs are associated with the quantity of water available from Lake Palestine.

Neches Run-of-River Supply. Dallas and UNRMWA are long-term partners on Lake Palestine with their initial water sale contract being in place since 1972.

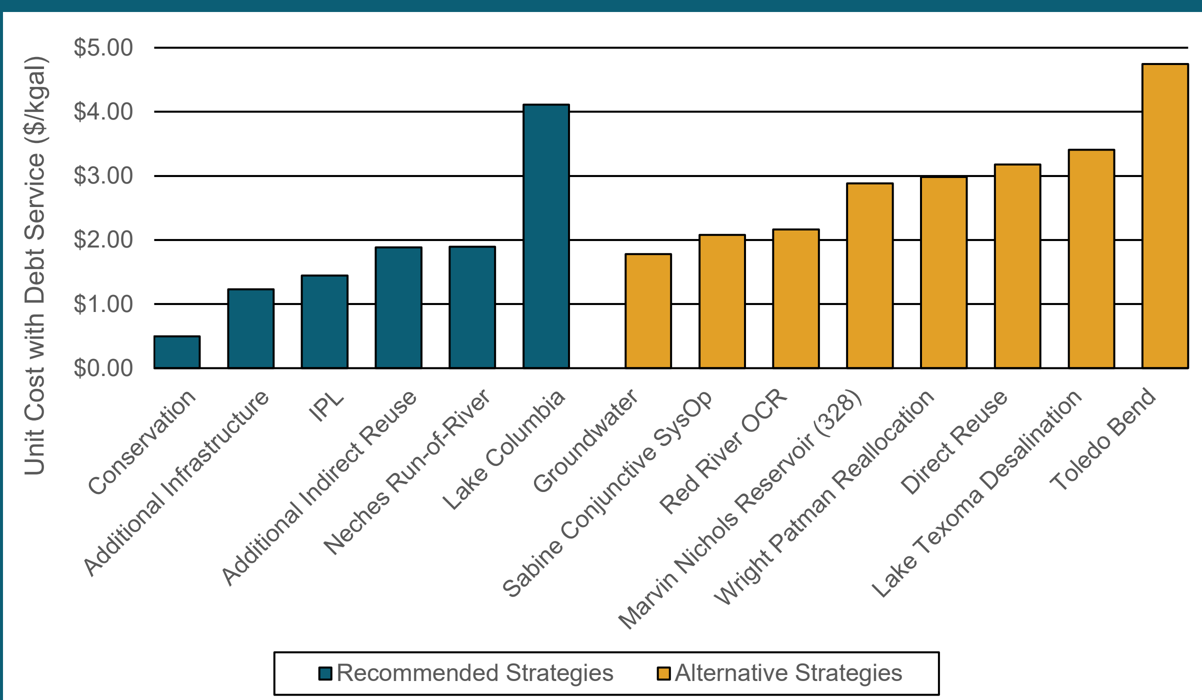
"*In 2013 Dallas and the Upper Neches River Municipal Water Authority (UNRMWA) initiated the Upper Neches River Water Supply Project Feasibility Study to evaluate options to replace the Fastrill Reservoir project that was rendered not feasible, at this time, by the establishment of a US Fish & Wildlife Service (USFWS) wildlife refuge in the footprint of the reservoir. The study provided technical evaluations of a range of potential water supply strategies for an Upper Neches Project….*"

"The selected Upper Neches Project strategy includes a new river intake and pump station for a run-of-river diversion from the Neches River near the SH 21 crossing. Water would be delivered through a 42-mile, 72-inch diameter pipeline to Dallas' pump station at Lake Palestine for delivery to Dallas through the IPL. Facilities include a small diversion dam on the Neches River, a river intake and pump station, and a transmission pipeline and booster pump station with delivery to the IPL pump station site near Lake Palestine."

Lake Columbia. *"Lake Columbia is a proposed reservoir project (previously known as Lake Eastex) of the Angelina and Neches River Authority (ANRA) and is a recommended strategy in the 2011 East Texas Regional Water Plan (Region I RWP). ANRA has been granted a water right permit (Permit No. 4228) by the TCEQ to impound 195,500 acre-feet in a new reservoir and to divert 76.3 MGD (85,507 acre-feet per year) for municipal and industrial purposes. ANRA estimates that after considering local needs, approximately 50 MGD of supply would be available to Dallas. The reservoir would be connected to Dallas' western system via a pipeline from Lake Columbia to the proposed IPL pump station at Lake Palestine. Water would then be delivered to the Lake Joe Pool area via the IPL. As currently planned, Dallas' capacity in the IPL is 150 MGD and, after considering Dallas' Lake Palestine supply of 102 MGD, the IPL will initially have available excess capacity of about 48 MGD. Considering the potential for Dallas to manage pumping rates from both Lakes Palestine and Columbia, it is reasonable for Dallas to potentially contract for up to 50 MGD of supply from Lake Columbia. The cost split is subject to future negotiations*

Strategy Unit Costs

Costs were developed for both recommended and alternative strategies. Costs are summarized in **Table 5D.2** and **Table 5D.3**.

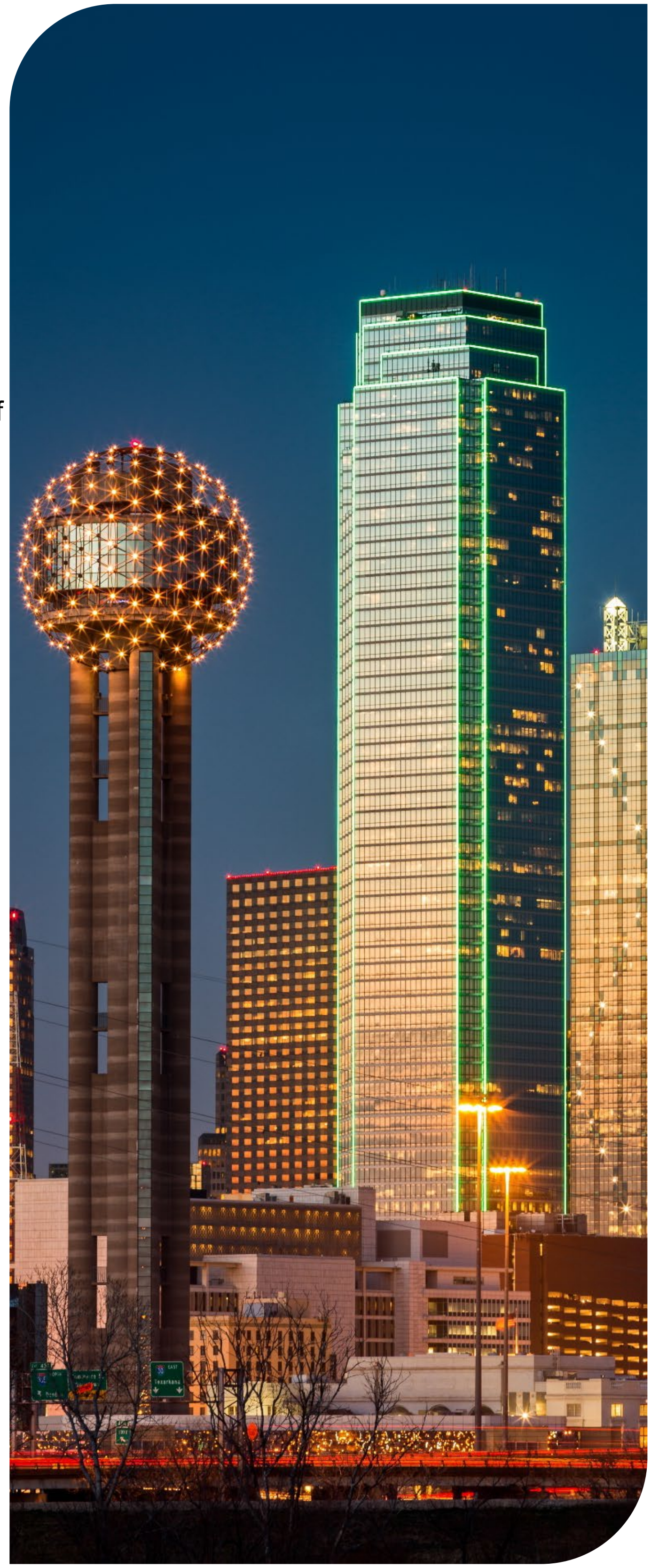


between Dallas and ANRA. Although for purpose of this study [Dallas Long Range Plan], the assumption was made that Dallas will be responsible for 70 percent of the dam, reservoir land acquisition, and relocations, and the local entities involved in the project will be responsible for the remaining 30 percent of these costs."

In January 2015 Dallas provided a letter to ANRA outlining Dallas' intent to pursue Lake Columbia as a recommended future strategy. ANRA is currently in the process of obtaining a US Army Corps of Engineers Section 404 permit.

Infrastructure to Treat and Deliver to Customers. In addition to securing raw water sources, Dallas must also treat the water, and Dallas is responsible for the infrastructure to deliver this treated water to its wholesale customers.

Several of DWU's recommended strategies involve connecting to and transporting supplies through the IPL. Due to capacity constraints of DWU's shared portion of the IPL, costs for a parallel IPL were included as well.



Downtown Dallas Skyline

Table 5D.1 Summary of Major Water Provider Plan – Dallas Water Utilities

Dallas Water Utilities (Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Demands						
Dallas	275,297	292,402	326,909	361,492	389,250	402,811
Addison	6,137	6,486	6,856	7,248	7,657	8,069
Carrollton	24,256	24,191	23,788	23,565	23,521	23,518
Cedar Hill	10,619	12,804	15,029	16,296	16,281	16,279
Cockrell Hill	417	431	415	405	536	1,140
Coppell	11,129	11,225	11,142	11,086	11,071	11,071
Balch Springs	2,749	2,894	3,066	3,293	3,546	3,808
Dallas County-Other (other than DFW airport)	126	65	77	88	171	232
Dallas County-Other (DFW airport only)	1,336	1,336	1,335	1,335	1,335	1,335
DeSoto	9,422	9,965	10,703	11,575	12,483	12,856
Duncanville	6,091	6,464	6,322	6,244	6,230	6,229
Farmers Branch	9,031	9,448	9,901	10,446	11,020	11,606
Flower Mound	6,166	6,166	6,166	6,166	6,166	6,166
Glenn Heights	1,824	2,413	3,049	3,797	4,544	6,214
Grand Prairie and Customers	33,454	34,195	37,499	37,246	37,187	37,182
Grapevine	2,778	2,847	2,701	2,674	2,696	2,730
Hutchins	2,186	3,033	3,888	4,748	5,612	6,479
Irving	17,052	5,000	5,000	5,000	5,000	5,000
Lancaster	7,670	9,755	11,407	12,634	13,905	15,186
Wilmer	*423*	*455*	*702*	*1,293*	*2,027*	*3,680*
Lewisville	20,142	22,440	25,329	28,688	31,973	31,969
Denton County FWSD 1-A	1,207	2,143	2,566	2,565	2,564	2,564
Ovilla	1,070	1,338	1,651	2,104	2,565	4,693
Red Oak	628	1,265	1,687	2,390	2,936	4,582
Seagoville	2,064	2,416	2,783	3,167	3,576	3,575
Combine WSC	352	408	470	565	671	786
Tarrant County-Other (DFW Airport)	1,335	1,335	1,335	1,335	1,335	1,335
The Colony	5,856	5,616	5,890	6,642	6,629	6,626
UTRWD Current Contract	42,919	49,097	51,809	52,622	53,281	53,952
Irrigation, Collin	2,844	2,844	2,844	2,844	2,844	2,844
Irrigation, Dallas	3,695	3,695	3,695	3,695	3,695	3,695
Manufacturing, Dallas Co	15,255	16,184	16,184	16,184	16,184	16,184
Steam Electric Power, Dallas	1,000	1,000	1,000	1,000	1,000	1,000
Irrigation, Denton	1,579	1,579	1,579	1,579	1,579	1,579
Manufacturing, Denton	26	26	26	26	26	26
Irrigation, Kaufman	28	28	28	28	28	28
Irrigation, Rockwall	347	347	347	347	347	347
Subtotal	**528,510**	**553,336**	**605,178**	**652,412**	**691,471**	**717,376**
Potential Future Customers						

Dallas Water Utilities (Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Denton and Customers	0	0	2,842	13,707	36,049	53,389
UTRWD Additional	0	0	0	5,605	11,210	11,210
Subtotal	***0***	***0***	***2,842***	***19,312***	***47,259***	***64,599***
Projected Demands	**528,510**	**553,336**	**608,020**	**671,724**	**738,730**	**781,975**
Existing Supplies						
Lake Ray Roberts/Lewisville/Elm Fork System	172,975	165,580	158,185	150,791	143,396	136,001
Grapevine Lake	7,367	7,367	7,367	7,142	6,896	6,650
Lake Ray Hubbard	55,730	54,828	53,926	53,024	52,122	51,220
Lake Tawakoni	174,080	169,120	164,160	159,200	154,240	149,280
Lake Fork	50,120	55,080	60,040	65,000	69,960	74,920
Direct Reuse (Golf courses)	1,121	1,121	1,121	1,121	1,121	1,121
White Rock Lake (Irrigation Only)	3,200	3,200	3,200	3,200	3,200	3,200
Indirect Reuse	43,451	49,167	52,547	57,540	69,313	77,705
Total Supplies	**508,044**	**505,463**	**500,546**	**497,018**	**500,248**	**500,097**
Need (Demand-Supply)	**20,466**	**47,873**	**107,474**	**174,706**	**238,482**	**281,878**
Water Management Strategies						
Conservation						
DWU Retail	*17,663*	*24,632*	*37,392*	*43,655*	*46,402*	*47,947*
Wholesale Customers	*11,846*	*15,085*	*15,673*	*18,263*	*21,645*	*24,923*
Additional Indirect Reuse						
Share of Additional Discharges to Lewisville Lake	*1,166*	*4,351*	*6,575*	*11,395*	*16,195*	*16,901*
Elm Fork Swap	*7,591*	*8,617*	*10,645*	*13,975*	*15,806*	*16,880*
Ray Hubbard Exchange	*20,477*	*22,783*	*24,899*	*25,483*	*26,931*	*28,778*
Main Stem Balancing Reservoir (Reuse)	*0*	*0*	*0*	*78,447*	*89,741*	*95,829*
Connect Lake Palestine (Palestine to IPL to Bachman)	0	105,370	104,564	103,704	102,791	101,555
Neches Run-of-River	0	0	0	0	47,250	47,250
Lake Columbia	0	0	0	0	0	56,000
Infrastructure to Treat and Deliver to Customers	*28,068*	*136,770*	*140,108*	*221,609*	*282,519*	*346,292*
Total Supplies from Strategies	**58,743**	**180,838**	**199,748**	**294,922**	**366,761**	**436,063**
Total Supplies	**566,787**	**686,301**	**700,294**	**791,940**	**867,009**	**936,160**
Reserve or (Shortage)	**38,277**	**132,965**	**92,274**	**120,216**	**128,279**	**154,185**
Management Supply Factor	**1.07**	**1.24**	**1.15**	**1.18**	**1.17**	**1.20**

Table 5D.2 Summary of Costs for Recommended Strategies - DWU

Strategy	Date to Be Developed	Quantity for DWU (Ac-Ft/Yr)	DWU Share of Capital Costs	Unit Cost ($/1000 gal) With Debt Service	Unit Cost ($/1000 gal) After Debt Service	Table for Details
Conservation (Retail)	2020	47,947	$16,933,907	$0.50	$0.26	H.11
Conservation (Wholesale)	2020	24,856	Included under County Summaries in Chapter 5E.			
Share of Additional Discharges to Lewisville Lake	2020	16,901	No costs associated with this WMS.			
Elm Fork Swap	2020	16,880	*To be determined*			
Ray Hubbard Exchange	2020	28,778				
Main Stem Balancing Reservoir (Reuse)	*2050*	*95,829*	*$772,904,000*	*$1.89*	*$0.63*	*H.34*
Connect Lake Palestine (Dallas Portion of IPL and IPL to Bachman)	2030	105,370	$717,381,000	$1.45	$0.46	H.25 & H.35
Neches Run-of-River	2060	47,250	$261,616,000	$1.89	$0.97	H.36
Lake Columbia	2070	56,000	$322,267,000	$1.77	$0.86	H.37
Infrastructure to Treat & Deliver to Customers	*2020*	*346,292*	$2,250,435,000	$1.23	$0.15	H.38
Parallel IPL	*2070*	*56,000*	$795,236,000	$2.34	$0.45	H.44
Total DWU Capital Costs			**$5,136,772,907**			

Table 5D.3 Summary of Costs for Alternative Strategies - DWU

Strategy	Online Date	Quantity for DWU (Ac-Ft/Yr)	DWU Share of Capital Costs	Unit Cost ($/1000 gal) With Debt Service	Unit Cost ($/1000 gal) After Debt Service	Table for Details
Direct Reuse Alternative	2020	2,501	$40,094,000	$3.18	$0.50	H.39
Carrizo-Wilcox Groundwater	2020	30,000	$185,710,000	$1.78	$0.75	H.40
Sabine Conjunctive SysOp (Off Channel Reservoir and Groundwater)	2020	104,200	$911,690,000	$2.08	$0.73	H.41
Red River Off Channel Reservoir	2020	114,000	$963,458,000	$2.16	$0.76	H.42
Marvin Nichols Reservoir (328)	2030	85,437	$1,092,760,000	$2.88	$0.71	H.21
Wright Patman Reallocation	2050	28,905	$397,470,000	$2.98	$0.91	H.24
Toledo Bend	2070	100,000	$2,010,393,000	$4.74	$1.39	H.19
Lake Texoma Desalination	2020	146,000	$1,429,468,000	$3.41	$1.78	H.43

5D.1.2 City of Fort Worth

The City of Fort Worth obtains raw water from the Tarrant Regional Water District (TRWD) and treats and distributes treated water to about 40 other water user groups in Tarrant County and surrounding counties.

The city also provides direct reuse water from Village Creek Wastewater Treatment Plant to meet non-potable water needs in the Cities of Arlington and Euless, Dallas-Fort Worth International Airport, and a few non-municipal customers within the City of Fort Worth. **Table 5D.4** shows the projected demands for Fort Worth and all customers.

The currently available supply to Fort Worth is limited by Fort Worth's current treatment capacity and by TRWD's raw water sources and transmission capacity. As Fort Worth increases treatment capacity and TRWD develops additional raw water supplies, Fort Worth's available supply will increase. The city also plans to implement additional direct reuse projects. Due to the city's ability to continue to purchase additional raw water supplies as needed, the management supply factor is kept at 1.00 in later decades. The City would not purchase supplies beyond their actual demands.

The recommended water management strategies for the City of Fort Worth are:

- **Conservation**
- **Alliance Direct Reuse**
- **Village Creek Water Reclamation Facility (WRF) Future Direct Reuse**
- **Mary's Creek WRF Future Direct Reuse**
- **Additional supply from Tarrant Regional Water District**
- **Expansion of Water Treatment Plants**

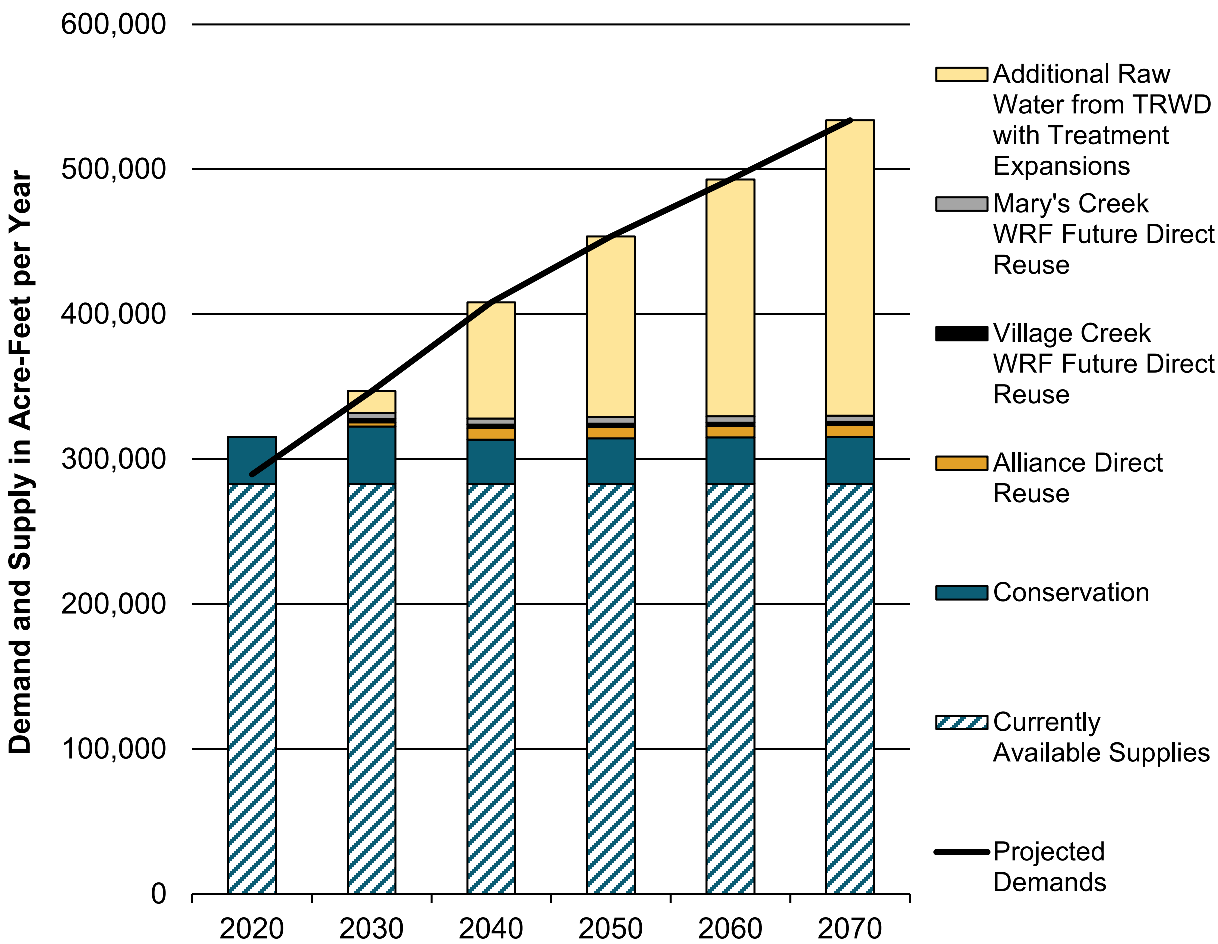
The City of Fort Worth has no alternative water management strategies. The recommended strategies are discussed individually below.

Fort Worth Skyline

Conservation. The City of Fort Worth has invested significant effort in its conservation program and has seen measurable results. The per capita use included in this plan ranges from 176 gpcd in 2020 down to 169 gpcd in 2070. Additional savings are expected through more conservation strategies. This strategy is the sum of projected conservation savings for Fort Worth and its existing and potential customers. Savings are based on the Region C recommended water conservation program and the City of Fort Worth's conservation program. Considered conservation measures include the Save Water Program, SmartFlush Toilet Replacement, SmartWater Audit, Twice a week Watering Ordinance, Indoor/Outdoor Surveys, W.I.S.E Guys Program, Pre-Rinse Spray Valves, Irrigation Nozzles, and Water Rate Increases measures. Any and all individual conservation strategies that Fort Worth chooses to implement in the future shall be considered to be consistent with this Plan for the purposes of obtaining TWDB financing. Not including savings from low-flow plumbing fixtures (which are built into the demand projections), conservation by Fort Worth and its customers is projected to reach over 32,500 acre-feet per year by 2070. Conservation savings are largest in 2030 due to savings associated with the Conservation & Condition Assessment Program (WCCAP).

Alliance Direct Reuse. This project would involve a partnership between Fort Worth, TRA, and Hillwood Corporation to serve

Figure 5D.2 Recommended Water Management Strategies for the City of Fort Worth



developments in the Alliance Airport area using effluent from TRA's Denton Creek Regional Wastewater System.

Village Creek and Mary's Creek Water Reclamation Facilities Future Direct Reuse. Fort Worth plans to further expand its direct reuse system by constructing additional conveyance and/or treatment facilities in other areas of the city.

Additional Supply from Tarrant Regional Water District. As the Tarrant Regional Water District develops new supplies and increases transmission capacity, Fort Worth's allocation of supply from the District will increase to meet projected demands.

Expansions of Water Treatment Plants. The City of Fort Worth has five water treatment plants: North Holly, South Holly, Rolling Hills, Eagle Mountain, and Westside. The current combined capacity of the existing water treatment plants is 497 mgd. In order to meet the projected demands, Fort Worth will expand water treatment plants to reach a total treatment capacity of 970 mgd by 2070. Due to uncertainty, expansions in later decades are listed as "General". Expansions at any of the city's water treatment plants are considered to be consistent with this strategy.

Strategy Unit Costs

Costs were developed for recommended strategies. Costs are summarized in **Table 5D.5**

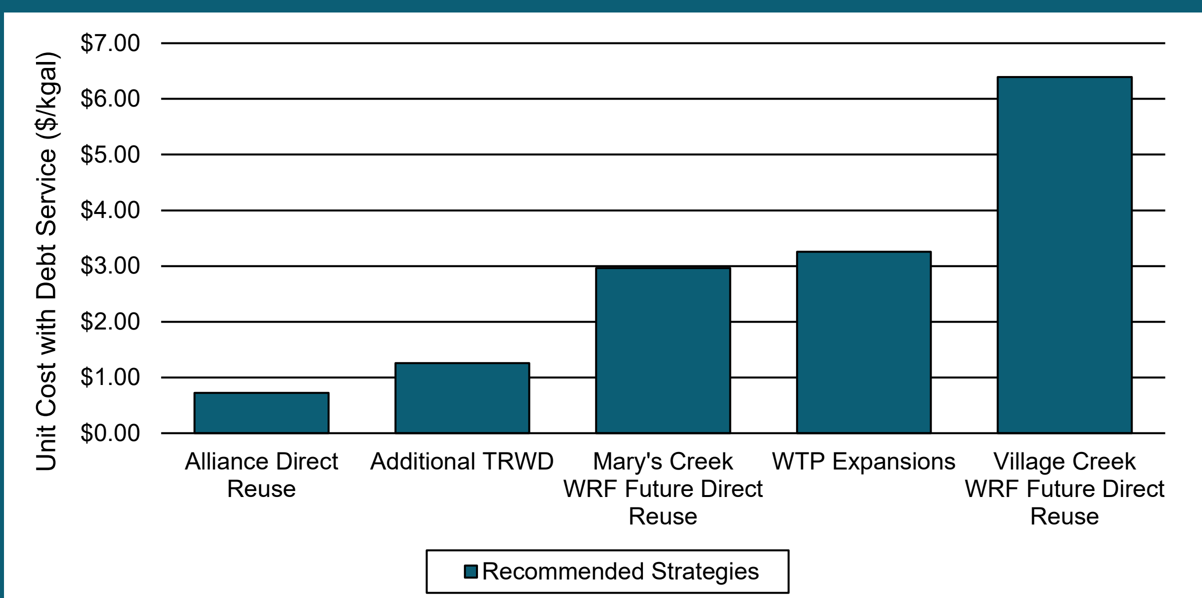


Table 5D.4 Summary of Major Water Provider Plan – Fort Worth

Fort Worth (Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Demands						
Fort Worth	189,110	234,597	286,277	317,771	345,469	373,410
Aledo	690	1,167	1,365	1,601	1,802	2,026
Bethesda WSC	2,469	2,946	3,447	4,006	4,623	5,275
Burleson	6,468	7,486	8,555	9,720	10,982	12,311
Crowley	2,248	2,597	3,093	3,728	4,805	5,513
Dallas County Other (DFWIA) Potable Demand	634	634	568	568	568	568
Dallas County Other (DFWIA) Reuse Demand	33	33	100	100	100	100
Dalworthington Gardens	545	551	557	566	577	588
Edgecliff	503	490	480	474	473	473
Everman	0	0	0	0	0	0
Forest Hill	1,359	1,377	1,445	1,699	2,159	2,811
Grand Prairie and Customers	1,401	1,401	1,401	1,401	1,401	1,401
Haltom City	5,238	5,179	5,260	5,619	6,039	6,581
Haslet	507	1,667	2,392	4,447	4,443	4,443
Hurst	6,318	6,309	6,173	6,098	6,085	6,084
Keller	12,339	13,148	13,073	13,028	13,013	13,012
Kennedale	606	505	759	1,042	1,334	1,629
Lake Worth	961	1,072	1,185	1,389	1,656	2,317
Manufacturing, Tarrant	9,611	10,505	10,505	10,505	10,505	10,505
North Richland Hills	8,541	8,971	8,836	8,760	8,744	8,743
Watauga	*2,844*	*2,740*	*2,655*	*2,608*	*2,600*	*2,599*
Northlake	609	1,436	2,034	2,832	3,630	3,630
Denton County Manufacturing	*26*	*26*	*26*	*26*	*26*	*26*
Richland Hills	906	943	986	1,129	1,270	1,458
Roanoke	2,255	2,797	3,345	3,339	3,337	3,336
Saginaw	3,169	3,528	3,903	4,087	4,080	4,079
Sansom Park	0	0	13	39	71	105
Southlake	11,455	12,813	14,945	17,109	19,314	21,556
Tarrant County Other	4,380	3,963	3,509	6,883	9,643	13,978
Tarrant County Other (DFWIA) Potable Demand	634	634	567	567	567	567
Tarrant County Other (DFWIA) Reuse	33	33	100	100	100	100
Trophy Club MUD 1	4,308	4,274	4,256	4,247	4,243	4,242
Westlake	1,782	4,884	7,982	8,927	8,925	8,925
Westover Hills	929	949	968	990	1,013	1,033
Westworth Village	401	423	447	475	506	538
White Settlement	1,471	1,497	1,535	1,862	2,522	3,187
Subtotal	***284,783***	***341,575***	***402,742***	***447,742***	***486,625***	***527,149***
Reuse Customers						
Arlington	178	178	178	178	178	178
Euless	368	368	368	368	368	368
Irrigation, Tarrant	2,000	2,000	2,000	2,000	2,000	2,000
Mining, Tarrant	1,754	1,811	1,677	1,677	1,677	1,677
Subtotal	***4,300***	***4,357***	***4,223***	***4,223***	***4,223***	***4,223***
Potential Future Customers						

Fort Worth (Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Pantego	0	33	33	33	33	33
Willow Park	166	553	819	1,163	1,677	1,971
Hudson Oaks	325	492	507	506	506	506
Subtotal	***491***	***1,078***	***1,359***	***1,702***	***2,216***	***2,510***
Projected Demands	**289,575**	**347,010**	**408,324**	**453,667**	**493,064**	**533,882**
- Potable Demand	*285,275*	*342,653*	*404,101*	*449,444*	*488,841*	*529,659*
- Direct Reuse Demand	*4,300*	*4,357*	*4,223*	*4,223*	*4,223*	*4,223*
Existing Supplies						
TRWD Raw Water	284,707	294,530	303,797	305,318	302,094	297,390
Water Treatment Capacity (497 MGD)	278,569	278,569	278,569	278,569	278,569	278,569
TRWD Limited by Treatment	278,569	278,569	278,569	278,569	278,569	278,569
Waterchase Golf Course Direct Reuse	897	897	897	897	897	897
Village Creek Direct Reuse	3,469	3,526	3,526	3,526	3,526	3,526
Total Supplies	**282,935**	**282,992**	**282,992**	**282,992**	**282,992**	**282,992**
Need (Demand - Supply)	**6,640**	**64,018**	**125,332**	**170,675**	**210,072**	**250,890**
Water Management Strategies						
Conservation (retail)	26,789	31,747	22,722	22,342	21,964	21,247
Conservation (wholesale)	5,812	7,970	7,910	9,058	10,118	11,344
Alliance Direct Reuse	0	2,800	7,840	7,840	7,840	7,840
Village Creek WRF Future Direct Reuse	0	2,442	2,442	2,442	2,442	2,442
Mary's Creek WRF Future Direct Reuse	0	4,245	4,245	4,245	4,245	4,245
Additional Raw Water Needed from TRWD with treatment as below:		14,814	80,173	124,748	163,463	203,772
Eagle Mountain - 35 MGD Expansion		*14,814*	*19,618*	*19,618*	*19,618*	*19,618*
West Plant - 23 MGD Expansion		*0*	*12,892*	*12,892*	*12,892*	*12,892*
Rolling Hills – 50 MGD Expansion		*0*	*28,025*	*28,025*	*28,025*	*28,025*
West Plant - 35 MGD Expansion		*0*	*19,618*	*19,618*	*19,618*	*19,618*
Eagle Mountain – 30 MGD Expansion		*0*	*20*	*16,815*	*16,815*	*16,815*
General – 50 MGD Expansion 1		*0*	*0*	*27,780*	*28,025*	*28,025*
General – 50 MGD Expansion 2		*0*	*0*	*0*	*28,025*	*28,025*
General – 50 MGD Expansion 3		*0*	*0*	*0*	*10,445*	*28,025*
General – 50 MGD Expansion 4		*0*	*0*	*0*	*0*	*22,729*
Total Supplies from Strategies	***32,601***	***64,018***	***125,332***	***170,675***	***210,072***	***250,890***
Total Supplies	**315,536**	**347,010**	**408,324**	**453,667**	**493,064**	**533,882**
Reserve or (Shortage)	**25,961**	**0**	**0**	**0**	**0**	**0**
Management Supply Factor	**1.09**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**

Table 5D.5 Summary of Costs for Recommended Strategies – City of Fort Worth

Strategy	Developed Before:	Quantity for Fort Worth (Ac-Ft/Yr)	Fort Worth Share of Capital Costs	Unit Cost ($/1000 gal) With Debt Service	Unit Cost ($/1000 gal) After Debt Service	Table for Details
Conservation (retail)	2020	31,747	$195,851,589	$1.63	$0.09	H.11
Conservation (wholesale)	2020	11,344	Included under County Summaries in Chapter 5E.			
Alliance Direct Reuse	2030	7,840	$23,102,000	$0.72	$0.08	H.61
Village Creek WRF Future Direct Reuse	2030	2,442	$97,410,000	$6.40	$1.03	H.59
Mary's Creek WRF Future Direct Reuse	2030	4,245	$46,576,000	$2.96	$0.59	H.60
Additional TRWD	2030	244,713	$0	$1.26	$1.26	None
Eagle Mountain – 35 MGD Expansion	*2030*	*19,618*	*$173,564,000*	*$3.28*	*$1.37*	*H.13*
West Plant – 23 MGD Expansion	*2040*	*12,892*	*$118,537,000*	*$3.41*	*$1.42*	*H.13*
Rolling Hills – 50 MGD Expansion	*2040*	*28,025*	*$242,347,000*	*$3.20*	*$1.34*	*H.13*
West Plant – 35 MGD Expansion	*2040*	*19,618*	*$173,564,000*	*$3.28*	*$1.37*	*H.13*
Eagle Mountain – 30 MGD Expansion	*2040*	*16,815*	*$150,636,000*	*$3.32*	*$1.39*	*H.13*
General – 50 MGD Expansion 1	*2050*	*28,025*	*$242,347,000*	*$3.20*	*$1.34*	*H.13*
General – 50 MGD Expansion 2	*2060*	*28,025*	*$242,347,000*	*$3.20*	*$1.34*	*H.13*
General – 50 MGD Expansion 3	*2060*	*28,025*	*$242,347,000*	*$3.20*	*$1.34*	*H.13*
General – 50 MGD Expansion 4	*2070*	*28,025*	*$242,347,000*	*$3.20*	*$1.34*	*H.13*
Total Capital Costs			**$2,190,975,589**			

5D.1.3 North Texas Municipal Water District

The North Texas Municipal Water District (NTMWD) serves much of the rapidly growing suburban area north and east of Dallas, supplying water to over 95 cities and water suppliers including the cities of Plano, Allen, Frisco, McKinney, Garland, and Mesquite. The population served by NTMWD is expected to more than double over the next 50 years, growing from about 1.8 million people in 2020 to 3.8 million in 2070. While the population will grow more than 110%, demands on the NTMWD are only expected to increase by just over 50% from 2020 to 2070. **Table 5D.6** shows the projected demands for NTMWD and all customers.

NTMWD's current primary sources of raw water are Lavon Lake, Chapman Lake, Lake Texoma, Lake Tawakoni and the East Fork Water Reuse Project. NTMWD has state water rights permits to store and divert water from these sources, but the lakes are managed and operated by the U.S. Army Corps of Engineers (USACE). Bois d'Arc Lake will be the first reservoir that NTMWD solely owns and operates. NTMWD provides treated water and owns and operates six water treatment plants.

The recommended water management strategies for NTMWD are:

- **Conservation**
- **Bois d'Arc Lake**
- **Additional Lake Texoma Blend Phase I and II**
- **Additional Measure to Access Full Lavon Yield (Raw Water #4)**
- **Expanded Wetland Reuse**
- **Additional Lavon Watershed Reuse**
- **Marvin Nichols Reservoir (328)**
- **Wright Patman Reallocation**
- **Oklahoma**
- **Infrastructure to Treat and Deliver to Customers**
    - **Fannin County Water Supply System**
    - **Treatment and Distribution Improvements (CIP)**
    - **Chapman Booster Pump Station**

The alternative water management strategies are:

- **Toledo Bend Reservoir**
- **Lake O' the Pines**
- **Lake Texoma with desalination at Leonard**
- **Carrizo-Wilcox Groundwater**
- **George Parkhouse Reservoir (North)**
- **George Parkhouse Reservoir (South)**
- **Aquifer Storage and Recovery**

These strategies are discussed individually below.

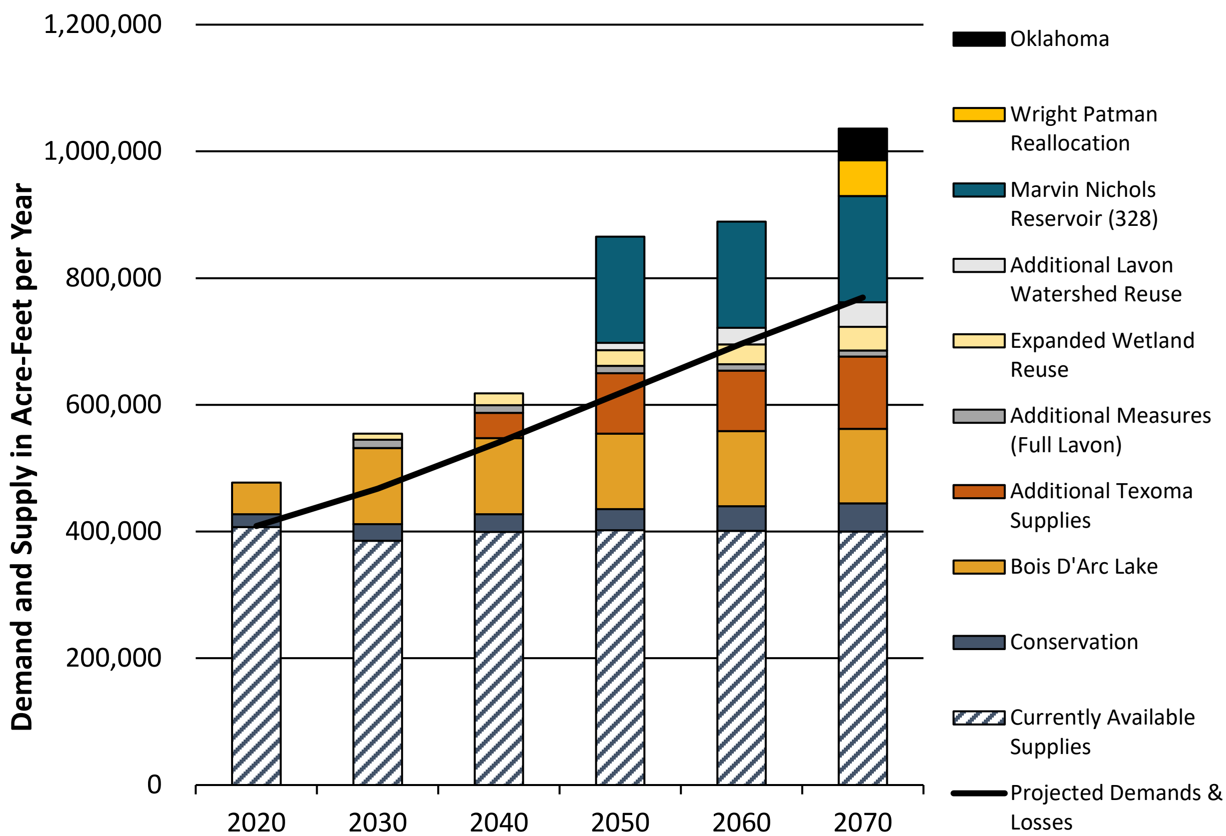
Conservation. Conservation is the projected conservation savings for NTMWD's existing and potential customers, based on the Region C recommended water conservation program. Not including savings from low-flow plumbing fixtures (which are built into the demand projections) and not including reuse, conservation by NTMWD customers is projected to reach over 44,400 acre-feet per year by 2070.

Bois d'Arc Lake. Bois d'Arc Lake, formerly known as Lower Bois d 'Arc Creek Reservoir, was a recommended strategy for the North Texas Municipal Water District (NTMWD) in the past four Region C Water Plans. [1, 2, 3] The project is located in Region C on Bois d'Arc Creek in Fannin County, northeast of the City of Bonham. At the conservation pool elevation of 534 feet MSL, the lake will have a surface area of 16,641 acres and a capacity of 367,609 acre-feet. Bois d'Arc Lake will provide up to 120,200 acre-feet per year for NTMWD and Fannin County.

This project is currently under construction and includes the dam and lake, raw water intake, and transmission pipeline to the Leonard Water Plant (also currently under construction), and approximately 19,000 acres of mitigation. Impoundment of water is expected to begin in 2021 with initial operation beginning in 2022.

Additional Lake Texoma Blend Phase I and II NTMWD holds a Texas water right in Lake Texoma to divert and use up to 197,000 acre-feet per year from the lake. Water from Lake Texoma is brackish, which means that the use of Texoma water requires the water to be blended with a freshwater source or desalinated. For NTMWD, there are three potential sources

Figure 5D.3 Recommended Water Management Strategies for the North Texas Municipal Water District



of water for blending: Bois d'Arc Lake, Marvin Nichols Reservoir and Wright Patman Reallocation supplies. If the Toledo Bend strategy is implemented this could be another potential source for blending. All of these sources are expected to have good quality water with TDS levels at 300 mg/l or less. The anticipated blending ratio for NTMWD water from Lake Texoma with these sources is 3:1. Additional transmission capacity will be needed by 2060 to deliver additional Lake Texoma supply to be blended for Lake Texoma Blend Phase II.

Additional Measures to Access Full Yield of Lake Lavon (Raw Water #4). If necessary, in drought conditions, NTMWD will take emergency measures to access water in Lake Lavon below elevation 467 MSL. These measures may include but are not limited to: construction of raw water pump station #4, extension and/or dredging of the pump station intake channel and utilizing floating barges equipped with pumps. Any emergency measures deemed necessary at the time will be considered to be consistent with this plan.

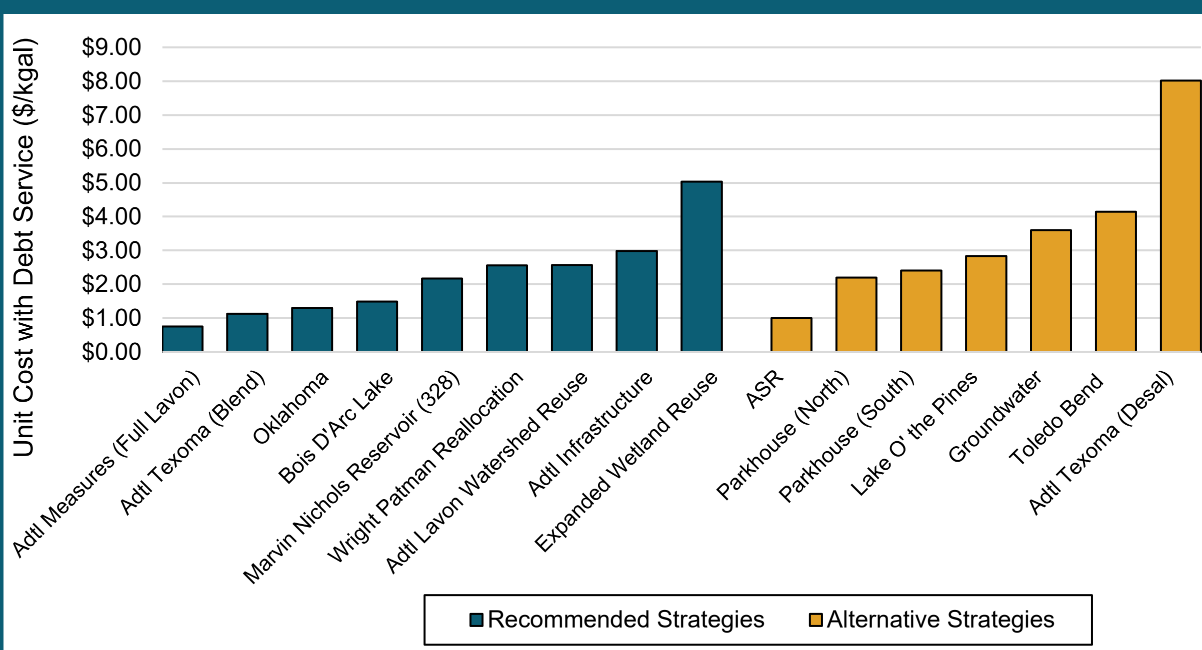
Expanded Wetland Reuse. The proposed Expanded Wetland Reuse project will treat return flows from wastewater treatment plants owned and operated by NTMWD. The return flows for this project come from two sources.

Elm Fork Swap The first source of water for the project are return flows from Dallas' (DWU) Central and Southside wastewater treatment plants, provided through a swap agreement between DWU and NTMWD. This agreement provides NTMWD return flow from DWU's Central and Southside WWTPs in equal exchange for NTMWD's return flows into DWU's reservoirs.

Additional Reuse The second is through growth in return flows from plants owned and operated by NTMWD that discharge into the East Fork of the Trinity River. It is expected that the quantity of return flows

Strategy Unit Costs

Costs were developed for both recommended and alternative strategies. Costs are summarized in **Table 5D.7** and **Table 5D.8.**



available from this source will exceed the treatment capacity of the existing East Fork Wetlands by the year 2030.

Additional Lavon Watershed Reuse. NTMWD is currently permitted for 71,882 acre-feet per year from Wilson Creek WWTP, as well as 1.01 MGD from Farmersville No. 1 WWTP, Farmersville No. 2 WWTP, and Seis Lagos WWTP. This provides a permitted constraint of 73,014 acre-feet per year. This strategy is for reuse of projected return flows beyond the current permitted amount. Treatment costs to remove nutrients are also included in this strategy.

Marvin Nichols Reservoir. This strategy assumes that Marvin Nichols Reservoir (at 328 MSL) will come online in 2050. This strategy is a joint recommended strategy for NTMWD, TRWD and UTRWD in Region C. Additionally, 20% of the supplies from Marvin Nichols Reservoir will be reserved for water users in Region D.

Wright Patman Reallocation. This strategy is assumed to come online in 2070. The USACE selected an increase of Lake Wright Patman to an elevation of 235 MSL to be the Tentatively Selected Plan (TSP) in February 2019. Like Marvin Nichols Reservoir, this is a joint recommended strategy for NTMWD, TRWD and UTRWD in Region C.

Toledo Bend. Toledo Bend Reservoir is an existing impoundment located in the Sabine River Basin on the border of Texas and Louisiana. It was built in the 1960s by SRA and SRA of Louisiana. The yield of the project is split equally between Texas and Louisiana. This is a joint alternative strategy to supply NTMWD, DWU, TRWD and UTRWD. It is planned to be a recommended strategy in 2080 for NTMWD and TRWD.

Oklahoma. At the present time, the Oklahoma Legislature has established a moratorium on the export of water from the

Bois d'Arc Lake Construction Aerial

state. For the long term, Oklahoma still remains a potential source of water supply for Region C users.

Infrastructure to Treat and Deliver to Customers:

Fannin County Water Supply System NTMWD will cooperate with Fannin County entities to develop a treated water supply system for Fannin County water users after Bois d'Arc Lake is developed by 2030.

Chapman Booster Pump Station Capital costs for this WMS will be split between NTMWD and Irving. This strategy will provide greater reliability of supply and operational flexibility and has no new supplies associated with it.

Treatment and Distribution Improvements In addition to securing raw water sources, NTMWD must also treat the water, and all infrastructure to deliver this treated water to its member cities is the responsibility of NTMWD. NTMWD has a schedule of projects necessary to do this. These projects are divided into decadal needs.

Additional Upper Sabine. NTMWD has temporary supplies through a contract with the SRA in Lake Tawakoni and Lake Fork. The total temporary contract amount from SRA is up to 40,000 acre-feet per year through October 2025. NTMWD plans to pursue an extension of these temporary supplies. However, due to the uncertainty of how much might be available, this strategy has not been included as a recommended or alternative strategy.

Table 5D.6 Summary of Major Water Provider Plan – North Texas Municipal Water District

North Texas MWD (Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Demands						
Ables Springs WSC	363	466	586	759	967	1,222
Allen	21,887	23,536	23,806	24,125	24,496	24,902
Manufacturing, Collin	*67*	*78*	*78*	*78*	*78*	*78*
Bear Creek SUD	689	1,044	1,472	2,035	2,673	3,658
Bonham	2,024	2,505	3,393	4,598	5,662	6,882
Manufacturing, Fannin	*12*	*12*	*12*	*12*	*12*	*12*
Caddo Basin SUD	1,015	1,275	1,670	2,219	2,983	4,044
Cash SUD	1,457	1,793	2,129	2,466	2,466	2,466
College Mound WSC	464	575	694	871	1,279	1,620
Copeville SUD	278	329	395	542	955	1,633
Crandall	763	926	1,104	1,368	1,381	1,381
East Fork SUD	1,913	2,045	2,229	2,378	2,599	2,823
Fairview	4,498	5,162	6,871	7,146	7,223	7,222
Farmersville	1,036	2,504	5,665	8,640	12,276	17,744
Caddo Basin SUD	*113*	*142*	*185*	*246*	*331*	*449*
Copeville SUD	*49*	*58*	*70*	*96*	*168*	*288*
North Farmersville WSC	*91*	*104*	*126*	*158*	*180*	*199*
Fate	2,818	3,626	4,869	6,422	7,803	8,663
Forney	3,090	3,554	4,509	5,634	8,343	11,114
High Point WSC	*221*	*262*	*308*	*378*	*568*	*734*
Talty SUD	*1,800*	*2,061*	*2,363*	*3,312*	*4,609*	*6,352*
Kaufman County Development District 1	*879*	*1,120*	*1,361*	*1,804*	*2,520*	*3,361*
Markout WSC	*415*	*526*	*637*	*843*	*1,177*	*1,569*
Manufacturing, Kaufman	*653*	*765*	*765*	*765*	*765*	*765*
Steam Electric Power, Kaufman	*1,121*	*1,121*	*1,121*	*1,121*	*1,121*	*1,121*
Forney Lake WSC	1,261	1,544	1,854	2,306	3,819	5,414
Frisco	44,000	49,127	59,711	74,656	83,008	87,175
Hackberry	*452*	*578*	*730*	*902*	*1,103*	*1,332*
Manufacturing, Collin	*67*	*78*	*78*	*78*	*78*	*78*
Manufacturing, Denton	*26*	*26*	*26*	*26*	*26*	*26*
Garland	41,106	43,868	45,346	45,444	45,644	45,644
Manufacturing, Collin	*22*	*26*	*26*	*26*	*26*	*26*
Manufacturing, Dallas	*2,948*	*3,115*	*3,115*	*3,115*	*3,115*	*3,115*
Steam Electric Power, Collin	*40*	*40*	*40*	*40*	*40*	*40*
Gastonia Scurry SUD	710	880	1,058	1,354	2,265	3,533
Greater Texoma Utility Authority						
Anna	*1,235*	*2,893*	*5,275*	*7,182*	*9,662*	*12,899*

North Texas MWD (Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Howe	*0*	*24*	*57*	*88*	*134*	*182*
Manufacturing, Grayson	*30*	*30*	*30*	*30*	*30*	*30*
Melissa	*3,210*	*11,682*	*16,629*	*20,906*	*24,150*	*25,009*
Van Alstyne	*10*	*202*	*475*	*750*	*1,912*	*2,539*
Josephine	346	553	784	1,038	1,074	1,074
Kaufman	1,280	1,533	1,841	2,875	3,752	4,602
Becker Jiba WSC	*323*	*401*	*480*	*669*	*933*	*1,243*
County Other, Kaufman	*98*	*176*	*194*	*195*	*802*	*1,835*
Manufacturing, Kaufman	*9*	*11*	*11*	*11*	*11*	*11*
North Kaufman WSC	*29*	*37*	*45*	*60*	*84*	*112*
Little Elm	4,075	4,564	4,550	4,538	4,528	4,528
Lucas	2,316	2,613	3,438	3,990	4,455	4,454
McKinney	40,856	44,424	48,984	59,223	70,879	76,807
Manufacturing, Collin	*225*	*260*	*260*	*260*	*260*	*260*
Melissa	*561*	*561*	*561*	*561*	*561*	*561*
Mesquite	22,334	23,847	26,347	28,428	30,653	32,932
Kaufman County MUD 11	*608*	*730*	*883*	*1,077*	*1,318*	*1,616*
Manufacturing, Dallas	*327*	*346*	*346*	*346*	*346*	*346*
Milligan WSC	450	511	614	766	870	963
Mount Zion WSC	501	615	740	886	1,061	1,241
Murphy	4,441	4,414	4,402	4,393	4,388	4,387
Nevada SUD	250	298	345	1,116	2,642	4,752
North Collin SUD	818	921	1,055	1,254	1,463	1,685
Parker	3,123	3,096	3,302	3,852	4,239	4,843
Plano	73,808	73,946	74,311	74,125	74,142	74,891
County Other, Collin	*127*	*115*	*106*	*96*	*681*	*1,335*
Manufacturing, Collin	*225*	*260*	*260*	*260*	*260*	*260*
The Colony	*1,200*	*2,000*	*2,200*	*2,200*	*2,200*	*2,200*
Princeton	1,184	3,964	7,951	9,320	9,303	9,298
Culleoka WSC	*597*	*596*	*901*	*1,094*	*1,237*	*1,546*
Prosper	5,169	7,028	8,909	10,925	12,942	12,941
Richardson	27,459	27,744	28,115	28,719	29,084	29,923
Manufacturing, Collin	*1,506*	*1,744*	*1,744*	*1,744*	*1,744*	*1,744*
Rockwall	9,902	14,346	21,079	22,002	23,798	25,611
Blackland WSC	*865*	*961*	*1,017*	*1,038*	*1,167*	*1,256*
County Other, Rockwall	*401*	*562*	*573*	*534*	*592*	*917*
Heath	*3,946*	*5,563*	*6,992*	*7,078*	*7,397*	*7,718*
Manufacturing, Rockwall	*31*	*36*	*36*	*36*	*36*	*36*
R C H WSC	*900*	*1,234*	*1,432*	*1,736*	*2,246*	*2,737*

North Texas MWD (Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Rose Hill SUD	441	523	613	773	1,022	1,569
Rowlett	10,331	10,936	11,608	12,182	12,671	13,328
Royse City	1,350	2,345	3,316	6,068	9,045	10,976
B H P WSC	*391*	*467*	*571*	*711*	*918*	*1,216*
Sachse	5,215	5,159	5,127	5,166	5,175	5,174
Seis Lagos UD	577	573	571	592	598	598
Sunnyvale	2,234	3,159	4,089	4,710	4,707	4,706
Terrell	3,857	7,237	9,786	11,370	12,658	14,741
College Mound WSC	*310*	*384*	*462*	*580*	*853*	*1,080*
County Other, Kaufman	*65*	*118*	*129*	*130*	*535*	*1,224*
Elmo WSC	*216*	*268*	*320*	*421*	*586*	*782*
High Point WSC	*221*	*261*	*307*	*378*	*567*	*734*
Manufacturing, Kaufman	*284*	*333*	*333*	*333*	*333*	*333*
North Kaufman WSC	*163*	*208*	*255*	*340*	*475*	*634*
Poetry WSC	*353*	*430*	*528*	*681*	*913*	*1,228*
Wylie	7,106	7,496	7,824	8,338	8,658	9,490
Manufacturing, Collin	*22*	*26*	*26*	*26*	*26*	*26*
Wylie Northeast SUD	674	795	924	1,498	2,238	3,295
Irrigation, Collin	1,640	1,640	1,640	1,640	1,640	1,640
Irrigation, Rockwall	672	672	672	672	672	672
Subtotal	***389,245***	***442,742***	***504,777***	***567,973***	***633,085***	***691,455***
Potential Future Customers						
Blue Ridge	0	613	6,353	14,705	20,995	29,112
Bois d Arc MUD	0	26	81	187	401	641
Celina	0	1,500	3,000	5,000	5,000	5,000
County Other, Fannin	0	50	50	316	1,815	3,510
Honey Grove	0	284	277	275	274	274
Leonard	0	347	353	363	376	390
Southwest Fannin County SUD	0	0	15	117	343	604
Trenton	0	5	204	568	1,095	1,619
Subtotal	***0***	***2,825***	***10,333***	***21,531***	***30,299***	***41,150***
Losses in Treatment & Delivery (5%)	**19,460**	**22,276**	**25,754**	**29,473**	**33,167**	**36,628**
Projected Demands	**408,705**	**467,843**	**540,864**	**618,977**	**696,551**	**769,233**
Existing Supplies						
Lake Lavon	92,280	91,802	91,324	90,846	90,368	89,890
Lake Texoma	69,998	73,738	76,401	76,975	76,795	76,614
Lake Chapman	42,768	42,525	42,282	42,039	41,796	41,553

North Texas MWD (Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Lavon Watershed Reuse	48,896	58,626	69,999	73,014	73,014	73,014
Lake Bonham	2,036	2,517	3,195	3,195	3,195	3,195
East Fork Reuse (with Ray Hubbard Pass through and Main Stem PS)	96,047	102,000	102,000	102,000	102,000	102,000
Upper Sabine Basin	51,201	10,655	10,565	10,475	10,395	10,293
Direct Reuse for Irrigation	3,713	3,713	3,713	3,713	3,713	3,713
Total Supplies	**406,939**	**385,576**	**399,479**	**402,257**	**401,276**	**400,272**
Need (Demand-Supply)	**1,766**	**82,267**	**141,385**	**216,720**	**295,275**	**368,961**
Water Management Strategies						
Conservation (Wholesale)	20,368	26,003	27,995	33,104	38,776	44,428
Bois D'Arc Lake	50,000	120,200	120,200	119,200	118,400	117,600
Additional Lake Texoma - Blend with Bois D'Arc Lake Supplies	0	0	39,571	39,733	39,467	39,200
Additional measure to access full Lavon yield (Raw Water #4)	0	13,361	12,398	11,435	10,473	9,510
Expanded Wetland Reuse						
Elm Fork Swap	*0*	*8,617*	*10,645*	*13,975*	*15,806*	*16,880*
Additional Reuse	*0*	*547*	*7,610*	*10,581*	*15,441*	*20,630*
Additional Lavon Watershed Reuse	0	0	0	11,826	26,140	38,780
Marvin Nichols Reservoir (328)	0	0	0	167,524	167,524	167,524
Additional Lake Texoma - Blend with Marvin Nichols Supplies	0	0	0	55,841	55,841	55,841
Wright Patman Reallocation	0	0	0	0	0	56,676
Additional Lake Texoma - Blend with Wright Patman Reallocation Supplies	0	0	0	0	0	18,892
Oklahoma	0	0	0	0	0	50,000
Fannin County Water Supply System	*0*	*686*	*1,067*	*2,982*	*6,274*	*9,941*
Treatment and Distribution (CIP)	*50,000*	*151,889*	*208,679*	*454,672*	*480,338*	*629,043*
Chapman Booster Pump Station	*0*	*0*	*0*	*0*	*0*	*0*
Total Supplies from Strategies	**70,368**	**168,728**	**218,419**	**463,220**	**487,867**	**635,961**
Total Supplies	**477,307**	**554,304**	**617,898**	**865,477**	**889,143**	**1,036,233**
Reserve or (Shortage)	**68,602**	**86,461**	**77,034**	**246,500**	**192,592**	**267,000**
Management Supply Factor	**1.17**	**1.18**	**1.14**	**1.40**	**1.28**	**1.35**

Table 5D.7 Summary of Costs for Recommended Strategies – North Texas Municipal Water District

Strategy	Date to be Developed	Quantity for NTMWD (Ac-Ft/Yr)	NTMWD Share of Capital Costs	Unit Cost ($/1000 gal) With Debt Service	Unit Cost ($/1000 gal) After Debt Service	Table for Details
Conservation[a]	2020	44,428	Included under County Summaries in Chapter 5E.			
Bois D'Arc Lake	2020	120,200	$939,638,000	$1.49	$0.25	H.46
Additional Lake Texoma Blend Phase I	2040	39,733	$228,206,000	$1.23	$0.28	H.47
Additional measure to access full Lavon yield (Raw Water #4)	2030	13,361	$32,753,000	$0.76	$0.23	H.45
Expanded Wetland Reuse	2030	37,510	$625,891,000	$5.03	$2.30	H.51
Additional Lavon Watershed Reuse	2050	38,780	$300,000	$2.57	$2.56	H.50
Marvin Nichols Reservoir (328)	2050	167,524	$1,702,936,000	$2.17	$0.43	H.20
Wright Patman Reallocation	2070	56,676	$730,827,000	$2.56	$0.63	H.23
Additional Lake Texoma Blend Phase II	2060	74,733	$346,367,000	$1.04	$0.32	H.48
Oklahoma	2070	50,000	$259,924,000	$1.30	$0.43	H.49
Fannin County Water Supply System	*2030*	*9,941*	*$131,891,000*	*$6.11*	*$3.25*	*H.53*
Treatment and Distribution (CIP)	*2020*	*629,043*	*$5,015,029,000*	*$1.55*	*$0.42*	*H.52*
Chapman Booster Pump Station	*2020*	*0*	*$21,659,000*	*$0.00*	*$0.00*	*H.26*
Total NTMWD Capital Costs			**$10,035,421,000**			

[a]Conservation savings are reflected in NTMWD's customers' conservation savings. NTMWD has an extensive water conservation program, the costs for which are not reflected in this table.

Table 5D.8 Summary of Costs for Alternative Strategies – North Texas Municipal Water District

Strategy	Online Date	Quantity for NTMWD (Ac-Ft/Yr)	NTMWD Share of Capital Costs	Unit Cost ($/1000 gal) With Debt Service	Unit Cost ($/1000 gal) After Debt Service	Table for Details
Toledo Bend	2070	100,000	$1,663,942,000	$4.15	$1.26	H.19
Lake O' the Pines	2030	50,000	$567,896,000	$2.83	$0.94	H.54
Lake Texoma – Desalinate at Leonard	2020	33,630	$880,563,000	$8.01	$3.65	H.55
Carrizo-Wilcox Groundwater	2020	42,000	$607,023,000	$3.60	$1.19	H.56
George Parkhouse Reservoir (North)	2050	85,200	$930,193,000	$2.20	$0.50	H.57
George Parkhouse Reservoir (South)	2050	92,800	$1,176,874,000	$2.41	$0.46	H.58
Aquifer Storage and Recovery	2020	2,500	$6,041,000	$1.00	$0.48	H.18

5D.1.4 Tarrant Regional Water District

Tarrant Regional Water District (TRWD) owns and operates a system of reservoirs and a reuse facility in the Trinity River Basin. The TRWD system provides water either directly or indirectly to over 80 water user groups and is expected to provide water to additional water user groups in the future. **Table 5D.9** shows the projected demands for TRWD and all customers.

Since the last regional plan was published, TRWD has almost completed its portion of the Integrated Pipeline Project (IPL), which is a joint pipeline with the City of Dallas, to deliver additional supplies from east Texas reservoirs. The completion of the IPL will increase TRWD's transmission capacity, bringing additional supplies from Richland-Chambers and Cedar Creek Reservoirs. The IPL is expected to be completed by 2030.

The total safe yield supply currently available from the TRWD system accounting for delivery infrastructure limits is about 487,000 acre-feet per year in 2020. The yield of the existing supply is estimated to decline to little more than 471,000 acre-feet per year by 2070. This supply is based on the safe yield of the TRWD reservoirs, rather than the firm yield. TRWD operates its raw water system in accordance with its Management Plan, which is based on the safe yield of the system. The firm yield available to TRWD, which is not used in this analysis but is required to be reported in the regional plan, is approximately 595,000 acre-feet per year in 2020.

The recommended water management strategies for TRWD are as follows:

- **Conservation**
- **Aquifer Storage and Recovery Pilot**
- **Additional Capacity to Convey Richland Chambers Reuse (IPL)**
- **Cedar Creek Wetland Reuse**
- **Reuse from TRA Central WWTP**
- **Lake Tehuacana**
- **Carrizo-Wilcox Groundwater**
- **Marvin Nichols Reservoir (328)**
- **Wright Patman Reallocation**
- **Additional Transmission Pipeline**

The alternative water management strategies are:

- **Toledo Bend**

These strategies are discussed individually below.

Safe Yields

Safe yield is defined as the water that could have been supplied from a reservoir or reservoir system during a repeat of drought-of-record conditions, leaving some amount (in this case, one year's supply) in reserve at the minimum content.

Source	Firm Yield in Ac-Ft/Yr		Safe Yield in Ac-Ft/Yr	
	2020	2070	2020	2070
West Fork (includes Bridgeport Local)	115,908	102,825	94,192	85,525
Cedar Creek Reservoir	204,587	202,700	158,891	150,400
Richland-Chambers (TRWD)	221,565	207,201	185,230	164,000
Lake Benbrook	6,740	6,671	5,391	5,370
Lake Arlington	9,700	8,950	7,640	7,090

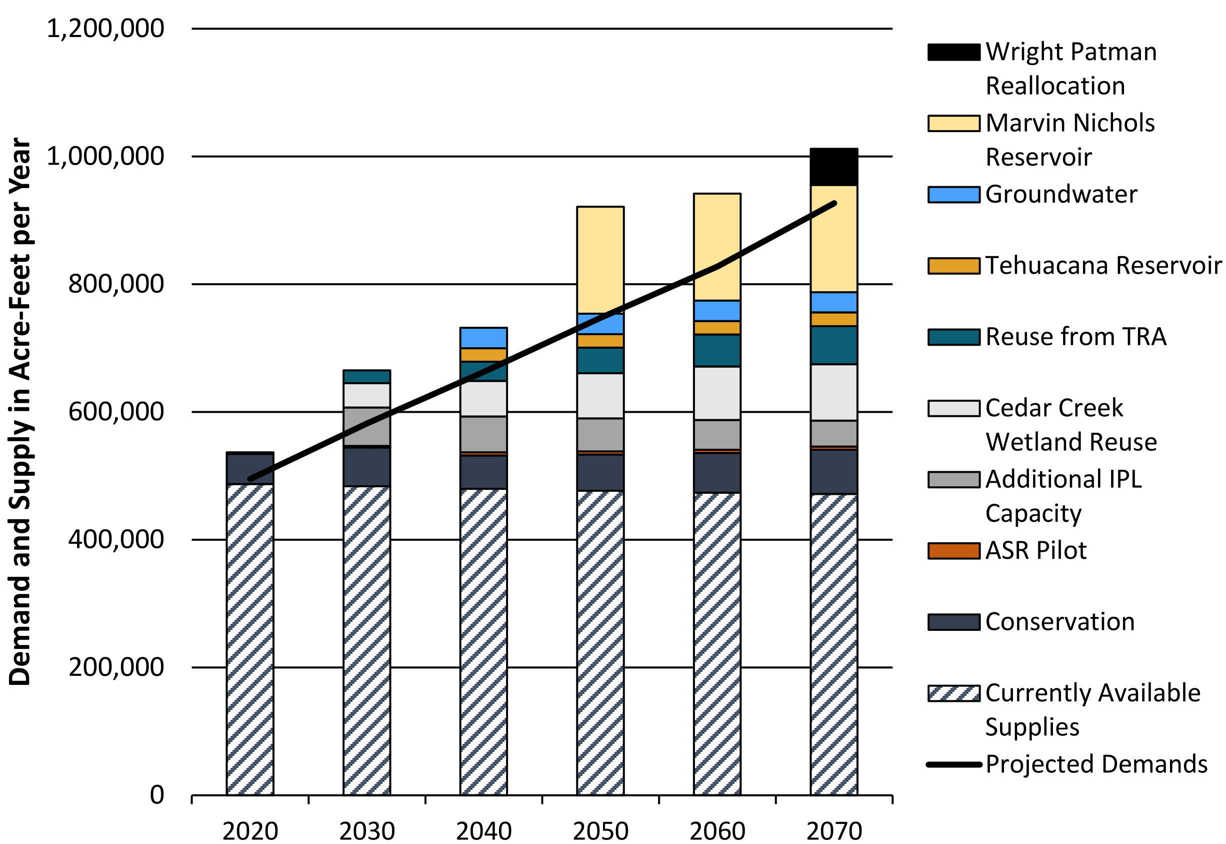
Conservation. Conservation for TRWD is the projected water savings from the Region C recommended water conservation program for TRWD's existing and potential customers. Not including savings from low-flow plumbing fixtures (which are built into the demand projections) and not including reuse, conservation by TRWD customers is projected to reach over 56,000 acre-feet per year by 2070.

Aquifer Storage and Recovery Pilot. TRWD is currently evaluating the potential for an ASR project near an existing surface water treatment facility. This pilot study is on-going, and the results are not available at this time. Conceptually, the ASR project would treat excess surface water at an existing water treatment plant. The treated water would then be stored in the Trinity aquifer during low demand winter or spring months and normal to wet years. This could be a phased project in multiple locations.

Additional Capacity to Convey Richland Chambers Reuse (IPL). As mentioned above, the Integrated Pipeline Project (IPL) is a joint pipeline with the City of Dallas which will deliver additional TRWD supplies from east Texas reservoirs. This supply includes the portions of the yield from Cedar Creek Lake and Richland-Chambers reuse project that are currently not available due to delivery constraints. This pipeline will also have capacity to deliver the new supply created by the reuse wetlands project at Cedar Creek Reservoir described below.

Cedar Creek Wetland Reuse. TRWD has water rights allowing the diversion of return flows of treated wastewater from the Trinity River. TRWD has already developed a reuse project at Richland-Chambers Reservoir, and a portion of the supply from this project is included in the currently available supply. The water is pumped from the Trinity River into the constructed George W. Shannon Wetlands for treatment and

Figure 5D.4 Recommended Water Management Strategies for Tarrant Regional Water District



then pumped into Richland-Chambers Reservoir. TRWD will be developing an additional similar reuse project at Cedar Creek Reservoir in the near future. In November 2014, TRWD's certificates of adjudication for these reuse projects were amended to increase the total permitted reuse diversion to 188,524 acre-feet per year, including 100,465 acre-feet per year at Richland-Chambers and 88,059 acre-feet per year at Cedar Creek Reservoir.

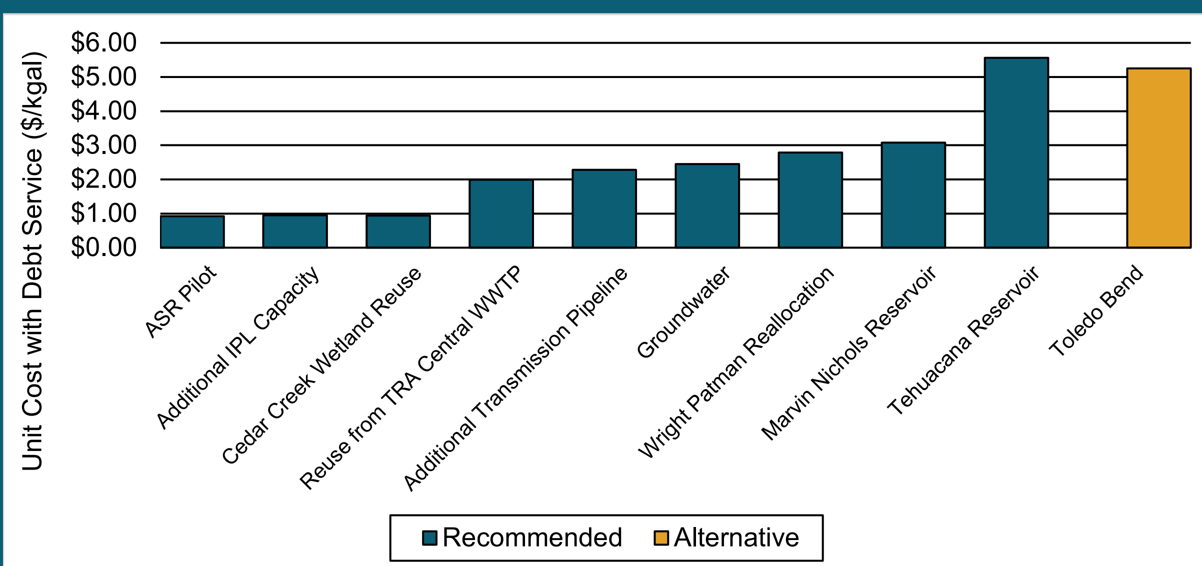
Reuse from TRA Central WWTP. TRA will provide TRWD with reuse water from the Central RWS. These supplies will be sent to Cedar Creek Wetland, with expansions to the wetland and transmission facilities as needed.

Lake Tehuacana. Lake Tehuacana is a proposed water supply project on Tehuacana Creek in Freestone County within the Trinity River Basin. Tehuacana Creek is a tributary of the Trinity River and lies immediately south of and adjacent to Richland Creek on which the existing Richland-Chambers Reservoir is located. Lake Tehuacana will connect to Richland-Chambers Reservoir by a 9,000-foot channel and be operated as an integrated extension of that reservoir. The project would have a firm yield of 25,400 acre-feet per year and a safe yield of 21,070 acre-feet per year. The reservoir would store approximately 338,000 acre-feet and inundate approximately 15,000 acres. The existing spillway for Richland-Chambers Reservoir has enough discharge capacity to accommodate the increased flood flows from Lake Tehuacana for the probable maximum flood event. Therefore, it is assumed that the dam for Lake Tehuacana can be constructed without a spillway and can function to increase storage for the Richland-Chambers-Tehuacana Reservoir and capture Tehuacana Creek flows. Developing this site will require obtaining a new water right and constructing the dam and reservoir.

Carrizo-Wilcox Groundwater. This strategy proposes to develop groundwater from the Carrizo-Wilcox and Queen City aquifers in Freestone and Anderson Counties. The groundwater would be transported approximately 28 miles to the

Strategy Unit Costs

Costs were developed for recommended and alternative strategies. Costs are summarized in **Table 5D.10** and **Table 5D.11**.



Integrated Pipeline (IPL) near Cedar Creek Reservoir. The IPL would then be used to move the groundwater to TRWD's service area. This strategy assumes the groundwater is mixed directly in the IPL with surface water and/or reuse water. This groundwater supply would supplement TRWD's existing water sources and provide diversity to its existing portfolio. The infrastructure required for this strategy includes 39 wells (most likely distributed over multiple well fields), well field piping, ground storage, pump station, and 28 miles of 36- to 54-inch diameter transmission pipeline.

Marvin Nichols Reservoir. This strategy assumes that Marvin Nichols Reservoir (at 328 MSL) will come online in 2050. This strategy is a joint recommended strategy for NTMWD, TRWD and UTRWD in Region C. Additionally, 20% of the supplies from Marvin Nichols Reservoir will be reserved for water users in Region D.

Wright Patman Reallocation. This strategy is assumed to come online in 2070. The USACE selected an increase of Lake Wright Patman to an elevation of 235 MSL to be the Tentatively Selected Plan (TSP) in February 2019. Like Marvin Nichols Reservoir, this is a joint recommended strategy for NTMWD, TRWD and UTRWD in Region C.

Toledo Bend. Toledo Bend Reservoir is an existing impoundment located in the Sabine River Basin on the border of Texas and Louisiana. It was built in the 1960s by SRA and SBRA of Louisiana. The yield of the project is split equally between Texas and Louisiana. This is a joint alternative strategy to supply NTMWD, DWU, TRWD and UTRWD. It is planned to be a recommended strategy in 2080 for NTMWD and TRWD.

Additional Transmission Pipeline. As demands continue to grow, TRWD will need to develop additional transmission infrastructure to transport raw water supplies. This strategy assumes an additional transmission pipeline with enough capacity to transport remaining recommended strategy supplies. However, any improved system operation or additional infrastructure for TRWD is consistent with the Region C Water Plan.

Richland Chambers Reservoir

Table 5D.9 Summary of Major Water Provider Plan – Tarrant Regional Water District

TRWD (Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Demands						
Arlington and customers	70,615	72,342	72,996	74,188	74,368	74,695
Azle	1,932	2,036	2,151	2,286	2,754	3,527
Benbrook Water Authority	4,965	5,415	5,882	6,598	7,345	7,345
Bridgeport	1,273	1,526	1,793	2,456	3,268	4,083
Community WSC	338	360	384	419	455	490
East Cedar Creek FWSD	1,351	1,500	1,669	1,853	2,059	2,288
Fort Worth	189,110	234,597	286,277	317,771	345,469	373,410
Aledo	*690*	*1,167*	*1,365*	*1,601*	*1,802*	*2,026*
Bethesda WSC	*2,469*	*2,946*	*3,447*	*4,006*	*4,623*	*5,275*
Burleson	*6,468*	*7,486*	*8,555*	*9,720*	*10,982*	*12,311*
Crowley	*2,248*	*2,597*	*3,093*	*3,728*	*4,805*	*5,513*
Dallas County Other (DFW Airport Only)	*634*	*634*	*568*	*568*	*568*	*568*
Dalworthington Gardens	*545*	*551*	*557*	*566*	*577*	*588*
Edgecliff	*503*	*490*	*480*	*474*	*473*	*473*
Forest Hill	*1,359*	*1,377*	*1,445*	*1,699*	*2,159*	*2,811*
Grand Prairie and Customers	*1,401*	*1,401*	*1,401*	*1,401*	*1,401*	*1,401*
Haltom City	*5,238*	*5,179*	*5,260*	*5,619*	*6,039*	*6,581*
Haslet	*507*	*1,667*	*2,392*	*4,447*	*4,443*	*4,443*
Hurst	*6,318*	*6,309*	*6,173*	*6,098*	*6,085*	*6,084*
Keller	*12,339*	*13,148*	*13,073*	*13,028*	*13,013*	*13,012*
Kennedale	*606*	*505*	*759*	*1,042*	*1,334*	*1,629*
Lake Worth	*961*	*1,072*	*1,185*	*1,389*	*1,656*	*2,317*
Manufacturing, Tarrant	*9,612*	*10,505*	*10,505*	*10,505*	*10,505*	*10,505*
North Richland Hills	*8,541*	*8,971*	*8,836*	*8,760*	*8,744*	*8,743*
Watauga	*2,844*	*2,740*	*2,655*	*2,608*	*2,600*	*2,599*
Northlake	*609*	*1,436*	*2,034*	*2,832*	*3,630*	*3,630*
Manufacturing, Denton	*26*	*26*	*26*	*26*	*26*	*26*
Richland Hills	*906*	*943*	*986*	*1,129*	*1,270*	*1,458*
Roanoke	*2,255*	*2,797*	*3,345*	*3,339*	*3,337*	*3,336*
Saginaw	*3,169*	*3,528*	*3,903*	*4,087*	*4,080*	*4,079*
Sansom Park	*0*	*0*	*13*	*39*	*71*	*105*
Southlake	*11,455*	*12,813*	*14,945*	*17,109*	*19,314*	*21,556*
County Other, Tarrant	*4,380*	*3,963*	*3,509*	*6,883*	*9,643*	*13,978*
Tarrant County Other (DFW Airport Only)	*634*	*634*	*567*	*567*	*567*	*567*
Trophy Club MUD 1	*4,308*	*4,274*	*4,256*	*4,247*	*4,243*	*4,242*
Westlake	*1,782*	*4,884*	*7,982*	*8,927*	*8,925*	*8,925*
Westover Hills	*929*	*949*	*968*	*990*	*1,013*	*1,033*
Westworth Village	*401*	*423*	*447*	*475*	*506*	*538*

TRWD (Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
White Settlement	*1,471*	*1,497*	*1,535*	*1,862*	*2,522*	*3,187*
Mabank	1,982	2,158	2,326	3,081	4,317	6,011
County Other, Kaufman	*62*	*62*	*62*	*62*	*62*	*62*
Malakoff	28	28	26	30	45	65
Mansfield and Customers	24,123	35,441	41,161	48,067	53,462	58,874
River Oaks	856	823	796	781	778	778
Runaway Bay	527	588	652	785	891	1,069
County Other, Wise	*731*	*759*	*709*	*856*	*957*	*2,894*
Springtown	903	1,196	1,189	1,184	1,183	1,183
County Other, Tarrant	231	209	185	362	508	736
Trinity River Authority	0	0	0	0	0	0
Bedford	*8,757*	*9,234*	*9,746*	*10,340*	*10,323*	*10,323*
Colleyville	*9,211*	*9,693*	*10,313*	*10,656*	*10,648*	*10,648*
Ennis and Customers	*0*	*617*	*1,561*	*3,988*	*5,758*	*15,325*
Grapevine	*11,535*	*11,535*	*11,535*	*11,535*	*11,535*	*11,535*
Euless	*6,588*	*6,824*	*6,642*	*6,542*	*6,523*	*6,522*
North Richland Hills	*4,271*	*4,486*	*4,418*	*4,380*	*4,372*	*4,372*
Waxahachie and Current Customers	*2,500*	*2,500*	*2,410*	*4,269*	*9,413*	*15,351*
Midlothian and Customers	8,125	13,315	15,650	15,190	15,950	17,072
Rockett SUD and Customers	4,348	5,914	6,828	9,349	13,279	19,859
Walnut Creek SUD and Customers	2,827	3,321	3,800	5,215	7,279	9,635
Weatherford	2,987	3,937	4,353	8,739	15,724	22,511
Hudson Oaks	*650*	*983*	*1,015*	*1,013*	*1,012*	*1,012*
County Other, Parker	*0*	*0*	*0*	*1,200*	*2,500*	*4,000*
Manufacturing, Parker	*20*	*20*	*20*	*20*	*20*	*20*
West Cedar Creek MUD	1,214	1,274	1,333	1,440	1,762	2,158
Kemp	*301*	*364*	*433*	*540*	*836*	*1,170*
West Wise SUD	454	454	457	465	481	497
Chico	*84*	*92*	*102*	*357*	*506*	*681*
Wise County WSD						
Decatur	*2,319*	*3,149*	*4,060*	*5,240*	*6,157*	*7,156*
Manufacturing, Wise	*45*	*50*	*50*	*50*	*50*	*50*
County Other, Henderson	251	167	173	86	0	60
County Other, Navarro	39	64	71	94	118	237
Manufacturing, Navarro	*5*	*5*	*5*	*5*	*5*	*5*
Steam Electric Power, Freestone	6,726	6,726	6,726	6,726	6,726	6,726
Mining, Henderson	130	152	144	145	144	141
Steam Electric Power, Henderson	659	659	659	659	659	659
Mining, Jack	2,690	1,103	974	1,004	1,036	1,127

TRWD (Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Steam Electric Power, Jack	3,772	3,772	3,772	3,772	3,772	3,772
Irrigation, Kaufman	125	125	125	125	125	125
Irrigation, Tarrant	1,478	1,478	1,478	1,478	1,478	1,478
Mining, Tarrant	3,566	1,023	0	0	0	0
Steam Electric Power, Tarrant	198	2,461	1,629	1,629	1,629	1,629
Irrigation, Wise	587	587	587	587	587	587
Mining, Wise	8,032	8,871	10,049	11,687	13,090	15,406
Steam Electric Power, Wise	2,894	2,894	2,894	2,894	2,894	2,894
Subtotal	***492,023***	***573,801***	***648,535***	***721,969***	***795,268***	***885,792***
Potential Future Customers						
Alvord	0	46	94	164	220	276
Annetta	0	200	200	200	200	200
Avalon Water Supply & Sewer Service	0	2	2	31	157	337
Cleburne[a]	0	0	5,601	11,202	11,202	11,202
Fairfield	0	0	0	630	973	1,686
Files Valley WSC	0	2	2	15	48	68
Grand Prairie	0	2,242	2,074	2,074	2,074	2,074
Hudson Oaks	325	492	507	506	506	506
Italy	0	5	5	84	357	684
Kennedale	0	280	280	280	280	280
Mountain Peak SUD	705	1,699	2,140	5,229	6,398	7,505
Pantego	0	67	66	66	66	66
Pelican Bay	0	0	0	3	5	7
Sardis-Lone Elm	1,208	2,326	2,404	2,649	2,908	2,906
South Ellis County WSC	0	0	0	165	490	892
Willow Park	166	553	819	1,163	1,677	1,971
County Other, Freestone	0	0	0	354	905	2,403
County Other, Kaufman	9	16	17	17	70	161
County Other, Parker	683	341	0	697	3,719	7,839
Subtotal Potential	***1,888***	***5,945***	***11,807***	***22,880***	***29,347***	***38,157***
Projected Demands	***495,119***	***582,072***	***662,746***	***747,498***	***827,523***	***926,855***
Existing Supplies						
West Fork System	94,192	92,458	90,725	88,992	87,258	85,525
Benbrook Lake	5,391	5,387	5,383	5,378	5,374	5,370
Lake Arlington	7,640	7,530	7,420	7,310	7,200	7,090
Cedar Creek Lake	158,641	156,942	155,244	153,546	151,848	150,150

TRWD (Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Richland-Chambers Reservoir	185,230	180,984	176,738	172,492	168,246	164,000
Richland-Chambers Reuse	35,931	40,202	44,455	49,078	53,899	59,762
Total Supplies	**487,025**	**483,503**	**479,965**	**476,797**	**473,826**	**471,897**
Need (Demand - Supply)	***8,094***	***98,569***	***182,781***	***270,701***	***353,698***	***454,958***
Water Management Strategies						
Conservation (Wholesale)	47,221	60,724	52,054	56,622	62,198	68,958
Aquifer Storage and Recovery Pilot	2,500	2,500	5,000	5,000	5,000	5,000
Additional Capacity to Convey Richland Chambers Reuse (IPL)	0	60,263	56,010	51,387	46,566	40,703
Cedar Creek Wetland Reuse	0	38,323	55,807	70,819	83,870	88,059
Reuse from TRA Central WWTP	0	20,000	30,000	40,000	50,000	60,000
Lake Tehuacana	0	0	21,070	21,070	21,070	21,070
Carrizo-Wilcox Groundwater	0	0	32,000	32,000	32,000	32,000
Marvin Nichols Reservoir	0	0	0	167,524	167,524	167,524
Wright Patman Reallocation	0	0	0	0	0	56,676
Additional Transmission Pipeline	*0*	*0*	*179,000*	*179,000*	*179,000*	*179,000*
Total Supplies from Strategies	**49,721**	**181,810**	**251,941**	**444,422**	**468,228**	**539,990**
Total Supplies	**536,746**	**665,313**	**731,906**	**921,219**	**942,054**	**1,011,887**
Reserve (Shortage)	**41,627**	**83,241**	**69,160**	**173,721**	**114,530**	**85,032**
Management Supply Factor	**1.08**	**1.14**	**1.10**	**1.23**	**1.14**	**1.09**

[a]Potential future demand for Cleburne would likely be met through an indirect sale from another wholesale water provider in Region C (TRWD would sell the water to the wholesale water provider who would then sell the water to Cleburne).

Table 5D.10 Summary of Costs for Recommended Strategies – Tarrant Regional Water District

Strategy	Date to be Developed	Quantity for TRWD (Ac-Ft/Yr)	TRWD Share of Capital Costs	Unit Cost ($/1000 gal)		Table for Details
				With Debt Service	After Debt Service	
Conservation (Wholesale)	2020	60,297	Included under County Summaries in Chapter 5E.			
Aquifer Storage and Recovery Pilot	2020	5,000	$14,264,000	$0.92	$0.30	H.28
Additional Capacity to Convey Richland Chambers Reuse (IPL)	2030	60,263	$507,733,000	$0.95	$0.48	H.25
Cedar Creek Wetland Reuse	2030	88,059	$226,318,000	$0.94	$0.51	H.29
Reuse from TRA Central WWTP	2030	60,000	$154,205,000	$1.99	$1.57	H.30
Lake Tehuacana	2040	21,070	$325,468,000	$3.28	$0.96	H.31
Carrizo-Wilcox Groundwater	2040	32,000	$191,469,000	$2.45	$1.15	H.32
Marvin Nichols Reservoir	2050	167,524	$2,360,638,000	$3.08	$0.68	H.20
Wright Patman Reallocation	2070	56,676	$765,040,000	$2.78	$0.75	H.23
Additional Transmission Pipeline	2040	179,000	$1,765,505,000	$2.28	$0.64	H.33
Total TRWD Capital Costs			**$6,310,640,000**			

Table 5D.11 Summary of Costs for Alternative Strategies – Tarrant Regional Water District

Strategy	Online Date	Quantity for TRWD (Ac-Ft/Yr)	TRWD Share of Capital Costs	Unit Cost ($/1000 gal)		Table for Details
				With Debt Service	After Debt Service	
Toledo Bend	2070	100,000	$2,246,057,000	$5.25	$1.50	H.19

5D.1.5 Trinity River Authority

The Trinity River Authority (TRA) currently provides water to Region C users in several ways:

- TRA provides water from its own water rights in four different lakes (Lakes Bardwell, Navarro Mills, Joe Pool, and Livingston).
- TRA purchases and treats water from the Tarrant Regional Water District (TRWD) and supplies Tarrant County cities through the Tarrant County Water Supply Project.
- TRA contracts with TRWD and provides raw water to water users in Ellis and Freestone Counties.
- TRA provides reuse water to entities in Collin, Dallas, Ellis and Kaufman Counties.

TRA also owns and operates several wastewater treatment plants, and has plans to develop a number of direct and indirect reuse projects in Region C. **Table 5D.12** shows the projected demands for TRA and all customers.

The following water management strategies are recommended for TRA:

- **Conservation**
- **Additional Supply from Tarrant Regional Water District**
- **Ennis Indirect Reuse**
- **Joe Pool Lake Reuse**
- **Tarrant and Denton County Direct Reuse**
- **Central Reuse to TRWD**
- **Central Reuse to Irving**

These projects are discussed below.

TRA Outfall

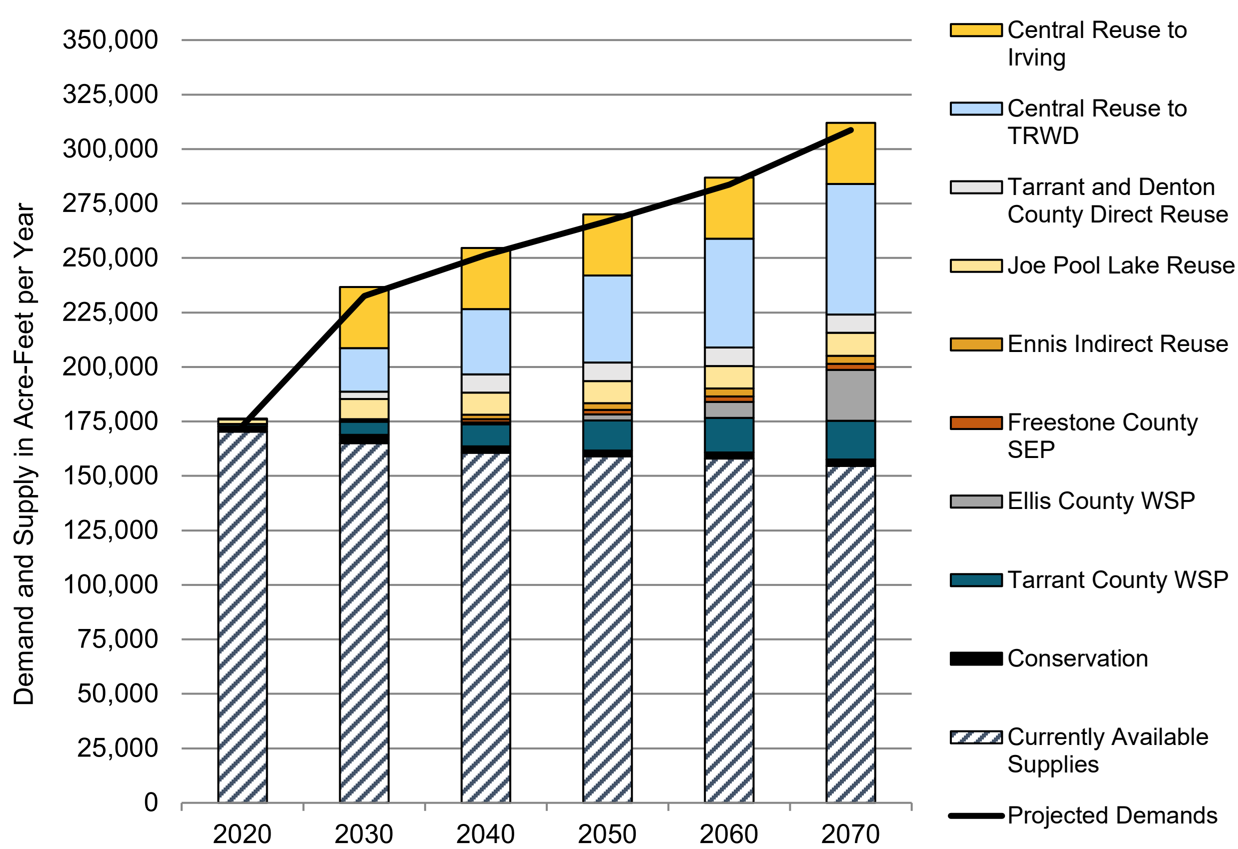
Conservation. Conservation is the projected conservation savings for existing and potential customers of the TRA, based on the Region C recommended water conservation program. Not including savings from low-flow plumbing fixtures (which are built into the demand projections) and not including reuse, conservation by TRA customers is projected to reach over 2,900 acre-feet per year by 2070.

Additional supply from Tarrant Regional Water District

Tarrant County Water Supply Project. As mentioned above, TRA purchases and treats water from the Tarrant Regional Water District (TRWD) and supplies Tarrant County cities through the Tarrant County Water Supply Project.

Ellis County Water Supply Project. The Ellis County Water Supply Project delivers raw water from the Tarrant Regional Water District (TRWD) pipelines to water suppliers in Ellis County. Raw water is diverted from the TRWD pipelines and treated at water treatment plants operated by Ennis, Waxahachie, and Rockett SUD. The supply that is currently available for the Ellis County Water Supply Project is limited by local treatment facilities and by TRWD currently available supply. Treatment plant expansions by Ennis, Waxahachie, and Rockett SUD, and TRWD strategies to obtain additional raw water will make sufficient water available to meet all future needs. The capital costs for any of these plant expansions will be borne by local entities and the capital costs for raw water strategies will be borne by TRWD, so no capital costs are shown for TRA.

Figure 5D.5 Recommended Water Management Strategies for Trinity River Authority



Steam Electric Power, Freestone. The Calpine Plant steam electric power demand is supplied by TRA with water obtained from TRWD.

Ennis Indirect Reuse. The source for this water management strategy will be effluent from the City of Ennis Wastewater Treatment Plant (WWTP). This reclaimed water would augment TRA's supply in Lake Bardwell. As amended, the permit allows TRA to divert up to 3,696 acre-feet per year for municipal use.

Joe Pool Lake Reuse. The source for this water management strategy will be effluent from the TRA Mountain Creek Regional Wastewater System (RWS). This water augments the Joe Pool Lake supply. As currently amended, the permit allows TRA to divert up to 4,368 acre-feet per year for municipal use. This strategy assumes that TRA will permit any additional yield available from this source based on future projected return flows.

Tarrant and Denton County Direct Reuse (Alliance Corridor). The source of this reuse water would be the TRA Denton Creek RWS. TRA customers could potentially use this water for irrigation and municipal use in Denton and Tarrant Counties. It is currently shown in the plan as a joint project between TRA and the City of Fort Worth.

Central Reuse to TRWD. The source of this reuse water will be effluent from TRA Central RWS. Supplies will be diverted from the Trinity River to the Cedar Creek wetlands (not currently constructed), then diverted to Cedar Creek reservoir to augment TRWD supplies.

Central Reuse to Irving. The City of Irving has a current contract with TRA for the option to purchase up to 25 million gallons per day (28,025 acre-feet per year) of effluent from TRA's Central Regional Wastewater Plant. Irving plans to develop a project to use this water within the next five years.

Table 5D.12 Summary of Major Water Provider Plan – Trinity River Authority

Trinity River Authority (Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Demands						
Navarro County Demands - Direct from TRA (Navarro Mills)						
Corsicana & Customers	17,828	17,325	16,317	15,308	14,300	13,292
Total Navarro County Demands	***17,828***	***17,325***	***16,317***	***15,308***	***14,300***	***13,292***
Ellis County Demands - Direct from TRA (Bardwell & Joe Pool) and from TRWD through TRA						
Ennis and Customers	5,200	5,652	8,387	11,664	13,787	23,121
Midlothian (Joe Pool only) and Customers	5,833	5,712	5,591	5,470	5,349	5,229
Waxahachie and Customers	10,299	10,565	11,013	13,192	18,142	23,886
Potential Future Ellis County Customers						
Avalon Water Supply and Sewer Service	*0*	*2*	*2*	*31*	*157*	*337*
Files Valley WSC	*0*	*2*	*2*	*15*	*48*	*68*
Italy	*0*	*5*	*5*	*84*	*357*	*684*
South Ellis County WSC	*0*	*0*	*0*	*165*	*490*	*892*
Total Ellis County Project Demand	***21,332***	***21,938***	***25,000***	***30,621***	***38,330***	***54,217***
Tarrant County Water Supply Project Demands						
Bedford	8,757	9,234	9,746	10,340	10,323	10,323
Colleyville	9,211	9,693	10,313	10,656	10,648	10,648
Euless	6,588	6,824	6,642	6,542	6,523	6,522
Grapevine	11,535	11,535	11,535	11,535	11,535	11,535
North Richland Hills	4,271	4,486	4,418	4,380	4,372	4,372
Total Tarrant County Project Demand	***40,362***	***41,772***	***42,654***	***43,453***	***43,401***	***43,400***
Reuse Demands						
Direct Reuse through Ten Mile WWTP to Dallas County Irrigation	125	125	125	125	125	125
Central Reuse to NTMWD	56,050	56,050	56,050	56,050	56,050	56,050
Las Colinas	8,000	8,000	8,000	8,000	8,000	8,000
Waxahachie	*Counted above Under Ellis County*					
Potential Future Reuse Demands						
Joe Pool Lake Reuse	2,107	9,203	10,100	10,224	10,324	10,470
Alliance Corridor Reuse Project (Tarrant and Denton Co)	0	3,356	8,396	8,396	8,396	8,396

Trinity River Authority (Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Central Reuse to TRWD	0	20,000	30,000	40,000	50,000	60,000
Central Reuse to Irving	486	28,025	28,025	28,025	28,025	28,025
Total Reuse Demands (Not including Waxahachie)	**66,768**	**124,759**	**140,696**	**150,820**	**160,920**	**171,066**
Other Demands						
Steam Electric Power, Freestone (from TRWD)	6,726	6,726	6,726	6,726	6,726	6,726
Steam Electric Power, Freestone (Livingston to Luminant)	20,000	20,000	20,000	20,000	20,000	20,000
Total Other Demands	***26,726***	***26,726***	***26,726***	***26,726***	***26,726***	***26,726***
Projected Demands	**173,016**	**232,520**	**251,393**	**266,928**	**283,677**	**308,701**
Existing Supplies						
Joe Pool Lake						
Midlothian	*5,833*	*5,712*	*5,591*	*5,470*	*5,349*	*5,229*
Grand Prairie (Not Connected)	*1,272*	*1,239*	*1,207*	*1,174*	*1,141*	*1,109*
Grand Prairie (Raw Water/ Irrigation)	*300*	*300*	*300*	*300*	*300*	*300*
Cedar Creek (Not Connected)	*7,346*	*7,346*	*7,346*	*7,346*	*7,346*	*7,346*
Duncanville (Not Connected)	*1,197*	*1,197*	*1,197*	*1,197*	*1,197*	*1,197*
Navarro Mills Lake	18,333	17,325	16,317	15,308	14,300	13,292
Bardwell Lake	9,600	9,295	8,863	8,432	8,000	7,568
Lake Livingston Upstream Diversion	20,000	20,000	20,000	20,000	20,000	20,000
Current Reuse						
Central Reuse to NTMWD	*56,050*	*56,050*	*56,050*	*56,050*	*56,050*	*56,050*
Central Reuse to Irving	*486*	*486*	*486*	*486*	*486*	*486*
Las Colinas	*8,000*	*8,000*	*8,000*	*8,000*	*8,000*	*8,000*
Lake Waxahachie	*3,479*	*3,882*	*4,614*	*5,129*	*5,129*	*5,129*
Ten Mile Creek WWTP Reuse	*125*	*125*	*125*	*125*	*125*	*125*
TRWD (Tarrant County)	39,411	35,801	32,542	30,069	27,827	26,047
TRWD (Ellis County)	2,500	2,741	3,098	5,749	8,899	9,200
TRWD (Freestone County Steam Electric Power)	6,722	5,912	5,245	4,683	4,306	3,981
Total Supplies	**170,839**	**165,649**	**161,248**	**159,935**	**158,883**	**155,466**
Need (Demand - Supply)	**2,177**	**66,871**	**90,145**	**106,993**	**124,794**	**153,235**
Water Management Strategies						
Conservation	2,476	3,796	2,848	2,691	2,836	2,985
TRWD Water						

Trinity River Authority (Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Tarrant County WSP	951	5,971	10,112	13,384	15,574	17,353
Ellis County WSP	0	380	877	2,729	7,273	23,457
Freestone County SEP	4	799	1,469	1,983	2,359	2,686
Reuse Strategies						
Ennis Indirect Reuse	0	0	2,025	3,109	3,696	3,696
Joe Pool Lake Reuse	2,107	9,203	10,100	10,224	10,324	10,470
Tarrant and Denton County Direct Reuse	0	3,356	8,396	8,396	8,396	8,396
Central Reuse to TRWD	0	20,000	30,000	40,000	50,000	60,000
Central Reuse to Irving	0	27,539	27,539	27,539	27,539	27,539
Total Supplies from Strategies	**5,538**	**71,044**	**93,366**	**110,055**	**127,997**	**156,582**
Total Supplies	**176,377**	**236,693**	**254,614**	**269,990**	**286,880**	**312,048**
Reserve or (Shortage)	**3,361**	**4,173**	**3,221**	**3,062**	**3,203**	**3,347**
Management Supply Factor	**1.0**	**1.0**	**1.0**	**1.0**	**1.0**	**1.0**

Table 5D.13 Summary of Costs for Recommended Strategies – Trinity River Authority

Strategy	Date to be Developed	Quantity for TRA (Ac-Ft/Yr)	TRA Share of Capital Costs	Unit Cost ($/1000 gal) With Debt Service	Unit Cost ($/1000 gal) After Debt Service	Table for Details
Conservation[a]	2020	3,796	Included under County Summaries in Chapter 5E.			
TRWD Water						
Tarrant County WSP	2020	17,353	$0	$3.61	$3.61	N/A
Ellis County WSP	2030	23,457	$0	$1.26	$1.26	N/A
Freestone County SEP	2030	2,686	$0	$0	$0	N/A
Joe Pool Lake Reuse[b]	2030	10,470	N/A	N/A	N/A	None
Tarrant and Denton County Direct Reuse	2030	8,396	Included in Fort Worth costs in Chapter 5D.			
Central Reuse to TRWD	2030	60,000	Included in TRWD costs in Chapter 5D.			
Central Reuse to Irving	2020	27,539	Included in Irving costs in Chapter 5E.			
Total TRA Capital Costs			**$0**			

[a]TRA has no retail sales, so conservation savings are reflected in their customers' conservation savings.

[b]There is no cost to get water in the lake. Capital costs and purchase costs to get the supply out of the lake are to be determined by who uses the supply.

5D.1.6 Upper Trinity Regional Water District

The Upper Trinity Regional Water District (UTRWD) currently supplies treated water to users in Denton, Collin, and Tarrant County. The UTRWD also provides direct reuse for irrigation in Denton County. **Table 5D.14** shows the projected demands for UTRWD and all customers.

The currently available supplies for UTRWD include water purchased from Commerce out of Chapman Lake, purchased raw water from Dallas Water Utilities (DWU) and reuse. Changes in supply over time are due primarily to changes in water availability from DWU and sedimentation. UTRWD owns and operates two water treatment plants. The Thomas E. Taylor Regional Water Treatment Plant and the Tom Harpool Regional Water Treatment Plant.

The recommended water management strategies for UTRWD include the following:

- **Conservation**
- **Additional Supplies from DWU (Up to Current Contracts)**
- **Additional DWU (Contract Increase)**
- **Lake Ralph Hall**
- **Lake Ralph Hall Indirect Reuse**
- **Additional Direct Reuse**
- **Marvin Nichols Reservoir (328)**
- **Wright Patman Reallocation**
- **Additional Indirect Reuse**
- **Treatment and Distribution System Improvements**

If any of the projects identified in the recommended plan are not implemented, the UTRWD may wish to pursue alternative strategies.

The following alternative water management strategies are recommended for UTRWD:

- **George Parkhouse Reservoir (North)**
- **George Parkhouse Reservoir (South)**
- **Red River Off-Channel Reservoir**
- **Lake Texoma**
- **Toledo Bend**
- **Oklahoma**
- **Additional Reuse**

Thomas E. Taylor Regional Water Treatment Plant

Conservation. Conservation is the projected conservation savings for UTRWD's existing and potential customers, based on the Region C recommended water conservation program. Not including savings from low-flow plumbing fixtures and not including reuse, conservation by UTRWD customers is projected to reach over 8,400 acre-feet per year by 2070.

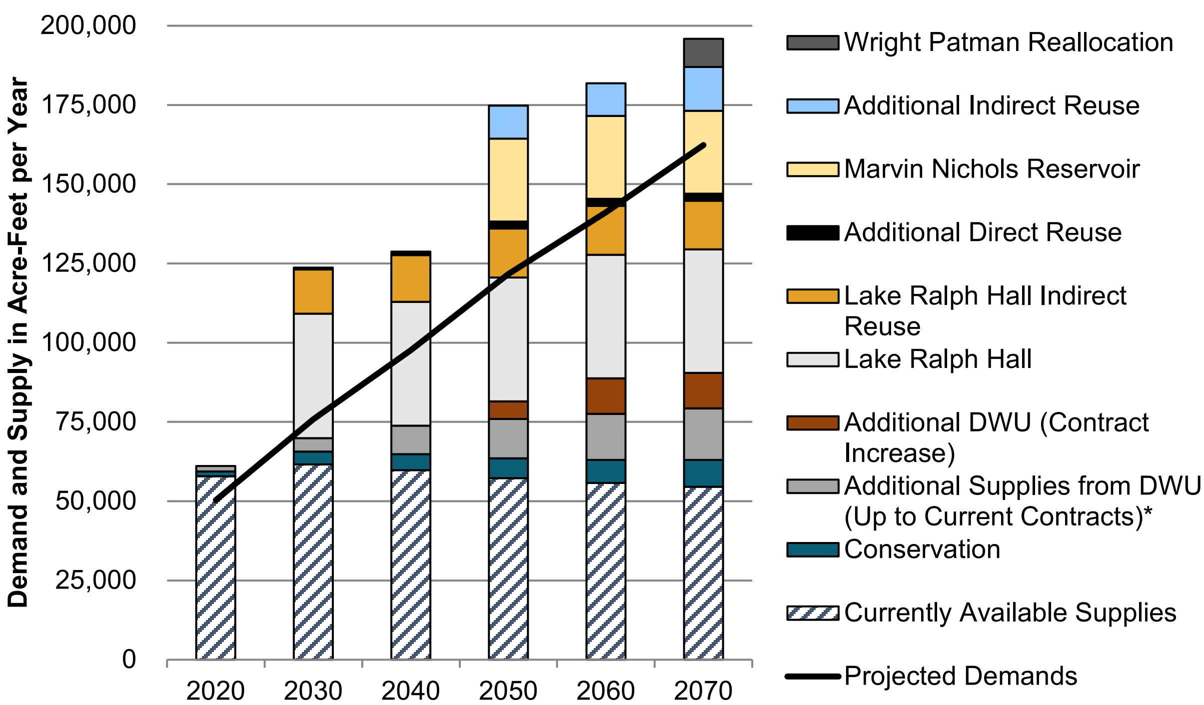
Additional Supplies from DWU (Up to Current Contracts). UTRWD's current contracts with DWU indicate that DWU will supply (1) water needed for several specific water suppliers in Denton County plus an additional 10 mgd and (2) an additional amount equal to 40 percent of UTRWD's supplies from Chapman Lake. Based on projected demands, the contracts would provide up to an additional 16,254 acre-feet per year in 2070. UTRWD is currently using less than the amount in this contract (due to the availability of other water supplies) but plans to eventually use the full contracted amount.

Additional DWU (Contract Increase). UTRWD plans to increase its contracted amount with DWU, the increased contracts could provide up to 11,210 acre-feet per year in 2070.

Lake Ralph Hall. Lake Ralph Hall is a proposed new reservoir on the North Fork of the Sulphur River in Fannin County in Region C. The lake would store 160,235 acre-feet of water and inundate 7,568 acres at the normal pool elevation of 551 ft MSL. The Upper Trinity Regional Water District (UTRWD) has a water right permit to impound and divert 45,000 acre-feet per year from Lake Ralph Hall. Of this amount, 39,220 acre-feet per year is firm supply. The Lake Ralph Hall project would include the construction of an earth-filled dam embankment across the valley of the North Sulphur River with a concrete uncontrolled principal spillway located adjacent to the existing channel of the river and an excavated unlined earthen channel emergency spillway. The project is expected to be constructed and supplying water by 2030.

Lake Ralph Hall Indirect Reuse. UTRWD will be seeking a state water right to reuse

Figure 5D.6 Recommended Water Management Strategies for Upper Trinity Regional Water District



return flows from water originating from Lake Ralph Hall, providing up to 21,179 acre-feet per year available by 2070. The source of this reuse water will be various UTRWD WWTPs in the Lewisville Lake Basin, based on a percentage of effluent that originates from Lake Ralph Hall. This reclaimed water would augment UTRWD's supply.

It will take some years before the full return flow amount is available. Currently much of the area to which UTRWD provides water service is rural and has individual septic systems. It is anticipated that as the area grows, municipal sewer collection systems will be developed, resulting in increased return flow.

Additional Direct Reuse. UTRWD plans to develop up to an additional 2,240 acre-feet per year of direct reuse in Denton County. The specific location of this supply is uncertain and will depend on demands in UTRWD's service area.

Marvin Nichols Reservoir This strategy assumes that Marvin Nichols Reservoir (at 328 MSL) will come online in 2050. This strategy is a joint recommended strategy for NTMWD, TRWD and UTRWD in Region C. Additionally, 20% of the supplies from Marvin Nichols Reservoir will be reserved for water users in Region D.

Wright Patman Reallocation. This strategy is assumed to come online in 2070. The USACE selected an increase of Lake Wright Patman to an elevation of 235 MSL to be the Tentatively Selected Plan (TSP) in February 2019. Like Marvin Nichols Reservoir, this is a joint recommended strategy for NTMWD, TRWD and UTRWD in Region C.

Additional Indirect Reuse. The source for this strategy will be the maximum allowable indirect reuse made available from implementation of the Sulphur Basin (Marvin Nichols 328 and Wright Patman Reallocation) water management strategies.

Water Treatment and Distribution Improvements. UTRWD will need to make improvements to its water treatment and distribution system to meet the demands of its customers. UTRWD has developed a capital improvement plan with specific projects through 2035. Estimated costs for improvements after 2035 are also included.

Strategy Unit Costs

Costs were developed for both recommended and alternative strategies. Costs are summarized in **Table 5D.15** and **Table 5D.16**.

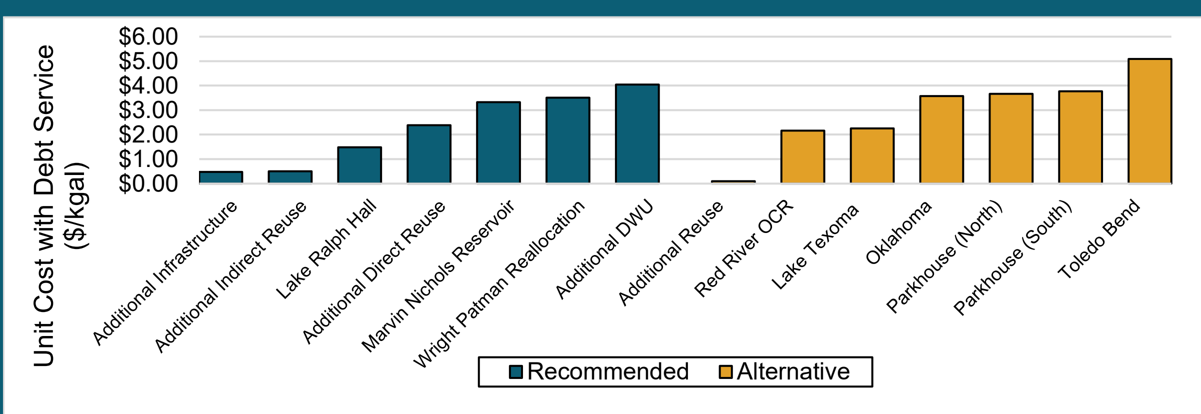


Table 5D.14 Summary of Major Water Provider Plan – Upper Trinity Regional Water District

Upper Trinity RWD (Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Demands						
Argyle WSC	1,976	2,750	3,775	3,843	3,908	3,905
Celina	4,574	11,596	19,582	29,476	35,287	41,095
Corinth	4,269	4,986	4,959	4,942	4,935	4,934
Cross Timbers WSC	993	1,476	1,553	1,644	1,739	1,777
County Other, Denton	899	1,153	1,596	3,492	6,155	12,167
Denton County FWSD 1-A	2,452	4,350	5,210	5,208	5,207	5,205
Denton County FWSD 7	3,418	3,405	3,403	3,401	3,399	3,397
Denton County FWSD 10	416	876	1,033	1,033	1,032	1,032
Flower Mound	12,340	14,301	14,633	15,059	15,529	16,200
Highland Village	2,424	2,702	2,797	2,919	3,052	3,052
Justin	226	805	1,386	1,433	1,479	1,479
Krum	485	806	1,182	1,602	2,081	2,557
Lake Cities Municipal Utility Authority	2,153	2,435	2,758	2,962	2,956	2,955
Mustang SUD	2,913	6,892	10,899	14,921	18,941	22,799
Denton County FWSD 10[a]	1,069	2,252	2,657	2,656	2,655	2,654
Paloma Creek North CRU[a]	1,700	2,303	2,302	2,301	2,299	2,298
Paloma Creek South CRU[a]	854	1,165	1,165	1,165	1,165	1,165
Total for Mustang SUD	*6,536*	*12,612*	*17,023*	*21,043*	*25,060*	*28,916*
Northlake	1,219	2,871	4,068	5,664	7,261	7,260
Providence Village WCID	938	930	929	927	925	925
Sanger	315	634	1,011	1,435	1,919	2,383
Denton County Irrigation (direct reuse)	897	1,457	2,018	3,137	3,137	3,137
Denton County Mining	1,388	232	1,142	2,396	3,588	4,822
Denton County Manufacturing	19	36	50	50	50	50
Subtotal	***47,937***	***70,413***	***90,108***	***111,666***	***128,699***	***147,248***
Potential Future Customers						
Aubrey	0	264	465	686	935	1,183
Bolivar WSC	0	992	1,137	1,306	1,514	1,751
Ladonia	0	81	134	204	303	303
Pilot Point	0	313	776	1,378	2,110	3,023
Ponder	0	177	381	609	868	1,121
Subtotal	***0***	***1,827***	***2,893***	***4,183***	***5,730***	***7,381***
Total Demand	**47,937**	**72,240**	**93,001**	**115,849**	**134,429**	**154,629**
Losses in Treatment and Delivery (5%)	**2,397**	**3,612**	**4,650**	**5,792**	**6,721**	**7,731**
Projected Demands	**50,334**	**75,852**	**97,651**	**121,641**	**141,150**	**162,360**
Existing Supplies						
DWU	41,194	44,851	42,886	40,173	38,727	37,698
Lake Chapman	11,795	11,729	11,662	11,594	11,528	11,460
Chapman Reuse	3,970	4,178	4,383	4,584	4,558	4,531
Direct Reuse	897	897	897	897	897	897
Total Supplies	**57,856**	**61,655**	**59,828**	**57,248**	**55,710**	**54,586**
Need (Demand - Supply)	**0**	**14,197**	**37,823**	**64,393**	**85,440**	**107,774**
Contracted Amount from DWU[b]	***42,919***	***49,097***	***51,809***	***52,622***	***53,281***	***53,952***

Upper Trinity RWD (Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Water Management Strategies						
Conservation (Wholesale)	1,508	4,048	5,064	6,256	7,321	8,487
Additional Supplies from DWU (Up to Current Contracts)[b]	1,725	4,246	8,923	12,449	14,554	16,254
Additional DWU (Contract Increase)	0	0	0	5,605	11,210	11,210
Lake Ralph Hall	0	39,220	39,142	39,064	38,986	38,908
Lake Ralph Hall Indirect Reuse	0	13,944	14,689	15,428	15,390	15,391
Additional Direct Reuse	0	560	1,121	2,240	2,240	2,240
Marvin Nichols Reservoir	0	0	0	26,152	26,152	26,152
Wright Patman Reallocation	0	0	0	0	0	8,848
Additional Indirect Reuse	0	0	0	10,340	10,340	13,838
Water Treatment and Distribution Improvements	*1,725*	*57,970*	*63,875*	*111,278*	*118,872*	*132,841*
Total Supplies from Strategies	**3,233**	**62,018**	**68,939**	**117,534**	**126,193**	**141,328**
Total Supplies	**61,089**	**123,673**	**128,767**	**174,782**	**181,903**	**195,914**
Reserve or (Shortage)	**10,755**	**47,821**	**31,116**	**53,141**	**40,753**	**33,554**
Management Supply Factor	**1.21**	**1.63**	**1.32**	**1.44**	**1.29**	**1.21**

[a]These entities contract directly with UTRWD for wholesale supply, but Mustang SUD is the contract operator for their water systems, providing general operational functions including billing, operations and maintenance, etc.
[b]UTRWD's current contracts with DWU indicate that DWU will supply 1) water needed for several specific water suppliers in Denton County + 10 MGD and 2) an additional amount equal to 40% of UTRWD's supplies from Chapman.

UTRWD Board Members and Guests at site location of Lake Ralph Hall

Table 5D.15 Summary of Costs for Recommended Strategies - UTRWD

Strategy	Date to be Developed	Quantity for UTRWD (Ac-Ft/Yr)	UTRWD Share of Capital Costs	Unit Cost ($/1000 gal) With Debt Service	Unit Cost ($/1000 gal) After Debt Service	Table for Details
Conservation[a]	2020	8,464	Included under County Summaries in Chapter 5E.			
Additional Supplies from DWU (Up to Current Contracts)[b]	2020	16,254	$0	$4.05	$4.05	None
Additional DWU (Contract Increase)	2050	11,210	$0	$4.05	$4.05	None
Lake Ralph Hall and Reuse[c]	2030	60,399	$469,158,000	$1.40	$0.25	H.62
Additional Direct Reuse	2030	2,240	$17,959,000	$2.38	$0.65	H.66
Additional Indirect Reuse	2050	13,838	$0	$0.50	$0.50	None
Marvin Nichols Reservoir	2050	26,152	$403,904,000	$3.33	$0.71	H.20
Wright Patman Reallocation	2070	8,848	$149,844,000	$3.51	$0.91	H.23
Water Treatment and Distribution Improvements	2020	132,841	$1,101,708,000	$0.72	$0.25	H.64
Total UTRWD Capital Costs			**$2,142,573,000**			

[a]UTRWD has no retail sales, so conservation savings are reflected in their customers' conservation savings.
[b]UTRWD's current contracts with DWU indicate that DWU will supply 1) water needed for several specific water suppliers in Denton County + 10 MGD and 2) an additional amount equal to 40% of UTRWD's supplies from Chapman.
[c]UTRWD will be seeking a state water right for return flows out of Lake Ralph Hall for up to 21,179 ac-ft/yr and cost estimates were developed based on this amount. However, for regional planning purposes the dry-year projected return flow value of 15,391 ac-ft/yr by 2070 is used.

Table 5D.16 Summary of Costs for Alternative Strategies - UTRWD

Strategy	Online Date	Quantity for UTRWD (Ac-Ft/Yr)	UTRWD Share of Capital Costs	Unit Cost ($/1000 gal) With Debt Service	Unit Cost ($/1000 gal) After Debt Service	Table for Details
George Parkhouse Reservoir (North)	2050	28,116	$469,733,000	$3.66	$0.83	H.68
George Parkhouse Reservoir (South)	2050	29,900	$549,322,000	$3.78	$0.78	H.69
Red River Off-Channel Reservoir	2020	15,000	$126,771,000	$2.16	$0.76	H.42
Lake Texoma	2020	25,000	$270,614,000	$2.25	$0.46	H.67
Toledo Bend	2070	50,000	$1,058,650,000	$5.09	$1.45	H.19
Oklahoma	2020	10,000	$150,183,000	$3.57	$1.06	H.65
Additional Reuse	2020	15,000	$1,750,000	$0.09	$0.07	H.66

5D.2 Recommended Strategies for Regional Water Providers

5D.2.1 City of Corsicana

The City of Corsicana provides municipal and manufacturing water to the majority of Navarro County and portions of Ellis, Hill, and Limestone Counties. Future projected demands include municipal and manufacturing demands. **Table 5D.17** lists the projected demands for Corsicana and customers.

The city's current water sources include Lake Halbert, Richland-Chambers Reservoir, and Navarro Mills Lake. The city has a water right for 13,650 acre-feet per year from Richland-Chambers Reservoir and they are authorized to divert and use 4,003 acre-feet of water from Lake Halbert.

The supply currently available to Corsicana from Navarro Mills Reservoir is limited to 11,210 acre-feet per year because of the existing water treatment plant capacity. The supply from Lake Halbert and Richland Chambers is limited to 2,242 acre-feet per year for the same reason.

The recommended strategies to meet the needs of Corsicana and its customers include:

- **Conservation**
- **New Halbert/Richland Chambers WTP**
- **Expansions of Halbert/Richland Chambers WTP**

If any of the projects identified in the recommended plan are not implemented, Corsicana may wish to pursue alternative strategies.

The following alternative water management strategies are recommended for Corsicana:

- **Navarro Mills WTP Expansion and Pipeline Replacement**

Lake Halbert and Lake Halbert Water Treatment Plant

Conservation. Conservation is the projected conservation savings for the City of Corsicana and its existing and potential customers, based on the Region C recommended water conservation program. Not including savings from low-flow plumbing fixtures (which are built into the demand projections), conservation by Corsicana and its customers is projected to reach 529 acre-feet per year by 2070.

New Water Treatment Plant to treat water delivered from Richland-Chambers Lake to Lake Halbert. The existing Water Treatment Plant at Lake Halbert has a peak capacity of 4 mgd. The facilities are aging, and Lake Halbert has no reliable supply. Corsicana has already built a pipeline and a 4 MGD pump station from Richland-Chambers reservoir to Lake Halbert. In order to increase the reliable water supply, the city will increase the capacity of the Richland-Chambers pump station and construct a new 8 mgd water treatment plant, taking the existing 4 mgd plant out of service.

Water Treatment Plant Expansions. As demands for treated water increase, Corsicana will expand the Lake Halbert Water Treatment Plant twice (by an additional 8 mgd during each expansion). This expansion will require an expansion of the pump station at Richland-Chambers Reservoir to deliver the additional water to the Halbert treatment plant.

Figure 5D.7 Recommended Water Management Strategies for Corsicana

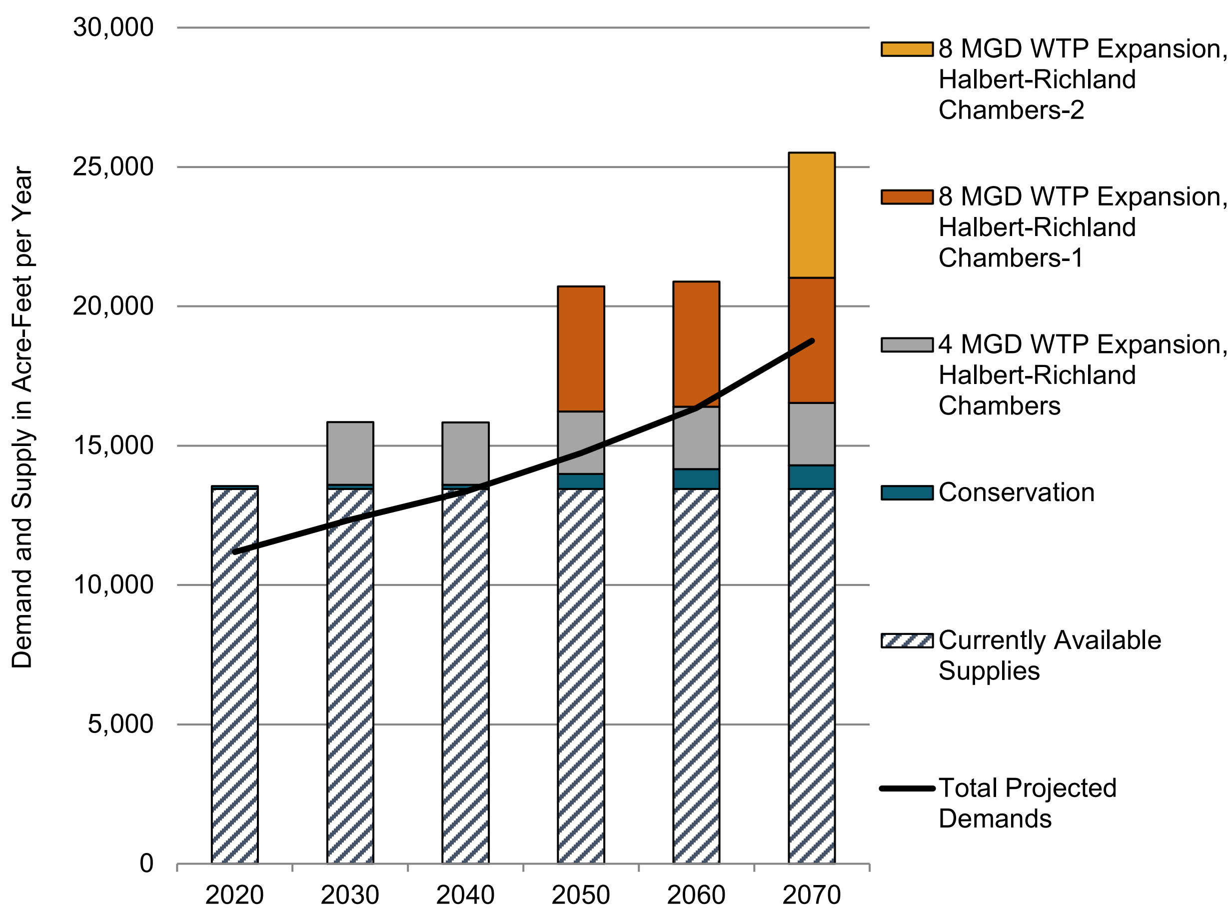


Table 5D.17 Summary of Major Water Provider Plan – City of Corsicana

Corsicana (Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Demands						
Corsicana	6,104	6,582	7,101	7,750	8,472	9,253
B and B WSC	242	242	255	293	355	440
Blooming Grove	163	175	187	204	223	243
Chatfield WSC	428	465	503	544	591	639
Corbet WSC	250	264	280	303	331	361
Dawson	149	151	155	159	165	172
Freestone County Other	42	41	36	44	105	272
Hill County Other (50%) (Reg G)	110	119	116	113	104	101
Kerens	216	227	241	263	288	314
M E N WSC	487	523	564	615	672	734
Navarro County Manufacturing	889	1,057	1,057	1,057	1,057	1,057
Navarro County Other	222	360	403	534	669	1,342
Navarro Mills WSC	333	352	376	407	444	485
Post Oak SUD	129	131	155	169	187	208
Birome (Region G)	147	147	147	147	147	147
Coolidge (Region G)	167	183	205	201	193	174
Hubbard (Region G)	147	149	162	152	140	120
Rice Water Supply and Sewer Service	1,089	1,306	1,567	1,901	2,288	2,736
Projected Demands	**11,314**	**12,474**	**13,510**	**14,856**	**16,431**	**18,798**
Existing Supplies						
Lake Halbert and Richland-Chambers System	13,863	13,855	13,847	13,838	13,830	13,822
Navarro Mills Reservoir	17,828	17,325	16,317	15,308	14,300	13,292
Total Supplies	**31,691**	**31,180**	**30,164**	**29,146**	**28,130**	**27,114**
Total Supplies limited by WTP Capacity (20 MGD Navarro Mills,4 MGD Halbert)	***13,452***	***13,452***	***13,452***	***13,452***	***13,452***	***13,452***
Need (Demand - Supply)	***0***	***0***	***58***	***1,404***	***2,979***	***5,346***
Water Management Strategies						
Conservation (retail)	*59*	*93*	*89*	*447*	*585*	*671*
Conservation (wholesale)	*34*	*55*	*56*	*86*	*122*	*176*
New 8 MGD Halbert/ Richland-Chambers WTP (4 MGD increase from current plant)	0	2,242	2,242	2,242	2,242	2,242
8 MGD Expansion of Halbert/Richland Chambers WTP (I)	0	0	0	4,484	4,484	4,484
8 MGD Expansion of Halbert/Richland Chambers WTP (II)	0	0	0	0	0	4,484
Total Supplies from Strategies	***93***	***2,390***	***2,387***	***7,259***	***7,433***	***12,057***
Total Supplies	***13,545***	***15,842***	***15,839***	***20,711***	***20,885***	***25,509***
Surplus or (Shortage)	**2,231**	**3,368**	**2,329**	**5,855**	**4,454**	**6,711**
Management Supply Factor	**1.20**	**1.27**	**1.17**	**1.39**	**1.27**	**1.36**

Table 5D.18 Summary of Costs for Recommended Strategies - Corsicana

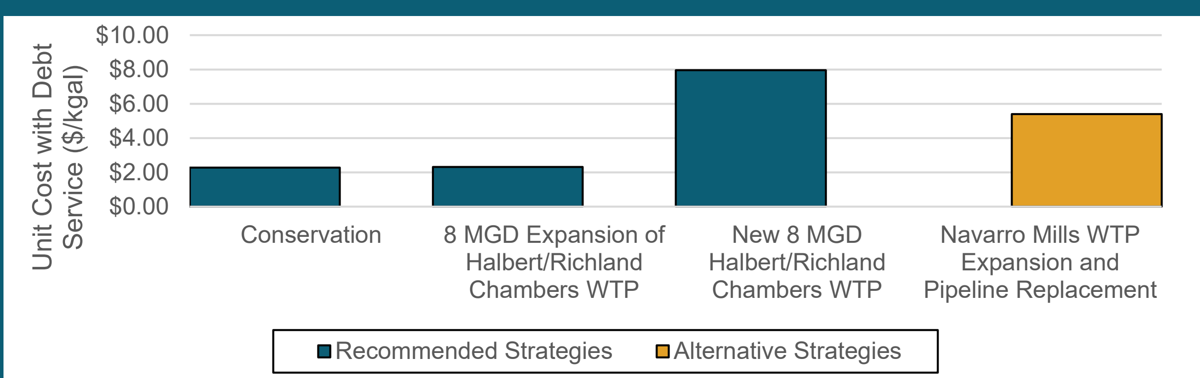
Strategy	Date to be Developed	Quantity for Corsicana (Ac-Ft/Yr)	Corsicana Share of Capital Costs	Unit Cost ($/1000 gal) With Debt Service	Unit Cost ($/1000 gal) After Debt Service	Table for Details
Conservation (retail)	2020	671	$620,621	$2.27	$0.49	H.11
Conservation (wholesale customers)	2020	176	Included under County Summaries in Chapter 5E.			
New 8 MGD Halbert/Richland Chambers WTP (4 MGD increase from current plant)	2030	2,242	$47,722,000	$7.95	$3.35	H.13
8 MGD Expansion of Halbert/Richland Chambers WTP (I)	2050	4,484	$27,697,000	$2.32	$0.98	H.13
8 MGD Expansion of Halbert/Richland Chambers WTP (II)	2070	4,484	$27,697,000	$2.32	$0.98	H.13
Total Corsicana Capital Costs			**$103,736,621**			

Table 5D.19 Summary of Costs for Alternative Strategies - Corsicana

Strategy	Date to be Developed	Quantity for Corsicana (Ac-Ft/Yr)	Corsicana Share of Capital Costs	Unit Cost ($/1000 gal) With Debt Service	Unit Cost ($/1000 gal) After Debt Service	Table for Details
Navarro Mills WTP Expansion and Pipeline Replacement	2050	5,605	$87,938,000	$5.40	$2.01	H.13
Total Corsicana Capital Costs			**$87,938,000**			

Strategy Unit Costs

Costs were developed for both recommended and alternative strategies. Costs are summarized in **Table 5D.18** and **Table 5D.19**.



5D.2.2 Greater Texoma Utility Authority

The Greater Texoma Utility Authority (GTUA) is a political subdivision of the State and is governed by a Board of Directors. GTUA provides its member cities with assistance in financing and construction of water and wastewater facilities. GTUA may also be requested to provide operations services for water and wastewater facilities by member cities and others.

An example of such services is the Collin-Grayson Municipal Alliance (CGMA). The Collin-Grayson Municipal Alliance is a pipeline to deliver water from NTMWD to Anna, Howe, Melissa and Van Alstyne in southern Grayson and northern Collin Counties. **Table 5D.20** lists the projected demands for GTUA and customers.

The GTUA has an existing water right for 83,200 acre-feet per year from Lake Texoma. Of this amount, 11,200 acre-feet per year (limited by the Sherman water treatment plant capacity) is available to existing customers as potable water. Several water users in the surrounding Cooke, Collin, Denton, and Grayson counties have water rights in Lake Texoma but no infrastructure to transport or treat the supplies. GTUA is currently sponsoring a study to evaluate potential configurations of a Regional Water System to treat and transport these supplies.

To meet the needs of GTUA's current and future demands, the following strategies are recommended:

- **Conservation**
- **GTUA Regional Water System – Phase 1**
- **GTUA Regional Water System – Phase 2**
- **Connection from Sherman to CGMA**
- **Parallel CGMA Pipeline (NTMWD)**

If any of the projects identified in the recommended plan are not implemented, GTUA may wish to pursue an alternative strategy.

The following alternative water management strategy is recommended for GTUA:

- **Grayson County Water Supply Project**

These strategies are discussed individually below.

Railway Bridge over Lake Texoma

Conservation. Conservation is the projected conservation savings for the GTUA's existing and potential customers, based on the recommended Region C water conservation program. Water savings by the GTUA and customers is projected to reach 4,418 acre-feet per year by 2070.

GTUA Regional Water System (Phase I and II). A regional water system strategy was developed for communities in northern Collin, Cooke, northern Denton and Grayson counties. Several of the entities in this area hold water rights in Lake Texoma but currently do not have access to this resource. This strategy focuses on treating and connecting these entities to Lake Texoma supplies. Phase One will connect participating entities south of Sherman and Phase Two will connect entities west of Sherman.

Connection from Sherman to CGMA. The proposed connection from Sherman to CGMA plans for 5 MGD peak delivery from Sherman.

Parallel CGMA Pipeline (NTMWD). The proposed parallel pipeline for the CGMA is needed to increase the delivery capacity for the system beyond 16,800 acre-feet per year.

Figure 5D.8 Recommended Strategies for Greater Texoma Utility Authority

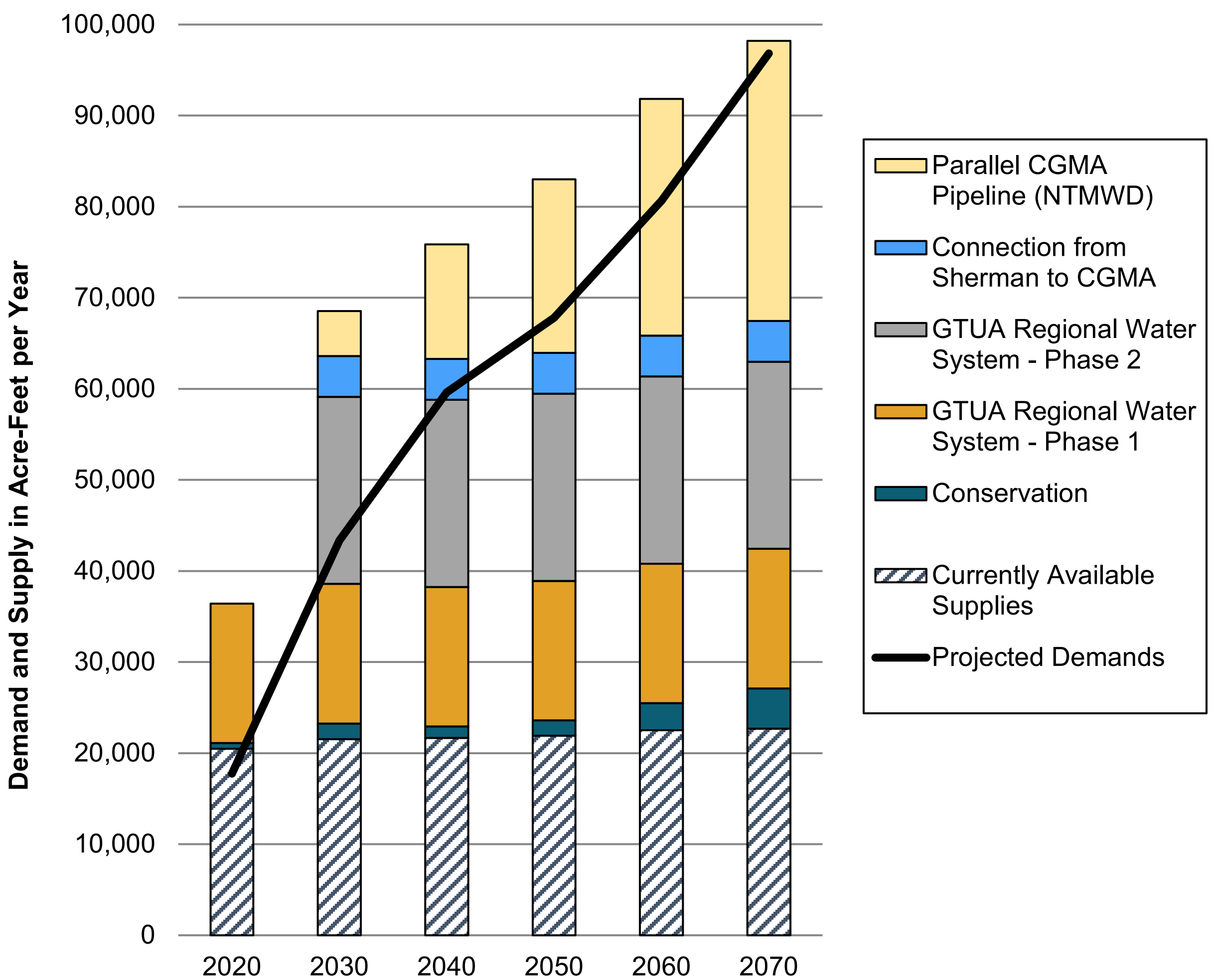


Table 5D.20 Summary of Regional Water Provider Plan – Greater Texoma Utility Authority

GTUA (Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Demands						
Sherman	4,967	5,309	5,418	6,275	10,091	18,492
County Other, Grayson	747	747	747	747	747	1,196
Dorchester	0	0	0	0	0	0
Manufacturing, Grayson	2,213	2,257	2,257	2,257	2,257	2,257
Marilee SUD	194	216	242	237	235	235
Steam Electric Power, Grayson	4,387	4,387	4,387	4,387	4,387	4,387
Bells	*0*	*10*	*36*	*54*	*384*	*587*
County Other, Grayson (Additional)	*0*	*760*	*860*	*960*	*1,060*	*1,160*
KentuckyTown WSC	*0*	*47*	*104*	*160*	*300*	*487*
Luella SUD	*0*	*40*	*85*	*118*	*181*	*277*
Pottsboro	*0*	*0*	*0*	*0*	*0*	*1,126*
South Grayson SUD	*0*	*51*	*156*	*222*	*293*	*354*
Southmayd	*49*	*59*	*70*	*85*	*146*	*229*
Tioga	*0*	*10*	*19*	*31*	*265*	*424*
Tom Bean	*0*	*27*	*52*	*83*	*157*	*353*
Whitewright	*0*	*0*	*50*	*50*	*100*	*100*
Subtotal	***12,557***	***13,920***	***14,483***	***15,666***	***20,603***	***31,664***
Other Grayson County through Denison						
Pottsboro	406	543	679	918	1,512	1,682
Subtotal	***406***	***543***	**679**	***918***	***1,512***	***1,682***
Collin-Grayson Municipal Alliance						
Anna	1,235	2,893	5,275	7,182	9,662	12,899
Howe	0	24	57	88	134	182
Grayson County Manufacturing	30	30	30	30	30	30
Melissa	3,210	11,682	16,629	20,906	24,150	25,009
Van Alstyne	10	202	475	750	1,912	2,539
Subtotal	***4,485***	***14,831***	**22,466**	***28,956***	***35,888***	***40,659***
GTUA Regional System (Future)						
Celina	0	5,605	5,605	5,605	5,605	5,605
Collinsville	0	91	153	231	256	411
County Other, Collin (Weston)	0	550	1,099	1,099	1,099	1,099
Gainesville and Customers	0	1,632	5,605	5,605	5,605	5,605
Gunter	297	695	2,859	2,859	2,859	2,859
Lake Kiowa SUD	0	886	886	886	886	886
Marilee SUD (Additional)	0	1,390	1,558	1,558	1,515	1,439
Northwest Grayson County WCID 1	0	194	572	572	572	572
Pilot Point	0	975	1,256	1,256	1,256	1,256

GTUA (Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Two Way SUD	0	867	1,007	1,204	1,603	1,682
Whitesboro	0	461	453	441	471	471
Woodbine WSC	0	716	942	942	942	942
Subtotal	***297***	***14,062***	***21,995***	***22,258***	***22,669***	***22,827***
Projected Demands	**17,745**	**43,356**	**59,623**	**67,798**	**80,672**	**96,832**
Treated Water Demand	*13,358*	*38,969*	*55,236*	*63,411*	*76,285*	*92,445*
Raw Water Demand	*4,387*	*4,387*	*4,387*	*4,387*	*4,387*	*4,387*
Existing Supplies						
Lake Texoma (Potable-Limited by Sherman WTP)	11,210	11,210	11,210	11,210	11,210	11,210
Supply for Pottsboro (from Denison)	406	543	679	918	1,512	1,682
Collin-Grayson Municipal Alliance Pipeline Project (From NTMWD)	4,485	5,400	5,400	5,400	5,400	5,400
Potable Water Available	16,101	17,153	17,289	17,528	18,122	18,292
Lake Texoma Raw (current use)[a]	4,387	4,387	4,387	4,387	4,387	4,387
Total Supplies	**20,488**	**21,540**	**21,676**	**21,915**	**22,509**	**22,679**
Treated Water Need (Demand-Supply)	**0**	**21,816**	**37,947**	**45,883**	**58,163**	**74,153**
Raw Water Need (Demand-Supply)	**0**	**0**	**0**	**0**	**0**	**0**
Water Management Strategies						
Conservation (Wholesale Customers)	607	1,712	1,249	1,668	2,965	4,418
GTUA Regional Water System – Phase 1	15,332	15,332	15,332	15,332	15,332	15,332
GTUA Regional Water System – Phase 2	0	20,540	20,540	20,540	20,540	20,540
Connection from Sherman to CGMA	0	4,484	4,484	4,484	4,484	4,484
Parallel CGMA Pipeline (NTMWD)	0	4,947	12,582	19,072	26,004	30,775
Total Supplies from Strategies	***15,939***	***47,015***	***54,187***	***61,096***	***69,325***	***75,549***
Total Supplies	**36,427**	**68,555**	**75,863**	**83,011**	**91,834**	**98,228**
Reserve or (Shortage)	**18,682**	**25,200**	**16,240**	**15,213**	**11,162**	**1,396**
Management Supply Factor	**2.05**	**1.58**	**1.27**	**1.22**	**1.14**	**1.01**

[a]GTUA has a water right in Texoma for 83,200 acre-feet per year. Currently, they have facilities to use 11,210 acre-feet per year of treated water and 6,163 acre-feet per year of raw water. Use of additional water will require additional facilities.

Table 5D.21 Summary of Costs for Recommended Strategies - GTUA

Strategy	Date to be Developed	Quantity for GTUA (Ac-Ft/Yr)	GTUA Share of Capital Costs	Unit Cost ($/1000 gal) With Debt Service	Unit Cost ($/1000 gal) After Debt Service	Table for Details
Conservation[a]	2020	4,418	Included under County Summaries in Chapter 5E.			
GTUA Regional Water System – Phase 1	2020	15,332	$243,986,000	$5.72	$3.06	H.72
GTUA Regional Water System – Phase 2	2030	20,540	$224,083,000	$4.75	$2.93	H.73
Connection from Sherman to CGMA	2030	4,484	$31,115,000	$1.78	$0.28	H.71
Parallel CGMA Pipeline (NTMWD)	2030	30,775	$89,989,000	$3.55	$2.72	H.70
Total GTUA Capital Costs			**$589,173,000**			

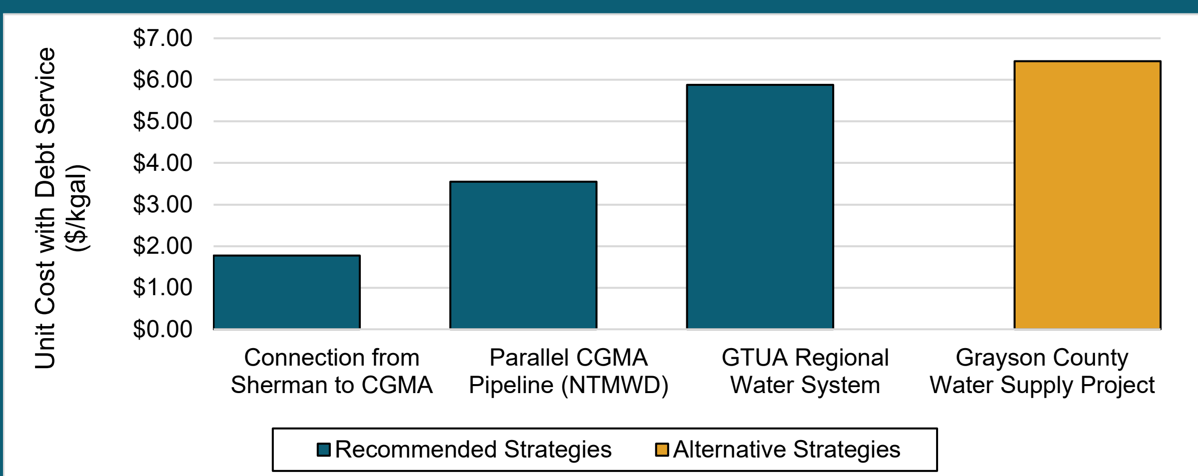
[a]GTUA has no retail sales, so conservation savings are reflected in their customers' conservation savings.

Table 5D.22 Summary of Costs for Alternative Strategies - GTUA

Strategy	Date to be Developed	Quantity for GTUA (Ac-Ft/Yr)	GTUA Share of Capital Costs	Unit Cost ($/1000 gal) With Debt Service	Unit Cost ($/1000 gal) After Debt Service	Table for Details
Grayson County Water Supply Project	2020	37,610	$657,965,000	$6.45	$3.53	H.74
Total GTUA Capital Costs			**$657,965,000**			

Strategy Unit Costs

Costs were developed for both recommended and alternative strategies. Costs are summarized in **Table 5D.21** and **Table 5D.22**.



5E Recommended Water Management Strategies for Water Providers by County

This chapter provides a summary of the projected demands, supplies and water management strategies (WMS) for wholesale water providers (WWPs) and water user groups (WUGs).

Included in this chapter is a section dedicated to each one of Region C's sixteen counties. Each section includes a county overview at the beginning to provide a snapshot of the county's overall water supply situation. Major water providers and regional water providers were discussed previously in **Chapter 5D**. Other wholesale water providers and water user groups are discussed in alphabetical order after each county overview. If a wholesale water provider or water user group is split between multiple counties, these entities are discussed in the county where the majority of the demand resides. Each county section concludes with a summary of costs for the WWP and WUG strategies discussed in the section.

As part of the preparation of this regional water plan, the consultants surveyed municipal WWPs and WUGs to gather information regarding current and future water plans. As appropriate and available, information regarding non-municipal WUGs was gathered from those entities supplying water to meet those demands. In addition, published plans of WUGs were considered in the preparation of this final adopted regional plan.

Many of the strategies included in this section are infrastructure projects needed to deliver and/or treat water included in another strategy. Quantities for these infrastructure projects have been shown in *gray italics* so they can be easily identified. To avoid double-counting quantities of supply, the quantities in *gray italics* are not included in the totals for the tables.

Conservation strategies are discussed in **Chapter 5B**. Estimated water savings are based on population growth and levels of conservation implemented to date. Water savings may fluctuate over the planning period. This is due in part to the passive savings assumed in the water demands and specific BMPs for each entity.

Section Outline

Section 5E.1 through 5E.16 – County Plans

Related Appendices

Appendix C – Adjustments to Projections

Appendix G – Water Management Strategy Evaluation

Appendix H – Cost Estimates

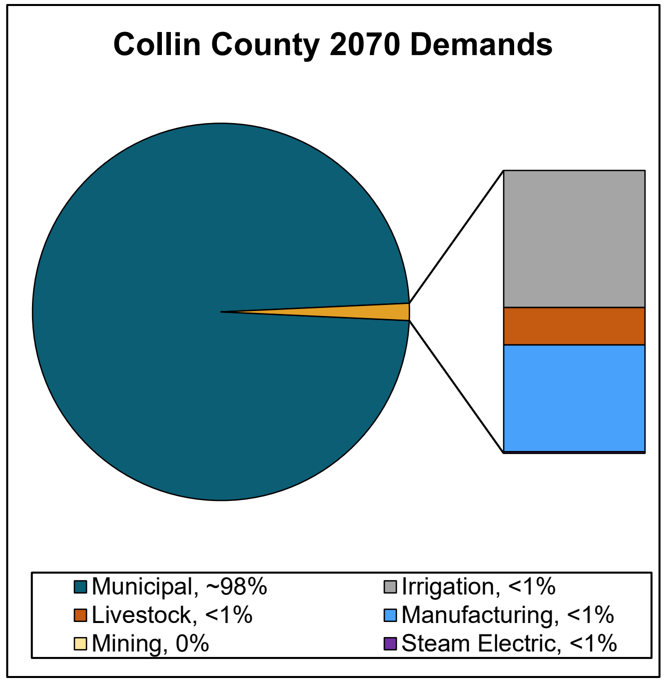
Appendix P – WMS Implementation Survey

Sixteen Counties in Region C

1. Collin
2. Cooke
3. Dallas
4. Denton
5. Ellis
6. Fannin
7. Freestone
8. Grayson
9. Henderson
10. Jack
11. Kaufman
12. Navarro
13. Parker
14. Rockwall
15. Tarrant
16. Wise

5E.1 Collin County

Collin County is located in the northeastern portion of Region C. **Figure 5E.2** shows water supplier service areas in the county**.**



Collin is one of the state's fastest growing counties and is part of one of the healthiest regional economies in the country. Population projections estimate that the population within Collin County is expected to exceed 2.3 million people by 2070.

Demands for the County are predominately municipal at over 97% of the total county demand. The county has relatively minimal irrigation, livestock, manufacturing and steam electric demands and no mining demands.

The North Texas Municipal Water District (NTMWD) serves most of the municipal and industrial water demand in Collin County. In addition to purchasing water from WWPs (especially NTMWD), other water sources include groundwater and direct reuse. An overall summary of population and demand projections for the county is shown in **Table 5E.1***,* and water management strategies for individual WWPs and WUGs are discussed on the following pages.

Collin County Quick Facts

2010 Population: 782,341

Projected 2070 Population: 2,373,092

Projected 2070 Demand: 412 MGD

County Seat: McKinney

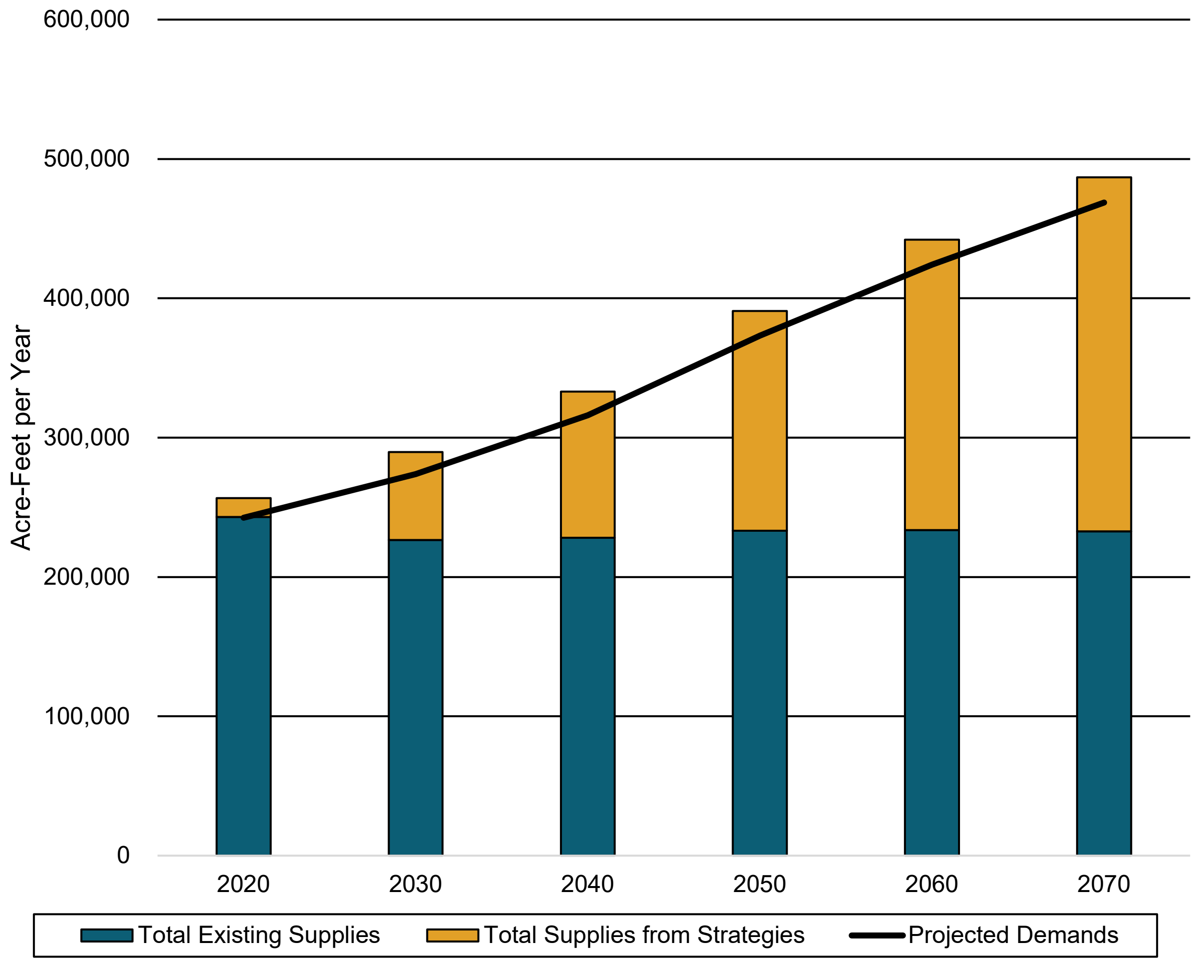
Economy: Government/services; manufacturing; retail and wholesale

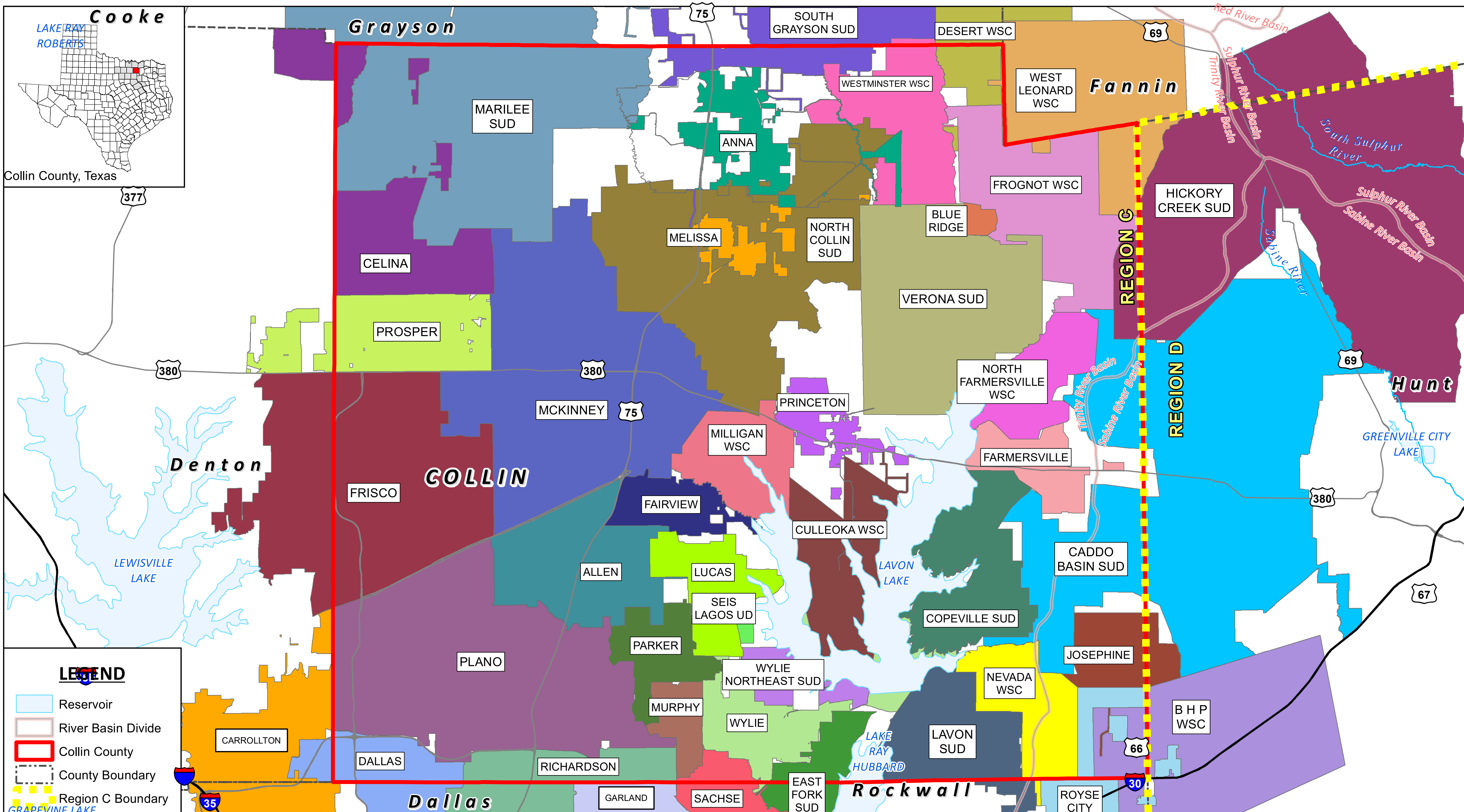
River Basins: Trinity (94%), Sabine (6%)

Table 5E.1 Summary of Collin County

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**1,050,506**	**1,239,303**	**1,497,921**	**1,807,279**	**2,093,720**	**2,373,092**
Projected Demands	**242,505**	**273,778**	**316,053**	**373,126**	**424,158**	**468,710**
Municipal	*235,967*	*266,884*	*309,159*	*366,232*	*417,264*	*461,816*
Irrigation	*3,340*	*3,340*	*3,340*	*3,340*	*3,340*	*3,340*
Livestock	*912*	*912*	*912*	*912*	*912*	*912*
Manufacturing	*2,246*	*2,602*	*2,602*	*2,602*	*2,602*	*2,602*
Mining	*0*	*0*	*0*	*0*	*0*	*0*
Steam Electric	*40*	*40*	*40*	*40*	*40*	*40*
Total Existing Supplies	**243,009**	**226,454**	**228,220**	**233,297**	**233,722**	**232,707**
Need (Demand - Supply)	**-**	**47,324**	**87,833**	**139,829**	**190,436**	**236,003**
Total Supplies from Strategies	**13,540**	**63,304**	**104,920**	**157,581**	**208,357**	**254,039**
Reserve (Shortage)	**14,044**	**15,980**	**17,087**	**17,752**	**17,921**	**18,036**

Figure 5E.1 Summary of Collin County Demands and Supplies





REGION C
Water Planning for North Texas

2021 Region C Water Plan

COLLIN COUNTY, TEXAS

FIGURE 5E.2

1 in = 4 miles

0 1 2 4 6

Miles

N W E S

Data Source(s): ESRI, USGS, TNRIS

TR116409: H:\WR_PLANNING\1 - Working\5E_County WMS\Collin1.mxd

5E.1.1 Wholesale Water Providers and Water User Groups

Collin County wholesale water providers (WWPs) and water user groups (WUGs) are discussed below (in alphabetical order). The costs for recommended and alternative water management strategies are presented in **Section 5E.1.2**. **Appendix H** has more detailed cost estimates.

Allen

Allen is located in south central Collin County and is nearly fully developed. Allen supplies a small manufacturing demand. Allen receives treated water supplies from NTMWD and plans to continue to be supplied by NTMWD. **Table 5E.2** shows the projected population and demand, the current supplies, and the water management strategies for Allen.

Table 5E.2 Summary of Water User Group - City of Allen

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**105,000**	**114,000**	**116,000**	**118,000**	**120,000**	**122,000**
Projected Demands						
Municipal Demand	21,887	23,536	23,806	24,125	24,496	24,902
Manufacturing, Collin	*67*	*78*	*78*	*78*	*78*	*78*
Total Projected Demands	***21,954***	***23,614***	***23,884***	***24,203***	***24,574***	***24,980***
Existing Supplies						
NTMWD	21,835	19,947	18,655	17,112	15,660	14,609
Total Existing Supplies	***21,835***	***19,947***	***18,655***	***17,112***	***15,660***	***14,609***
Need (Demand - Supply)	***119***	***3,667***	***5,229***	***7,091***	***8,914***	***10,371***
Water Management Strategies						
Water Conservation	1,436	1,592	1,483	1,574	1,690	1,813
NTMWD	0	2,075	3,746	5,517	7,224	8,558
Total Supplies from Strategies	***1,436***	***3,667***	***5,229***	***7,091***	***8,914***	***10,371***
Reserve (Shortage)	**1,317**	**0**	**0**	**0**	**0**	**0**

Anna

Anna is expected to experience rapid growth over the planning horizon. Anna is in north Collin County and currently receives supplies from groundwater (Trinity and Woodbine aquifers) and treated supplies from NTMWD (through GTUA's Collin-Grayson Municipal Alliance). Water management strategies for Anna are conservation, new well(s) and expansion of supplies through the Collin-Grayson Municipal Alliance (CGMA). Future treated supplies through the CGMA could originate from either NTMWD or Sherman. An alternative water management strategy for Anna is supplies from the Grayson County Water Supply Project. **Table 5E.3** shows the projected population and demand, the current supplies, and the water management strategies for Anna.

Table 5E.3 Summary of Water User Group - City of Anna

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**15,037**	**25,747**	**41,195**	**53,553**	**69,619**	**90,505**
Projected Demands						
Municipal Demand	2,389	4,047	6,429	8,336	10,816	14,053
Total Projected Demands	***2,389***	***4,047***	***6,429***	***8,336***	***10,816***	***14,053***
Currently Available Supplies						
Trinity Aquifer	445	445	445	445	445	445
Woodbine Aquifer	709	709	709	709	709	709
NTMWD through GTUA (CGMA)	1,226	1,668	1,668	1,668	1,668	1,668
Total Currently Available Supplies	***2,380***	***2,822***	***2,822***	***2,822***	***2,822***	***2,822***
Need (Demand - Supply)	***9***	***1,225***	***3,607***	***5,514***	***7,994***	***11,231***
Water Management Strategies						
Water Conservation	238	805	80	132	207	316
New Well(s) in Woodbine Aquifer	200	200	200	200	200	200
Sherman through GTUA (CGMA)	0	1,235	875	1,053	1,112	1,207
NTMWD through GTUA (CGMA)	0	420	3,527	5,382	7,787	10,915
Total Supplies from Strategies	***438***	***2,660***	***4,682***	***6,767***	***9,306***	***12,638***
Reserve (Shortage)	**429**	**1,435**	**1,075**	**1,253**	**1,312**	**1,407**
Alternative Water Management Strategy						
Grayson County Water Supply Project	***0***	***420***	***3,527***	***5,382***	***7,787***	***10,915***

B H P Water Supply Corporation

B H P WSC supplies retail water service to Collin County and is a new water user group for the *2021 Region C Regional Water Plan*. The WSC gets treated water supplies from NTMWD through Royse City. Water management strategies for B H P WSC are conservation and additional supplies from NTMWD. **Table 5E.4** shows the projected population and demand, the current supplies, and the water management strategies for B H P WSC.

Table 5E.4 Summary of Water User Group - B H P WSC

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**5,233**	**6,647**	**8,426**	**10,583**	**13,664**	**18,110**
Projected Demands						
Municipal Demand	391	467	571	711	918	1,216
Total Projected Demand	***391***	***467***	***571***	***711***	***918***	***1,216***
Currently Available Supplies						
NTMWD through Royse City	389	395	446	502	585	711
Total Currently Available Supplies	***389***	***395***	***446***	***502***	***585***	***711***
Need (Demand – Supply)	***2***	***72***	***125***	***209***	***333***	***505***
Water Management Strategies						
Water Conservation	0	1	1	1	2	3
NTMWD through Royse City	2	71	124	208	331	502
Total Supplies from Strategies	***2***	***72***	***125***	***209***	***333***	***505***
Reserve (Shortage)	**0**	**0**	**0**	**0**	**0**	**0**

Bear Creek Special Utility District (Formerly Called Lavon SUD)

Bear Creek SUD, previously known as Lavon SUD, supplies water to parts of Collin and Rockwall Counties in Region C. The SUD receives treated water supplies from NTMWD and is projected to grow rapidly over the planning horizon. Water management strategies for Bear Creek SUD are conservation and additional water from NTMWD. **Table 5E.5** shows the projected population and demand, the current supplies, and the water management strategies for Bear Creek SUD.

Table 5E.5 Summary of Water User Group – Bear Creek SUD

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**5,849**	**9,130**	**13,079**	**18,209**	**23,981**	**32,857**
Projected Demands						
Municipal Demand	689	1,044	1,472	2,035	2,673	3,658
Total Projected Demands	***689***	***1,044***	***1,472***	***2,035***	***2,673***	***3,658***
Currently Available Supplies						
NTMWD	686	882	1,150	1,439	1,703	2,139
Total Currently Available Supplies	***686***	***882***	***1,150***	***1,439***	***1,703***	***2,139***
Need (Demand - Supply)	***3***	***162***	***322***	***596***	***970***	***1,519***
Water Management Strategies						
Water Conservation	26	43	61	93	132	192
NTMWD	0	119	261	503	838	1,327
Total Supplies from Strategies	***26***	***162***	***322***	***596***	***970***	***1,519***
Reserve (Shortage)	**23**	**0**	**0**	**0**	**0**	**0**

Blue Ridge

The City of Blue Ridge is in northeast Collin County. The city's current water supply is limited to groundwater (Woodbine aquifer). Due to the long-term projected growth and limited supplies from the Woodbine aquifer, it is assumed that Blue Ridge will contract with NTMWD for additional supplies. Water management strategies for Blue Ridge are conservation, establishing a direct connection to NTMWD, and purchasing treated water supplies from NTMWD. **Table 5E.6** shows the projected population and demand, the current supplies, and the water management strategies for Blue Ridge. The reserve shown is caused by projected decreased reliance on the City's groundwater supplies.

Table 5E.6 Summary of Water User Group - City of Blue Ridge

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**2,425**	**4,190**	**39,507**	**81,703**	**116,583**	**161,591**
Projected Demands						
Municipal Demand	413	687	6,403	14,735	21,025	29,142
Total Projected Demands	***413***	***687***	***6,403***	***14,735***	***21,025***	***29,142***
Currently Available Supplies						
Woodbine Aquifer	400	400	400	400	400	400
Total Currently Available Supplies	***400***	***400***	***400***	***400***	***400***	***400***
Need (Demand - Supply)	***13***	***287***	***6,003***	***14,335***	***20,625***	***28,742***
Water Management Strategies						
Water Conservation	21	46	423	1,042	1,558	2,255
NTMWD	0	567	5,930	13,663	19,437	26,857
Direct connection and Additional Delivery Infrastructure from NTMWD	*0*	*567*	*5,930*	*13,663*	*19,437*	*26,857*
Total Supplies from Strategies	***21***	***613***	***6,353***	***14,705***	***20,995***	***29,112***
Reserve (Shortage)	**8**	**326**	**350**	**370**	**370**	**370**

Caddo Basin Special Utility District

Caddo Basin SUD is split almost evenly between Collin County in Region C and Hunt County in Region D. Caddo Basin SUD currently receives treated water supplies from NTMWD and is expected to continue to use NTMWD supplies. A portion of the SUD's supplies are purchased through Farmersville (another customer of NTMWD), but most supplies are through a direct connection with NTMWD. Water management strategies for Caddo Basin SUD are conservation and additional water from NTMWD. **Table 5E.7** shows the projected population and demand, the current supplies, and the water management strategies for Caddo Basin SUD.

Table 5E.7 Summary of Water User Group – Caddo Basin SUD (Regions C and D)

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**10,115**	**13,263**	**17,792**	**23,883**	**32,195**	**43,698**
Projected Demands						
Municipal Demand	1,128	1,417	1,855	2,465	3,314	4,493
Total Projected Demands	***1,128***	***1,417***	***1,855***	***2,465***	***3,314***	***4,493***
Currently Available Supplies						
NTMWD through Farmersville	112	120	145	174	211	262
NTMWD	1,009	1,077	1,304	1,569	1,901	2,365
Total Currently Available Supplies	***1,121***	***1,197***	***1,449***	***1,743***	***2,112***	***2,627***
Need (Demand - Supply)	***7***	***220***	***406***	***722***	***1,202***	***1,866***
Water Management Strategies						
Water Conservation	2	4	4	7	12	18
NTMWD	5	216	402	715	1,190	1,848
Total Supplies from Strategies	***7***	***220***	***406***	***722***	***1,202***	***1,866***
Reserve (Shortage)	**0**	**0**	**0**	**0**	**0**	**0**

Carrollton

Carrollton is located in Denton, Dallas, and Collin Counties. The water management strategies for Carrollton are discussed under Denton County in **Section 5E.4**.

Celina

The City of Celina is located in northwest Collin County and Denton County and is projected to experience rapid growth. The city currently receives its water supply from the Upper Trinity Regional Water District (UTRWD). Due to the long-term projected growth, the City is planning a number of water management strategies to meet projected needs. Water management strategies for Celina are conservation, additional water from UTRWD, supplies from GTUA Regional Water System through Sherman, and establishing a direct connection to purchase water from NTMWD. **Table 5E.8** shows the projected population and demand, the current supplies, and the water management strategies for Celina.

Table 5E.8 Summary of Water User Group – City of Celina

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Project Population	**22,000**	**56,286**	**95,224**	**143,425**	**171,713**	**200,000**
Projected Demands						
Municipal Demand	4,574	11,596	19,582	29,476	35,287	41,095
Total Projected Demands	***4,574***	***11,596***	***19,582***	***29,476***	***35,287***	***41,095***
Currently Available Supplies						
UTRWD	4,574	8,072	8,968	8,968	8,968	8,968
Total Currently Available Supplies	***4,574***	***8,072***	***8,968***	***8,968***	***8,968***	***8,968***
Need (Demand - Supply)	***0***	***3,524***	***10,614***	***20,508***	***26,319***	***32,127***
Water Management Strategies						
Water Conservation	236	744	1,224	1,941	2,441	2,980
UTRWD	0	2,780	9,390	18,567	23,878	29,147
GTUA Regional Water System through Sherman	0	5,605	5,605	5,605	5,605	5,605
NTMWD	0	1,500	3,000	5,000	5,000	5,000
Total Supplies from Strategies	***236***	***10,629***	***19,219***	***31,113***	***36,924***	***42,732***
Reserve (Shortage)	**236**	**7,105**	**8,605**	**10,605**	**10,605**	**10,605**

Collin County Irrigation

Irrigation demand projections include the water necessary for irrigation activities, including field crops, orchards, pasture, turf grass, vineyards, golf courses irrigated by raw water, and limited aquaculture operations. Most irrigation in Collin County is for golf course irrigation. **Table 5E.9** shows the projected demand, the current supplies, and the water management strategies for Collin County Irrigation. Currently available supplies include groundwater from the Trinity and Woodbine aquifers, direct reuse, local supplies, and purchased supplies from DWU.

The Texas Water Development Board classifies the use of potable water for golf course irrigation as a part of municipal use. The use of raw water or reuse of treated wastewater effluent for golf course irrigation is classified as irrigation use.

Table 5E.9 Summary of Water User Group – Collin County Irrigation

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Demands						
Total Projected Demands	***3,340***	***3,340***	***3,340***	***3,340***	***3,340***	***3,340***
Currently Available Supplies						
DWU	2,730	2,598	2,354	2,171	2,067	1,988
Direct Reuse from The Colony	457	457	457	457	457	457
Direct Reuse from NTMWD	1,640	1,640	1,640	1,640	1,640	1,640
Local Supplies	408	408	408	408	408	408
Trinity Aquifer	404	404	404	404	404	404
Woodbine Aquifer	97	97	97	97	97	97
Total Currently Available Supplies	***5,736***	***5,604***	***5,360***	***5,177***	***5,073***	***4,994***
Need (Demand - Supply)	***0***	***0***	***0***	***0***	***0***	***0***
Water Management Strategies						
DWU	114	246	490	673	777	856
Total Supplies from Strategies	***114***	***246***	***490***	***673***	***777***	***856***
Reserve (Shortage)	**2,510**	**2,510**	**2,510**	**2,510**	**2,510**	**2,510**

Collin County Livestock

Livestock water use is defined as water used in the production of livestock, both for consumption and for cleaning and environmental purposes. **Table 5E.10** shows the projected demand and the current supplies for Collin County Livestock. The current supplies for Collin County Livestock are local surface water supplies. This source is sufficient to meet the projected demands.

Table 5E.10 Summary of Water User Group – Collin County Livestock

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Demands						
Total Projected Demands	***912***	***912***	***912***	***912***	***912***	***912***
Currently Available Supplies						
Local Supplies	1,002	1,002	1,002	1,002	1,002	1,002
Total Currently Available Supplies	***1,002***	***1,002***	***1,002***	***1,002***	***1,002***	***1,002***
Need (Demand - Supply)	***0***	***0***	***0***	***0***	***0***	***0***
Water Management Strategies						
None	0	0	0	0	0	0
Total Supplies from Strategies	***0***	***0***	***0***	***0***	***0***	***0***
Reserve (Shortage)	**90**	**90**	**90**	**90**	**90**	**90**

Collin County Manufacturing

Manufacturing water use is defined as water used to produce manufactured goods. **Table 5E.11** shows the projected demand, the current supplies, and the water management strategies for Collin County Manufacturing. Most manufacturing in Collin County is supplied by entities that obtain supplies from NTMWD. A much smaller portion of the demand is supplied by groundwater through wells located in the Woodbine aquifer. Recommended water management strategies include additional supplies from NTMWD and new well(s) in the Woodbine aquifer. Conservation was considered for this water user group but is not recommended because of the uncertainty in the ability to implement conservation measures given the multiple entities, facilities, and various manufacturing processes that make up this WUG.

Table 5E.11 Summary of Water User Group – Collin County Manfucaturing

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Demands						
Total Projected Demands	**2,246**	**2,602**	**2,602**	**2,602**	**2,602**	**2,602**
Currently Available Supplies						
Woodbine Aquifer	130	130	130	130	130	130
NTMWD through Allen	66	66	61	55	50	46
NTMWD through Frisco	66	66	61	55	50	46
NTMWD through Garland	22	22	20	18	17	15
NTMWD through McKinney	224	219	203	183	166	152
NTMWD through Plano	224	219	203	183	166	152
NTMWD through Richardson	1,498	1,473	1,362	1,233	1,111	1,020
NTMWD through Wylie	22	22	20	18	17	15
Total Currently Available Supplies	***2,252***	***2,217***	***2,060***	***1,875***	***1,707***	***1,576***
Need (Demand - Supply)	***0***	***385***	***542***	***727***	***895***	***1,026***
Water Management Strategies						
Water Conservation	0	0	0	0	0	0
NTMWD	12	385	542	727	895	1,026
New Well(s) in Woodbine Aquifer	0	78	78	78	78	78
Total Supplies from Strategies	***12***	***463***	***620***	***805***	***973***	***1,104***
Reserve (Shortage)	**18**	**78**	**78**	**78**	**78**	**78**

Collin County Mining

Mining demand includes water used for oil and gas development, as well as extraction of coal and lignite, sand aggregate, and other resources. There is no projected mining demand in Collin County.

Collin County Other

Collin County Other includes individual domestic users and water suppliers too small to be classified as water user groups. In Collin County these entities include the Air Park HOA, Altoga and Weston WSC. The entities included in Collin County Other currently receive water supplies from either groundwater (Trinity and/or Woodbine aquifers) or from NTMWD. Water management strategies for these entities include conservation, additional water from NTMWD, and supplies from the GTUA Regional Water System through Sherman. **Table 5E.12** shows the projected population and demand, the current supplies, and the water management strategies for Collin County Other.

Table 5E.12 Summary of Water User Group – Collin County Other

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**4,000**	**4,000**	**4,000**	**4,000**	**7,944**	**12,350**
Projected Demands						
Municipal Demand	627	615	606	596	1,181	1,835
Total Projected Demands	***627***	***615***	***606***	***596***	***1,181***	***1,835***
Currently Available Supplies						
Trinity Aquifer	250	250	250	250	250	250
Woodbine Aquifer	250	250	250	250	250	250
NTMWD through Plano	126	97	82	67	434	781
Total Currently Available Supplies	***626***	***597***	***582***	***567***	***934***	***1,281***
Need (Demand - Supply)	***1***	***18***	***24***	***29***	***247***	***554***
Water Management Strategies						
Water Conservation	5	7	6	8	20	37
NTMWD	0	11	18	21	227	517
GTUA Regional Water System through Sherman	0	550	1,099	1,099	1,099	1,099
Total Supplies from Strategies	***5***	***568***	***1,123***	***1,128***	***1,346***	***1,653***
Reserve (Shortage)	**4**	**550**	**1,099**	**1,099**	**1,099**	**1,099**

Collin County Steam Electric Power

Steam electric power demands generally represent the cooling water needs during power generation. These demands do not include water that is used in cogeneration facilities (which is included in manufacturing projections), facilities which do not require water for production, or hydro-electric generation facilities. **Table 5E.13** shows the projected demand, the current supplies, and the water management strategies for Collin County Steam Electric Power. Demands in Collin County are for the Ray Olinger Steam Electric Plant (Garland Power & Light). Collin County Steam Electric Power is currently supplied by raw water purchased from NTMWD through Garland. These supplies are sufficient to meet the projected demands over the planning horizon, and there are no water management strategies for this WUG.

Table 5E.13 Summary of Water User Group – Collin County Steam Electric Power

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Demands						
Total Projected Demands	***40***	***40***	***40***	***40***	***40***	***40***
Currently Available Supplies						
NTMWD through Garland	40	40	40	40	40	40
Total Currently Available Supplies	***40***	***40***	***40***	***40***	***40***	***40***
Need (Demand - Supply)	***0***	***0***	***0***	***0***	***0***	***0***
Water Management Strategies						
None	0	0	0	0	0	0
Total Supplies from Strategies	***0***	***0***	***0***	***0***	***0***	***0***
Reserve (Shortage)	**0**	**0**	**0**	**0**	**0**	**0**

Copeville Special Utility District

The service area for Copeville SUD is on the east shore of Lake Lavon in eastern Collin County. The SUD receives treated water supplies from NTMWD through the City of Farmersville and from a direct connection. Water management strategies for Copeville SUD include conservation and additional water from NTMWD. **Table 5E.14** shows the projected population and demand, the current supplies, and the water management strategies for Copeville SUD.

Table 5E.14 Summary of Water User Group – Copeville SUD

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**3,959**	**4,945**	**6,148**	**8,574**	**15,171**	**26,007**
Projected Demands						
Municipal Demand	327	387	465	638	1,123	1,921
Total Projected Demands	***327***	***387***	***465***	***638***	***1,123***	***1,921***
Currently Available Supplies						
NTMWD through Farmersville	49	49	54	67	107	168
NTMWD	277	278	309	384	608	955
Total Currently Available Supplies	***326***	***327***	***363***	***451***	***715***	***1,123***
Need (Demand - Supply)	***1***	***60***	***102***	***187***	***408***	***798***
Water Management Strategies						
Water Conservation	9	11	14	21	41	80
NTMWD	0	49	88	166	367	718
Total Supplies from Strategies	***9***	***60***	***102***	***187***	***408***	***798***
Reserve (Shortage)	**8**	**0**	**0**	**0**	**0**	**0**

Culleoka Water Supply Corporation

The service area for Culleoka WSC is located between the two arms of Lake Lavon in central Collin County. The WSC receives treated water supplies from NTMWD through Princeton. Water management strategies for Culleoka WSC include conservation and additional water from NTMWD. **Table 5E.15** shows the projected population and demand, the current supplies, and the water management strategies for Culleoka WSC.

Table 5E.15 Summary of Water User Group – Culleoka WSC

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**5,500**	**5,787**	**8,739**	**10,615**	**12,000**	**15,000**
Projected Demands						
Municipal Demand	597	596	901	1,094	1,237	1,546
Total Projected Demands	***597***	***596***	***901***	***1,094***	***1,237***	***1,546***
Currently Available Supplies						
NTMWD through Princeton	593	503	704	774	789	903
Total Currently Available Supplies	***593***	***503***	***704***	***774***	***789***	***903***
Need (Demand - Supply)	***4***	***93***	***197***	***320***	***448***	***643***
Water Management Strategies						
Water Conservation	5	7	9	16	24	35
NTMWD	0	86	188	304	424	608
Total Supplies from Strategies	***5***	***93***	***197***	***320***	***448***	***643***
Reserve (Shortage)	**1**	**0**	**0**	**0**	**0**	**0**

Dallas

Dallas is a major wholesale water provider that supplies water in Dallas, Collin, Denton, Kaufman, and Rockwall Counties. See Dallas Water Utilities (DWU) in **Chapter 5D**.

Desert WSC

Desert WSC serves parts of Collin, Fannin, and Grayson Counties. Water management strategies for Desert WSC are discussed under Fannin County in **Section 5E.6.1**.

East Fork Special Utility District

East Fork SUD is located in southern Collin County and extends into Dallas and Rockwall Counties as well. The SUD receives treated water supplies from NTMWD. Water management strategies for East Fork SUD include conservation and additional water from NTMWD with additional delivery infrastructure. **Table 5E.16** shows the projected population and demand, the current supplies, and the water management strategies for East Fork SUD.

Table 5E.16 Summary of Water User Group – East Fork SUD

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**15,700**	**17,500**	**19,500**	**21,000**	**23,000**	**25,000**
Projected Demands						
Municipal Demand	1,913	2,045	2,229	2,378	2,599	2,823
Total Projected Demands	***1,913***	***2,045***	***2,229***	***2,378***	***2,599***	***2,823***
Currently Available Supplies						
NTMWD	1,903	1,727	1,741	1,681	1,657	1,651
Total Currently Available Supplies	***1,903***	***1,727***	***1,741***	***1,681***	***1,657***	***1,651***
Need (Demand - Supply)	***10***	***318***	***488***	***697***	***942***	***1,172***
Water Management Strategies						
Water Conservation	87	105	113	130	155	179
NTMWD	0	213	375	567	787	993
Additional Delivery Infrastructure from NTMWD	*0*	*213*	*375*	*567*	*787*	*993*
Total Supplies from Strategies	***87***	***318***	***488***	***697***	***942***	***1,172***
Reserve (Shortage)	**77**	**0**	**0**	**0**	**0**	**0**

Fairview

The Town of Fairview is located in central Collin County and is adjacent to the Heard Wildlife Sanctuary. It is bordered by McKinney, the county seat, to the north, by Allen to the west and south, and by Lucas to the southeast. The town receives treated water supplies from NTMWD. Water management strategies for Fairview include conservation and additional water from NTMWD. **Table 5E.17** shows the projected population and demand, the current supplies, and the water management strategies for Fairview.

Table 5E.17 Summary of Water User Group – City of Fairview

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**12,592**	**14,529**	**19,397**	**20,193**	**20,418**	**20,418**
Projected Demands						
Municipal Demand	4,498	5,162	6,871	7,146	7,223	7,222
Total Projected Demands	***4,498***	***5,162***	***6,871***	***7,146***	***7,223***	***7,222***
Currently Available Supplies						
NTMWD	4,474	4,360	5,367	5,052	4,603	4,223
Total Currently Available Supplies	***4,474***	***4,360***	***5,367***	***5,052***	***4,603***	***4,223***
Need (Demand - Supply)	***24***	***802***	***1,504***	***2,094***	***2,620***	***2,999***
Water Management Strategies						
Water Conservation	186	259	331	368	396	420
NTMWD	0	543	1,173	1,726	2,224	2,579
Total Supplies from Strategies	***186***	***802***	***1,504***	***2,094***	***2,620***	***2,999***
Reserve (Shortage)	**162**	**0**	**0**	**0**	**0**	**0**

Farmersville

The City of Farmersville is located in eastern Collin County and receives treated water supplies from NTMWD. The city is at the intersection of U.S. Highway 380 and State Highway 78 and is expected to grow rapidly in the coming decades. Water management strategies for Farmersville include conservation and additional water from NTMWD. **Table 5E.18** shows the projected population and demand, the current supplies, and the water management strategies for Farmersville.

Table 5E.18 Summary of Water User Group – City of Farmersville

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**8,660**	**21,680**	**49,295**	**75,393**	**107,169**	**154,965**
Projected Demands						
Municipal Demand	1,036	2,504	5,665	8,640	12,276	17,744
Total Projected Demands	***1,036***	***2,504***	***5,665***	***8,640***	***12,276***	***17,744***
Currently Available Supplies						
NTMWD	1,031	2,115	4,425	6,109	7,824	10,377
Total Currently Available Supplies	***1,031***	***2,115***	***4,425***	***6,109***	***7,824***	***10,377***
Need (Demand - Supply)	***5***	***389***	***1,240***	***2,531***	***4,452***	***7,367***
Water Management Strategies						
Water Conservation	8	33	71	137	236	399
NTMWD	0	356	1,169	2,394	4,216	6,968
Total Supplies from Strategies	***8***	***389***	***1,240***	***2,531***	***4,452***	***7,367***
Reserve (Shortage)	**3**	**0**	**0**	**0**	**0**	**0**

Frisco

The City of Frisco is a rapidly growing community in west Collin County and east Denton County. The City purchases treated water from NTMWD and obtains reuse supplies from wastewater plants operated by NTMWD. Reuse supplies originate from the Stewart Creek West and Panther Creek wastewater treatment plants and are used by the City of Frisco for irrigation at parks, schools, neighborhoods and golf courses. The City also owns two groundwater wells that are used for municipal irrigation purposes. The City plans to replace these groundwater supplies with reuse supplies over the planning horizon due to issues with high salinity and reliability. Water management strategies for Frisco are conservation, additional water from NTMWD, and additional direct reuse. **Table 5E.19** shows the projected population and demand, the current supplies, and the water management strategies for Frisco. The reserve that is shown is equal to the City's existing groundwater supplies after 2020.

Table 5E.19 Summary of Water User Group – City of Frisco

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**188,343**	**212,165**	**257,873**	**321,456**	**357,565**	**375,000**
Projected Demands						
Municipal Demand	45,726	51,122	61,968	77,175	85,788	89,955
Manufacturing, Collin	*67*	*78*	*78*	*78*	*78*	*78*
Manufacturing, Denton	*26*	*26*	*26*	*26*	*26*	*26*
Total Projected Demands	***45,819***	***51,226***	***62,072***	***77,279***	***85,892***	***90,059***
Currently Available Supplies						
NTMWD	43,854	41,587	46,718	52,856	52,965	51,043
Direct Reuse	1,401	1,401	1,401	1,401	1,401	1,401
Trinity Aquifer	65	65	65	65	65	65
Woodbine Aquifer	75	75	75	75	75	75
Total Currently Available Supplies	***45,395***	***43,128***	***48,259***	***54,397***	***54,506***	***52,584***
Need (Demand - Supply)	***424***	***8,098***	***13,813***	***22,882***	***31,386***	***37,475***
Water Management Strategies						
Water Conservation	2,433	3,134	3,698	4,739	5,500	6,044
NTMWD	0	4,510	9,399	17,165	24,647	30,192
Additional Direct Reuse	325	594	856	1,118	1,379	1,379
Total Supplies from Strategies	***2,758***	***8,238***	***13,953***	***23,022***	***31,526***	***37,615***
Reserve (Shortage)	**2,334**	**140**	**140**	**140**	**140**	**140**

Frognot Water Supply Corporation

Frognot WSC is located predominately in northeastern Collin County and has a small service area in Hunt County in Region D. The WSC is a new WUG for the *2021 Region C Regional Water Plan*. Frognot WSC currently uses groundwater and gets supplies from the Woodbine aquifer. The only water management strategy for the WSC is conservation. **Table 5E.20** shows the projected population and demand, the current supplies, and the water management strategies for Frognot WSC.

Table 5E.20 Summary of Water User Group – City of Frognot WSC

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**1,657**	**1,936**	**2,364**	**2,975**	**3,396**	**3,779**
Projected Demands						
Municipal Demand	174	196	236	294	334	372
Total Projected Demand	***174***	***196***	***236***	***294***	***334***	***372***
Currently Available Supplies						
Woodbine Aquifer	372	372	372	372	372	372
Total Currently Available Supplies	***372***	***372***	***372***	***372***	***372***	***372***
Need (Demand – Supply)	***0***	***0***	***0***	***0***	***0***	***0***
Water Management Strategies						
Water Conservation	2	2	2	4	5	7
Total Supplies from Strategies	***2***	***2***	***2***	***4***	***5***	***7***
Reserve (Shortage)	**200**	**178**	**138**	**82**	**43**	**7**

Garland

Garland is a municipality and wholesale water provider in northeastern Dallas, Collin, and Rockwall Counties. Demands and strategies for Garland are discussed under Dallas County in **Section 5E.3**.

Hickory Creek Special Utility District

Hickory Creek SUD is primarily located in Hunt County in the North East Texas Region (Region D), with some service area in northeast Collin County and south Fannin County in Region C. Water management strategies for Region C are described under Fannin County in **Section 5E.6**.

Josephine

Josephine is located predominately in southeastern Collin County, with a small portion located in Hunt County in the North East Texas Region (Region D). Josephine receives treated water supplies from NTMWD and plans to continue to do so. Water management strategies for Josephine include conservation and additional water from NTMWD. **Table 5E.21** shows the projected population and demand, the current supplies, and the water management strategies for Josephine.

Table 5E.21 Summary of Water User Group – City of Josephine (Region C and D)

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**1,618**	**2,625**	**3,743**	**4,958**	**5,135**	**5,135**
Projected Demands						
Municipal Demand	346	553	784	1,038	1,074	1,074
Total Projected Demands	***346***	***553***	***784***	***1,038***	***1,074***	***1,074***
Currently Available Supplies						
NTMWD	344	467	612	734	685	628
Total Currently Available Supplies	***344***	***467***	***612***	***734***	***685***	***628***
Need (Demand – Supply)	***2***	***86***	***172***	***304***	***389***	***446***
Water Management Strategies						
Water Conservation	13	22	30	42	47	50
NTMWD	0	64	142	262	342	396
Total Supplies from Strategies	***13***	***86***	***172***	***304***	***389***	***446***
Reserve (Shortage)	**11**	**0**	**0**	**0**	**0**	**0**

Lucas

The City of Lucas is located in south central Collin County. Lucas receives treated water supplies from NTMWD and plans to continue to do so. Water management strategies for Lucas include conservation and additional water from NTMWD. **Table 5E.22** shows the projected population and demand, the current supplies, and the water management strategies for Lucas.

Table 5E.22 Summary of Water User Group – City of Lucas

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**7,822**	**8,908**	**11,794**	**13,720**	**15,330**	**15,330**
Projected Demands						
Municipal Demand	2,316	2,613	3,438	3,990	4,455	4,454
Total Projected Demands	***2,316***	***2,613***	***3,438***	***3,990***	***4,455***	***4,454***
Currently Available Supplies						
NTMWD	2,304	2,208	2,685	2,821	2,839	2,605
Total Currently Available Supplies	***2,304***	***2,208***	***2,685***	***2,821***	***2,839***	***2,605***
Need (Demand – Supply)	***12***	***405***	***753***	***1,169***	***1,616***	***1,849***
Water Management Strategies						
Water Conservation	161	296	390	474	544	559
NTMWD	0	109	363	695	1,072	1,290
Total Supplies from Strategies	***161***	***405***	***753***	***1,169***	***1,616***	***1,849***
Reserve (Shortage)	**149**	**0**	**0**	**0**	**0**	**0**

Marilee Special Utility District (Formerly Called Gunter Rural WSC)

Marilee SUD is located in northeastern Collin County and southeastern Grayson County. The water supply plan for Marilee SUD is discussed under Grayson County in **Section 5E.8**.

McKinney

The City of McKinney is the county seat of Collin County and is located in central Collin County. McKinney supplies several customers including portions of Collin County Manufacturing and Melissa. McKinney gets all of its treated water supplies from NTMWD and plans to continue to do so in the future. Water management strategies for McKinney include conservation and additional water from NTMWD. **Table 5E.23** shows the projected population and demand, the current supplies, and the water management strategies for McKinney.

Table 5E.23 Summary of Water User Group – City of McKinney

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**186,565**	**205,000**	**227,522**	**275,828**	**330,324**	**357,967**
Projected Demands						
Municipal Demand	40,856	44,424	48,984	59,223	70,879	76,807
Melissa	*561*	*561*	*561*	*561*	*561*	*561*
Manufacturing, Collin	*225*	*260*	*260*	*260*	*260*	*260*
Total Projected Demands	***41,642***	***45,245***	***49,805***	***60,044***	***71,700***	***77,628***
Currently Available Supplies						
NTMWD	41,418	38,219	38,899	42,449	45,693	45,399
Total Currently Available Supplies	***41,418***	***38,219***	***38,899***	***42,449***	***45,693***	***45,399***
Need (Demand – Supply)	***224***	***7,026***	***10,906***	***17,595***	***26,007***	***32,229***
Water Management Strategies						
Water Conservation	2,535	3,307	3,780	4,848	5,791	6,428
NTMWD	0	3,719	7,126	12,747	20,216	25,801
Total Supplies from Strategies	***2,536***	***7,026***	***10,906***	***17,595***	***26,007***	***32,229***
Reserve (Shortage)	**2,311**	**0**	**0**	**0**	**0**	**0**

Melissa

Melissa is located in northern Collin County. The city receives its water supply from groundwater (Woodbine aquifer) and from NTMWD (through McKinney and through the GTUA Collin-Grayson Municipal Alliance pipeline). Melissa is expected to grow rapidly over the planning horizon. Water management strategies for Melissa include conservation, additional water from NTMWD (through McKinney), and additional water from NTMWD and/or Sherman (through the GTUA Collin-Grayson Municipal Alliance pipeline). **Table 5E.24** shows the projected population and demand, the current supplies, and the water management strategies for Melissa. The reserve is equivalent to the supplies from Sherman through the CGMA. Due to the rapid growth that is projected, it is important to the City to have a reliable and diverse water supply portfolio.

Table 5E.24 Summary of Water User Group – City of Melissa

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**17,938**	**57,000**	**80,000**	**100,000**	**115,072**	**119,072**
Projected Demands						
Municipal Demand	3,946	12,418	17,365	21,642	24,886	25,745
Total Projected Demands	***3,946***	***12,418***	***17,365***	***21,642***	***24,886***	***25,745***
Currently Available Supplies						
Woodbine Aquifer	175	175	175	175	175	175
NTMWD through McKinney	558	474	438	396	358	328
NTMWD through GTUA	2,852	2,852	2,852	2,852	2,852	2,852
Total Currently Available Supplies	***3,585***	***3,501***	***3,465***	***3,423***	***3,385***	***3,355***
Need (Demand – Supply)	***361***	***8,917***	***13,900***	***18,219***	***21,501***	***22,390***
Water Management Strategies						
Water Conservation	176	611	825	1,100	1,348	1,480
NTMWD through McKinney	0	59	96	136	172	201
Sherman through GTUA (CGMA)	0	3,172	3,497	3,296	3,112	2,974
NTMWD through GTUA (CGMA)	208	8,247	12,979	16,983	19,981	20,709
Total Supplies from Strategies	***384***	***12,089***	***17,397***	***21,515***	***24,613***	***25,364***
Reserve (Shortage)	**23**	**3,172**	**3,497**	**3,296**	**3,112**	**2,974**

Milligan Water Supply Corporation

Milligan WSC is located in central Collin County and is bordered to the west by McKinney. The WSC receives treated water supplies from NTMWD and plans to continue to do so. Milligan WSC's water management strategies include conservation and additional water from NTMWD. **Table 5E.25** shows the projected population and demand, the current supplies, and the water management strategies for Milligan WSC.

Table 5E.25 Summary of Water User Group – Milligan WSC

Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**3,728**	**4,352**	**5,312**	**6,680**	**7,604**	**8,423**
Projected Demands						
Municipal Demand	450	511	614	766	870	963
Total Projected Demand	***450***	***511***	***614***	***766***	***870***	***963***
Currently Available Supplies						
NTMWD	447	431	480	542	554	563
Total Currently Available Supplies	***447***	***431***	***480***	***542***	***554***	***563***
Need (Demand – Supply)	***3***	***80***	***134***	***224***	***316***	***400***
Water Management Strategies						
Water Conservation	4	6	6	10	15	19
NTMWD	0	74	128	214	301	381
Total Supplies from Strategies	***4***	***80***	***134***	***224***	***316***	***400***
Reserve (Shortage)	**1**	**0**	**0**	**0**	**0**	**0**

Murphy

The City of Murphy is located in southern Collin County and receives treated water supplies from NTMWD. Water management strategies for Murphy are conservation and water from NTMWD. **Table 5E.26** shows the projected population and demand, the current supplies, and the water management strategies for Murphy.

Table 5E.26 Summary of Water User Group – City of Murphy

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**19,330**	**19,330**	**19,330**	**19,330**	**19,330**	**19,330**
Projected Demands						
Municipal Demand	4,441	4,414	4,402	4,393	4,388	4,387
Total Projected Demands	***4,441***	***4,414***	***4,402***	***4,393***	***4,388***	***4,387***
Currently Available Supplies						
NTMWD	4,417	3,729	3,438	3,105	2,796	2,565
Total Currently Available Supplies	***4,417***	***3,729***	***3,438***	***3,105***	***2,796***	***2,565***
Need (Demand - Supply)	***24***	***685***	***964***	***1,288***	***1,592***	***1,822***
Water Management Strategies						
Water Conservation	214	248	241	256	270	285
NTMWD	0	437	723	1,032	1,322	1,537
Total Supplies from Strategies	***214***	***685***	***964***	***1,288***	***1,592***	***1,822***
Reserve (Shortage)	**190**	**0**	**0**	**0**	**0**	**0**

Nevada Special Utility District

Nevada SUD supplies water to part of Collin and Rockwall Counties. The SUD receives treated water supplies from NTMWD and plans to continue to do so. The water management strategies include conservation and additional water from NTMWD. **Table 5E.27** shows the projected population and demand, the current supplies, and the water management strategies for Nevada SUD.

Table 5E.27 Summary of Water User Group – Nevada SUD

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**2,493**	**3,074**	**3,623**	**11,856**	**28,150**	**50,671**
Projected Demands						
Municipal Demand	250	298	345	1,116	2,642	4,752
Total Projected Demand	***250***	***298***	***345***	***1,116***	***2,642***	***4,752***
Currently Available Supplies						
NTMWD	249	252	269	790	1,683	2,779
Total Currently Available Supplies	***249***	***252***	***269***	***790***	***1,683***	***2,779***
Need (Demand – Supply)	***1***	***46***	***76***	***326***	***959***	***1,973***
Water Management Strategies						
Water Conservation	10	12	13	49	130	250
NTMWD	0	34	63	277	829	1,723
Total Supplies from Strategies	***10***	***46***	***76***	***326***	***959***	***1,973***
Reserve (Shortage)	**9**	**0**	**0**	**0**	**0**	**0**

North Collin Special Utility District

North Collin SUD is located in north Collin County. The SUD currently receives treated water supplies from NTMWD and plans to continue to do so. Water management strategies for North Collin SUD include conservation and additional water from NTMWD. **Table 5E.28** shows the projected population and demand, the current supplies, and the water management strategies for North Collin SUD.

Table 5E.28 Summary of Water User Group – North Collin SUD

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**5,566**	**6,442**	**7,509**	**9,006**	**10,529**	**12,143**
Projected Demands						
Municipal Demand	818	921	1,055	1,254	1,463	1,685
Total Projected Demands	***818***	***921***	***1,055***	***1,254***	***1,463***	***1,685***
Currently Available Supplies						
NTMWD	814	778	824	887	933	986
Total Currently Available Supplies	***814***	***778***	***824***	***887***	***933***	***986***
Need (Demand - Supply)	***4***	***143***	***231***	***367***	***530***	***699***
Water Management Strategies						
Water Conservation	7	11	11	17	26	38
NTMWD	0	132	220	350	504	661
Total Supplies from Strategies	***7***	***143***	***231***	***367***	***530***	***699***
Reserve (Shortage)	**3**	**0**	**0**	**0**	**0**	**0**

North Farmersville Water Supply Corporation

North Farmersville WSC supplies water in Collin County and is located north of the City of Farmersville. The WSC receives treated water supplies from NTMWD through Farmersville. The water management strategies for North Farmersville WSC include conservation and additional supplies from NTMWD. **Table 5E.29** shows the projected population and demand, the current supplies, and the water management strategies for North Farmersville WSC.

Table 5E.29 Summary of Water User Group – North Farmersville WSC

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**417**	**486**	**594**	**747**	**850**	**942**
Projected Demands						
Municipal Demand	91	104	126	158	180	199
Total Projected Demand	***91***	***104***	***126***	***158***	***180***	***199***
Currently Available Supplies						
NTMWD through Farmersville	91	88	98	112	115	116
Total Currently Available Supplies	***91***	***88***	***98***	***112***	***115***	***116***
Need (Demand – Supply)	***0***	***16***	***28***	***46***	***65***	***83***
Water Management Strategies						
Water Conservation	3	7	8	10	12	14
NTMWD	0	9	20	36	53	69
Total Supplies from Strategies	***3***	***16***	***28***	***46***	***65***	***83***
Reserve (Shortage)	**3**	**0**	**0**	**0**	**0**	**0**

Parker

The City of Parker is located in south Collin County and receives treated water supplies from NTMWD. Water management strategies for Parker include conservation and additional water from NTMWD, including additional delivery infrastructure. **Table 5E.30** shows the projected population and demand, the current supplies, and the water management strategies for Parker.

Table 5E.30 Summary of Water User Group – City of Parker

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**7,316**	**7,316**	**7,811**	**9,117**	**10,035**	**11,465**
Projected Demands						
Municipal Demand	3,123	3,096	3,302	3,852	4,239	4,843
Total Projected Demands	***3,123***	***3,096***	***3,302***	***3,852***	***4,239***	***4,843***
Currently Available Supplies						
NTMWD	2,803	2,559	2,486	2,596	2,561	2,667
Total Currently Available Supplies	***2,803***	***2,559***	***2,486***	***2,596***	***2,561***	***2,667***
Need (Demand - Supply)	***320***	***537***	***816***	***1,256***	***1,678***	***2,176***
Water Management Strategies						
Water Conservation	178	202	211	259	305	372
NTMWD	142	335	605	997	1,373	1,804
Additional Delivery Infrastructure from NTMWD	*142*	*335*	*605*	*997*	*1,373*	*1,804*
Total Supplies from Strategies	***320***	***537***	***816***	***1,256***	***1,678***	***2,176***
Reserve (Shortage)	**0**	**0**	**0**	**0**	**0**	**0**

Plano

The City of Plano is located in southwest Collin County and southeast Denton County. Plano provides water to a portion of The Colony and to some manufacturing within Plano. The city receives all of its treated water supplies from NTMWD. Water management strategies for Plano include conservation and water from NTMWD. **Table 5E.31** shows the projected population and demand, the current supplies, and the water management strategies for Plano.

Table 5E.31 Summary of Water User Group – City of Plano

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**286,600**	**291,144**	**295,663**	**296,547**	**297,000**	**300,000**
Projected Demands						
Municipal Demand	73,808	73,946	74,311	74,125	74,142	74,891
The Colony	*1,200*	*2,000*	*2,200*	*2,200*	*2,200*	*2,200*
County Other, Collin	*127*	*115*	*106*	*96*	*681*	*1,335*
Manufacturing, Collin	*225*	*260*	*260*	*260*	*260*	*260*
Total Projected Demands	***75,360***	***76,321***	***76,877***	***76,681***	***77,283***	***78,686***
Currently Available Supplies						
NTMWD	74,954	64,469	60,043	54,212	49,250	46,017
Total Currently Available Supplies	***74,954***	***64,470***	***60,043***	***54,212***	***49,250***	***46,017***
Need (Demand - Supply)	***406***	***11,851***	***16,834***	***22,469***	***28,033***	***32,669***
Water Management Strategies						
Water Conservation	3,687	4,147	4,435	4,214	4,483	4,798
NTMWD	0	7,705	12,399	18,255	23,550	27,871
Total Supplies from Strategies	***3,687***	***11,851***	***16,834***	***22,469***	***28,033***	***32,669***
Reserve (Shortage)	**3,281**	**0**	**0**	**0**	**0**	**0**

Princeton

Princeton is at the intersections of U.S. Highway 380 and Farm Roads 75, 1377, and 982, seven miles east of McKinney in east central Collin County. The City supplies its citizens and provides wholesale supplies to Culleoka Water Supply Corporation. Princeton obtains all of its treated water supplies from the North Texas Municipal Water District and plans to continue to do so. **Table 5E.32** shows the projected demand, the current supplies, and the water management strategies for Princeton.

Table 5E.32 Summary of Wholesale Water Provider and Customers - Princeton

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Demands						
Princeton	1,184	3,964	7,951	9,320	9,303	9,298
Culleoka WSC	597	596	901	1,094	1,237	1,546
Total Projected Demands	***1,781***	***4,560***	***8,852***	***10,414***	***10,540***	***10,844***
Currently Available Supplies						
NTMWD	1,771	3,852	6,914	7,363	6,717	6,340
Total Currently Available Supplies	***1,771***	***3,852***	***6,914***	***7,363***	***6,717***	***6,340***
Need (Demand - Supply)	***10***	***708***	***1,938***	***3,051***	***3,823***	***4,504***
Water Management Strategies						
Conservation (retail)	11	56	100	147	178	209
Conservation (wholesale)	5	7	9	16	24	35
NTMWD	0	645	1,829	2,888	3,621	4,260
Total Supplies from Strategies	***16***	***708***	***1,938***	***3,051***	***3,823***	***4,504***
Reserve (Shortage)	**6**	**0**	**0**	**0**	**0**	**0**

Prosper

The City of Prosper is located in western Collin County and eastern Denton County. The city currently receives treated water supplies from NTMWD. Water management strategies for Prosper include conservation and additional water from NTMWD, including additional delivery infrastructure. **Table 5E.33** shows the projected population and demand, the current supplies, and the water management strategies for Prosper.

Table 5E.33 Summary of Water User Group – City of Prosper

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**20,160**	**27,609**	**35,058**	**43,029**	**51,000**	**51,000**
Projected Demands						
Municipal Demand	5,169	7,028	8,909	10,925	12,942	12,941
Total Projected Demands	***5,169***	***7,028***	***8,909***	***10,925***	***12,942***	***12,941***
Currently Available Supplies						
NTMWD	5,130	5,605	5,605	5,605	5,605	5,605
Total Currently Available Supplies	***5,130***	***5,605***	***5,605***	***5,605***	***5,605***	***5,605***
Need (Demand - Supply)	***39***	***1,423***	***3,304***	***5,320***	***7,337***	***7,336***
Water Management Strategies						
Water Conservation	230	346	423	556	701	744
NTMWD	0	1,077	2,881	4,764	6,636	6,592
Additional Delivery Infrastructure from NTWMD	*0*	*1,077*	*2,881*	*4,764*	*6,636*	*6,592*
Total Supplies from Strategies	***230***	***1,423***	***3,304***	***5,320***	***7,337***	***7,336***
Reserve (Shortage)	**191**	**0**	**0**	**0**	**0**	**0**

Richardson

Richardson is located in north Dallas County and southwest Collin County. Since most of the population is in Dallas County, its water supply plan is discussed under Dallas County in **Section 5E.3**.

Royse City

Royse City is located in northeast Rockwall County and southeast Collin County. Since most of the population is in Rockwall County, its water supply plan is discussed under Rockwall County in **Section 5E.14.**

Sachse

Sachse is located in north Dallas County and south Collin County. Since most of the population is in Dallas County, its water supply plan is discussed under Dallas County in **Section 5E.3**.

Seis Lagos Utility District

Seis Lagos Utility District is located in central Collin County on the western shore of Lake Lavon. The District currently receives treated water supplies from NTMWD. Water management strategies for Seis Lagos UD include conservation and water from NTMWD. **Table 5E.34** shows the projected population and demand, the current supplies, and the water management strategies for Seis Lagos UD.

Table 5E.34 Summary of Water User Group – Seis Lagos Utility District

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**2,041**	**2,041**	**2,041**	**2,124**	**2,148**	**2,148**
Projected Demands						
Municipal Demand	577	573	571	592	598	598
Total Projected Demands	***577***	***573***	***571***	***592***	***598***	***598***
Currently Available Supplies						
NTMWD	573	484	446	418	381	350
Total Currently Available Supplies	***573***	***484***	***446***	***418***	***381***	***350***
Need (Demand - Supply)	***4***	***89***	***125***	***174***	***217***	***248***
Water Management Strategies						
Water Conservation	24	27	26	29	31	33
NTMWD	0	62	99	145	186	215
Total Supplies from Strategies	***24***	***89***	***125***	***174***	***217***	***248***
Reserve (Shortage)	**20**	**0**	**0**	**0**	**0**	**0**

South Grayson Special Utility District

South Grayson SUD is located in south Grayson County and north Collin County. The water supply plan for South Grayson SUD is discussed under Grayson County in **Section 5E.8**.

Verona Special Utility District

Verona SUD is located in northeastern Collin County, south of Westminster WSC. The SUD receives its water supply from the Woodbine aquifer, and the water management strategies are conservation and new groundwater well(s) in the Woodbine aquifer. **Table 5E.35** shows the projected population and demand, the current supplies, and the water management strategies for Verona SUD.

Table 5E.35 Summary of Water User Group – Verona SUD

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**2,648**	**3,091**	**3,772**	**4,744**	**5,400**	**5,983**
Projected Demands						
Municipal Demand	266	301	360	448	509	563
Total Projected Demand	***266***	***301***	***360***	***448***	***509***	***563***
Currently Available Supplies						
Woodbine Aquifer	266	266	266	266	266	266
Total Currently Available Supplies	***266***	***266***	***266***	***266***	***266***	***266***
Need (Demand – Supply)	***0***	***35***	***94***	***182***	***243***	***297***
Water Management Strategies						
Water Conservation	2	4	4	6	8	11
New Well(s) in Woodbine Aquifer	0	31	90	176	235	286
Total Supplies from Strategies	***2***	***35***	***94***	***182***	***243***	***297***
Reserve (Shortage)	**2**	**0**	**0**	**0**	**0**	**0**

West Leonard Water Supply Corporation

West Leonard WSC serves Collin and Fannin Counties in Region C and Hunt County in Region D. The water management strategies for West Leonard WSC are discussed under Fannin County in **Section 5E.6**.

Westminster Water Supply Corporation

Westminster WSC serves Collin and Grayson County. The WSC receives its water supply from the Woodbine aquifer. Since the WSC's projected demands can be met with the existing supplies, the only water management strategy included for this entity is conservation. **Table 5E.36** shows the projected population and demand, the current supplies, and the water management strategies for Westminster WSC.

Table 5E.36 Summary of Water User Group – Westminster WSC

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**1,909**	**2,228**	**2,716**	**3,412**	**3,891**	**4,321**
Projected Demands						
Municipal Demand	259	294	354	442	503	558
Total Projected Demand	***259***	***294***	***354***	***442***	***503***	***558***
Currently Available Supplies						
Woodbine Aquifer	552	552	552	552	552	552
Total Currently Available Supplies	***552***	***552***	***552***	***552***	***552***	***552***
Need (Demand – Supply)	***0***	***0***	***0***	***0***	***0***	***6***
Water Management Strategies						
Water Conservation	2	3	4	6	8	11
Total Supplies from Strategies	***2***	***3***	***4***	***6***	***8***	***11***
Reserve (Shortage)	**295**	**261**	**202**	**116**	**57**	**5**

Wylie

Wylie is located in southern Collin County, with some area also extending into Dallas and Rockwall Counties. The City of Wylie currently receives treated water supplies from NTMWD and is home to NTMWD's Wylie Water Treatment Plant. Water management strategies for Wylie include conservation and additional water from NTMWD. **Table 5E.37** shows the projected population and demand, the current supplies, and the water management strategies for Wylie. It should be noted that some parts of the City of Wylie receives treated water supplies from Wylie Northeast SUD. The population in **Table 5E.37** (water service area population) is less than the population of the whole city.

Table 5E.37 Summary of Water User Group – City of Wylie

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**47,156**	**50,465**	**53,076**	**56,812**	**59,109**	**64,809**
Projected Demands						
Municipal Demand	7,106	7,496	7,824	8,338	8,658	9,490
Manufacturing, Collin	*22*	*26*	*26*	*26*	*26*	*26*
Total Projected Demands	***7,128***	***7,522***	***7,850***	***8,364***	***8,684***	***9,516***
Currently Available Supplies						
NTMWD	7,089	6,354	6,131	5,913	5,534	5,565
Total Currently Available Supplies	***7,089***	***6,354***	***6,131***	***5,913***	***5,534***	***5,565***
Need (Demand - Supply)	***39***	***1,168***	***1,719***	***2,451***	***3,150***	***3,951***
Water Management Strategies						
Water Conservation	377	435	443	499	546	622
NTMWD	0	733	1,276	1,952	2,604	3,329
Total Supplies from Strategies	***377***	***1,168***	***1,719***	***2,451***	***3,150***	***3,951***
Reserve (Shortage)	**338**	**0**	**0**	**0**	**0**	**0**

Wylie Northeast Special Utility District

Wylie Northeast SUD is located in Collin County north of the City of Wylie. Wylie Northeast SUD currently receives treated water supplies from NTMWD. Water management strategies for Wylie Northeast SUD include conservation and additional water from NTMWD, with additional delivery infrastructure. The quantities shown for additional delivery infrastructure projects in the *Region C Regional Water Plan* are assumed to be equivalent to the additional supplies from the wholesale water provider. **Table 5E.38** shows the projected population and demand, the current supplies, and the water management strategies for Wylie.

Table 5E.38 Summary of Water User Group – Wylie Northeast SUD

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**4,958**	**5,976**	**7,015**	**11,464**	**17,153**	**25,279**
Projected Demands						
Municipal Demand	674	795	924	1,498	2,238	3,295
Total Projected Demands	***674***	***795***	***924***	***1,498***	***2,238***	***3,295***
Currently Available Supplies						
NTMWD	671	672	722	1,059	1,426	1,927
Total Currently Available Supplies	***671***	***672***	***722***	***1,059***	***1,426***	***1,927***
Need (Demand - Supply)	***3***	***123***	***202***	***439***	***812***	***1,368***
Water Management Strategies						
Water Conservation	5	9	9	22	43	74
NTMWD	0	114	193	417	769	1,294
Additional Delivery Infrastructure from NTWMD	*0*	*114*	*193*	*417*	*769*	*1,294*
Total Supplies from Strategies	***5***	***123***	***202***	***439***	***812***	***1,368***
Reserve (Shortage)	**2**	**0**	**0**	**0**	**0**	**0**

5E.1.2 Summary of Costs for Collin County

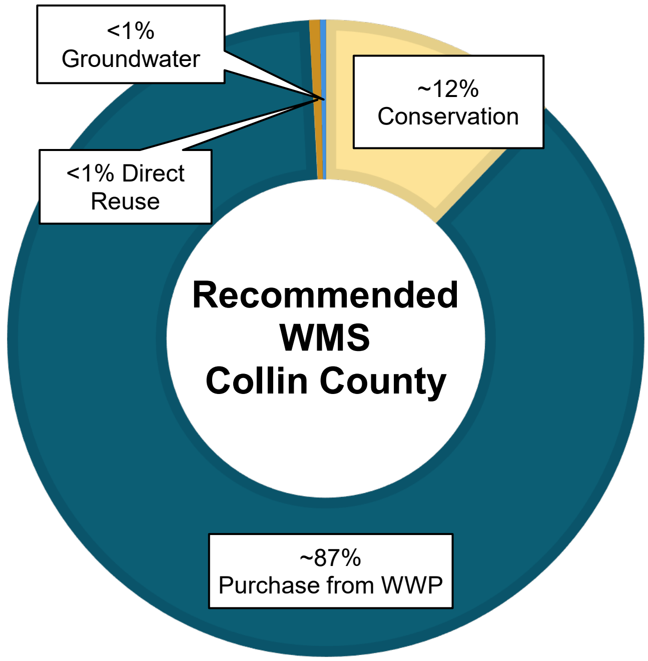


Table 5E.39 summarizes the costs of the water management strategies recommended for the WUGs and WWPs who have the majority of their demand located in Collin County. Total quantities from **Table 5E.39** will not necessarily match total county demands. This is due mainly to water users whose sum of strategies results in a reserve as well as due to water users located in multiple counties (or wholesale water providers who develop strategies and then sell water to users in other counties). Quantities from infrastructure projects needed to deliver and/or treat water (shown in *gray italics*) are not included since the supplies are associated with other strategies. To avoid double-counting quantities of supplies, the quantities in gray italics are **not** included in the total.

The majority of the future supplies needed to meet demands for WUGs located within Collin County are projected to come through purchases from wholesale water providers. Other strategies include conservation, direct reuse and groundwater.

Table 5E.40 summarizes the recommended water management strategies within Collin County for individual WUGs and WWPs. Alternative strategies are also included. More detailed cost estimates are located in **Appendix H.**

Table 5E.39 Summary of Recommended Water Management Strategies for Collin County

Type of Strategy	Quantity (Ac-Ft/Yr)	Capital Costs
Conservation[a]	30,659	$17,854,953
Purchase from WWP	219,874	$0
Additional Delivery Infrastructure	*107,379*	*$62,865,000*
Direct Reuse	1,379	$77,241,000
Groundwater	564	$5,446,000
Total	**252,476**	**$163,406,953**

[a]The conservation quantities represent the sum of the individual water user groups who have the majority of their service areas located in the county, not the total conservation in the county.

Table 5E.40 Summary of Costs for Collin County

WWP or WUG	Strategy	Online by:	Quantity (Ac-Ft/Yr)[b]	Capital Costs[c]	Unit Cost ($/1000 gal) With Debt Service	Unit Cost ($/1000 gal) After Debt Service	Table
WWPs							
Garland[a]	Conservation	See Dallas County.					
	Other WMSs						
Princeton	Conservation (retail)	2020	209	$118,491	$2.33	$0.00	H.11
	Conservation (wholesale)	2020	Included with WUGs				
	NTMWD	2030	4,260	$0	$2.78	$2.78	None
WUGs							
Allen	Conservation	2020	1,813	$1,516,556	$0.46	$0.08	H.11
	NTMWD	2030	8,526	$0	$2.78	$2.78	None
Anna	Conservation	2020	316	$164,611	$1.82	$0.00	H.11
	New Well(s) in Woodbine Aquifer	2020	200	$2,846,000	$5.11	$2.04	H.14
	Sherman through GTUA (CGMA)	2030	1,235	$0	$3.48	$3.48	None
	NTMWD through GTUA (CGMA)	2030	10,915	$0	$0.50	$0.50	None
	CGMA	*2030*	*12,150*	*See GTUA in **Chapter 5D**.*			
B H P WSC[a]	Conservation	2030	3	$0	$0.00	$0.00	H.11
	NTMWD	2020	502	$0	$2.78	$2.78	None
	Connection to NTMWD	*2020*	*502*	*$3,108,000*	*$1.57*	*$0.24*	*H.75*
Bear Creek SUD[a]	Conservation	2020	192	$55,186	$0.46	$0.05	H.11
	NTMWD	2030	1,327	$0	$2.78	$2.78	None
Blue Ridge	Conservation	2020	2,255	$55,892	$1.82	$1.16	H.11
	NTMWD	2020	14,573	$0	$2.78	$2.78	None
	Connection to NTMWD	*2030*	*2,242*	*$5,795,000*	*$0.65*	*$0.09*	*H.76*
	Upsize connection to NTMWD	*2040*	*12,331*	*$6,890,000*	*$0.15*	*$0.03*	*H.77*
	Upsize connection to NTMWD	*2060*	*12,284*	*$6,871,000*	*$0.15*	*$0.03*	*H.78*
Caddo Basin SUD	Conservation	2020	18	$5,095	$0.55	$0.00	H.11
	NTMWD	2020	1,848	$0	$2.78	$2.78	None
Carrollton[a]	Conservation	See Denton County.					
	DWU						
Celina[a]	Conservation	2020	2,980	$384,870	$1.20	$0.35	H.11
	UTRWD	2030	29,147	$0	$3.00	$3.00	None

WWP or WUG	Strategy	Online by:	Quantity (Ac-Ft/Yr)[b]	Capital Costs[c]	Unit Cost ($/1000 gal) With Debt Service	Unit Cost ($/1000 gal) After Debt Service	Table
	GTUA Regional Water System	2030	5,605	$0	$5.72	$3.06	H.72
	NTMWD	2030	5,000	$0	$2.78	$2.78	None
	Connect to NTWMD	*2030*	*5,000*	*$17,491,000*	*$0.89*	*$0.13*	*H.79*
Copeville SUD	Conservation	2020	80	$19,436	$0.47	$0.06	H.11
	NTMWD	2030	718	$0	$2.78	$2.78	None
Culleoka WSC	Conservation	2020	35	$41,495	$1.79	$0.11	H.11
	NTMWD	2030	608	$0	$2.78	$2.78	None
Dallas[a]	Conservation	See DWU in **Chapter 5D**.					
	Other WMSs						
Desert WSC[a]	Conservation	See Fannin County.					
	Other WMSs						
East Fork SUD[a]	Conservation	2020	179	$526,225	$1.31	$0.00	H.11
	NTMWD	2030	993	$0	$2.78	$2.78	None
	Additional Delivery Infrastructure from NTWMD	*2030*	*993*	*$5,308,000*	*$1.27*	*$0.12*	*H.80*
Fairview	Conservation	2020	420	$205,518	$0.51	$0.18	H.11
	NTMWD	2030	2,579	$0	$2.78	$2.78	None
Farmersville	Conservation	2020	399	$105,003	$2.83	$0.11	H.11
	NTMWD	2030	6,968	$0	$2.78	$2.78	None
Frisco[a]	Conservation	2020	6,044	$8,759,700	$1.15	$0.28	H.11
	Direct reuse	2020	1,379	$77,241,000	$13.51	$1.42	H.81
	NTMWD	2020	30,149	$0	$2.78	$2.78	None
Frognot WSC[a]	Conservation	2020	7	$8,218	$0.89	$0.00	H.11
Hickory Creek SUD[a] (Region C Portion Only)	None	See Fannin County.					
Josephine[a]	Conservation	2020	50	$26,276	$0.97	$0.30	H.11
	NTMWD	2030	396	$0	$2.78	$2.78	None
Lucas	Conservation	2020	559	$112,910	$1.48	$0.61	H.11
	NTMWD	2030	1,290	$0	$2.78	$2.78	None
Marilee SUD[a]	Conservation	2020	23	$1,169,389	$25.25	$0.00	H.11
	GTUA Regional Water System	2030	1,546	$0	$5.72	$3.06	None
McKinney	Conservation	2020	6,396	$775,316	$0.91	$0.57	H.11
	NTMWD	2030	25,492	$0	$2.78	$2.78	None
Melissa	Conservation	2020	1,480	$177,086	$0.42	$0.09	H.11

WWP or WUG	Strategy	Online by:	Quantity (Ac-Ft/Yr)[b]	Capital Costs[c]	Unit Cost ($/1000 gal) With Debt Service	Unit Cost ($/1000 gal) After Debt Service	Table
	NTMWD	2030	20,910	$0	$2.78	$2.78	None
	Additional Delivery Infrastructure from NTWMD	*2030*	*201*	*$2,754,000*	*$0.34*	*$0.05*	*H.82*
	Sherman through GTUA (CGMA)	2030	3,497	$0	$3.48	$3.48	None
	NTMWD through GTUA (CGMA)	2020	20,709	$0	$0.50	$0.50	None
	CGMA	*2020*	*24,206*	*See GTUA in **Chapter 5D**.*			
Milligan WSC	Conservation	2020	19	$63,934	$3.45	$0.00	H.11
	NTMWD	2030	381	$0	$2.78	$2.78	None
Murphy	Conservation	2020	285	$68,544	$0.50	$0.31	H.11
	NTMWD	2030	1,537	$0	$2.78	$2.78	None
Nevada SUD[a]	Conservation	2020	250	$15,904	$0.34	$0.05	H.11
	NTMWD	2030	1,723	$0	$2.78	$2.78	None
North Collin SUD	Conservation	2020	38	$21,134	$0.65	$0.11	H.11
	NTMWD	2030	661	$0	$2.78	$2.78	None
North Farmersville WSC	Conservation	2020	14	$6,269	$2.53	$0.71	H.11
	NTMWD	2030	3	$0	$2.78	$2.78	None
Parker	Conservation	2020	372	$178,062	$0.50	$0.22	H.11
	NTMWD	2020	1,804	$0	$2.78	$2.78	None
	Additional Delivery Infrastructure from NTWMD	*2020*	*1,669*	*$4,309,000*	*$1.08*	*$0.20*	*H.83*
Plano[a]	Conservation	2020	4,691	$1,563,143	$0.32	$0.06	H.11
	NTMWD	2030	27,871	$0	$2.78	$2.78	None
Prosper[a]	Conservation	2020	744	$859,194	$0.98	$0.10	H.11
	NTMWD	2030	6,636	$0	$2.78	$2.78	None
	Additional Delivery Infrastructure from NTWMD	*2030*	*6,636*	*$4,608,000*	*$0.20*	*$0.05*	*H.84*
Richardson[a]	Conservation	See Dallas County.					
	NTMWD						
Royse City[a]	Conservation	See Rockwall County.					
	NTMWD						
Sachse[a]	Conservation	See Dallas County.					
	NTMWD						

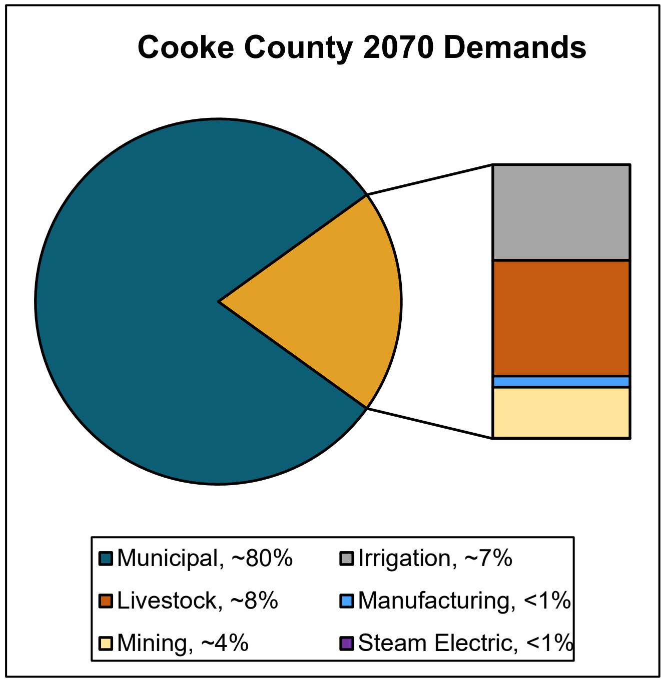
WWP or WUG	Strategy	Online by:	Quantity (Ac-Ft/Yr)[b]	Capital Costs[c]	Unit Cost ($/1000 gal) With Debt Service	Unit Cost ($/1000 gal) After Debt Service	Table
Seis Lagos UD	Conservation	2020	33	$162,761	$1.84	$0.23	H.11
	NTMWD	2030	215	$0	$2.78	$2.78	None
South Grayson SUD[a]	Conservation	See Grayson County.					
	Connect to Sherman						
Verona SUD	Conservation	2020	11	$15,102	$1.63	$0.00	H.11
	New Well(s) in Woodbine Aquifer	2030	286	$2,163,000	$3.58	$1.95	H.14
West Leonard WSC[a]	Conservation	See Fannin County.					
Westminster WSC[a]	Conservation	2020	11	$16,477	$1.78	$0.00	H.11
Wylie[a]	Conservation	2020	622	$462,569	$0.26	$0.00	H.11
	NTMWD	2020	3,329	$0	$2.78	$2.78	None
Wylie Northeast SUD	Conservation	2020	74	$175,408	$7.58	$0.11	H.11
	NTMWD	2030	1,294	$0	$2.78	$2.78	None
	Additional Delivery Infrastructure from NTWMD	*2030*	*1,294*	*$5,731,000*	*$1.13*	*$0.18*	*H.85*
County Other and Non-Municipal							
County Other, Collin	Conservation	2020	37	$19,179	$0.83	$0.00	H.11
	GTUA Regional Water System	2030	1,099	$0	$5.72	$3.06	H.72
	NTMWD	2030	517	$0	$2.78	$2.78	None
Irrigation, Collin	DWU	2020	856	$0	$4.05	$4.05	None
Livestock, Collin	None	None					
Manufacturing, Collin	New Well(s) in Woodbine Aquifer	2030	78	$437,000	$1.43	$0.22	H.14
	NTMWD	2020	1,026	$0	$2.78	$2.78	None
Mining, Collin	None	None					
Steam Electric Power, Collin	None	None					

[a]Water User Groups extend into more than one county
[b]Quantities listed are for the WUG only. They do not include the WUG's customers.
[c]Purchases from wholesale water providers that require no new infrastructure have no capital costs. The unit costs shown in the table represent the cost to purchase water from the WWP.

5E.2 Cooke County

Cooke County is located in the north central portion of Region C. **Figure 5E.4** shows water supplier service areas in the county.

Cooke County is projected to more than double in population from about 40,000 in 2020 to 95,000 in 2070.



Demands for the County are predominately municipal. The second and third largest demands for most of the planning period are livestock and irrigation. Mining demand is high in 2020 but decreases in later decades. Manufacturing and steam electric demands account for less than 5% of the county's total demands.

The City of Gainesville provides most of the water to Cooke County. In addition to purchasing water from WWPs, other water sources include surface water supplies (Moss Lake and Muenster Lake), and direct reuse. An overall summary of the County's projections is shown in **Table 5E.1**, and water management strategies for individual WWPs and WUGs are discussed on the following pages.

Cooke County Quick Facts

2010 Population: 38,437

Projected 2070 Population: 95,351

Projected 2070 Demand: 14 MGD

County Seat: Gainesville

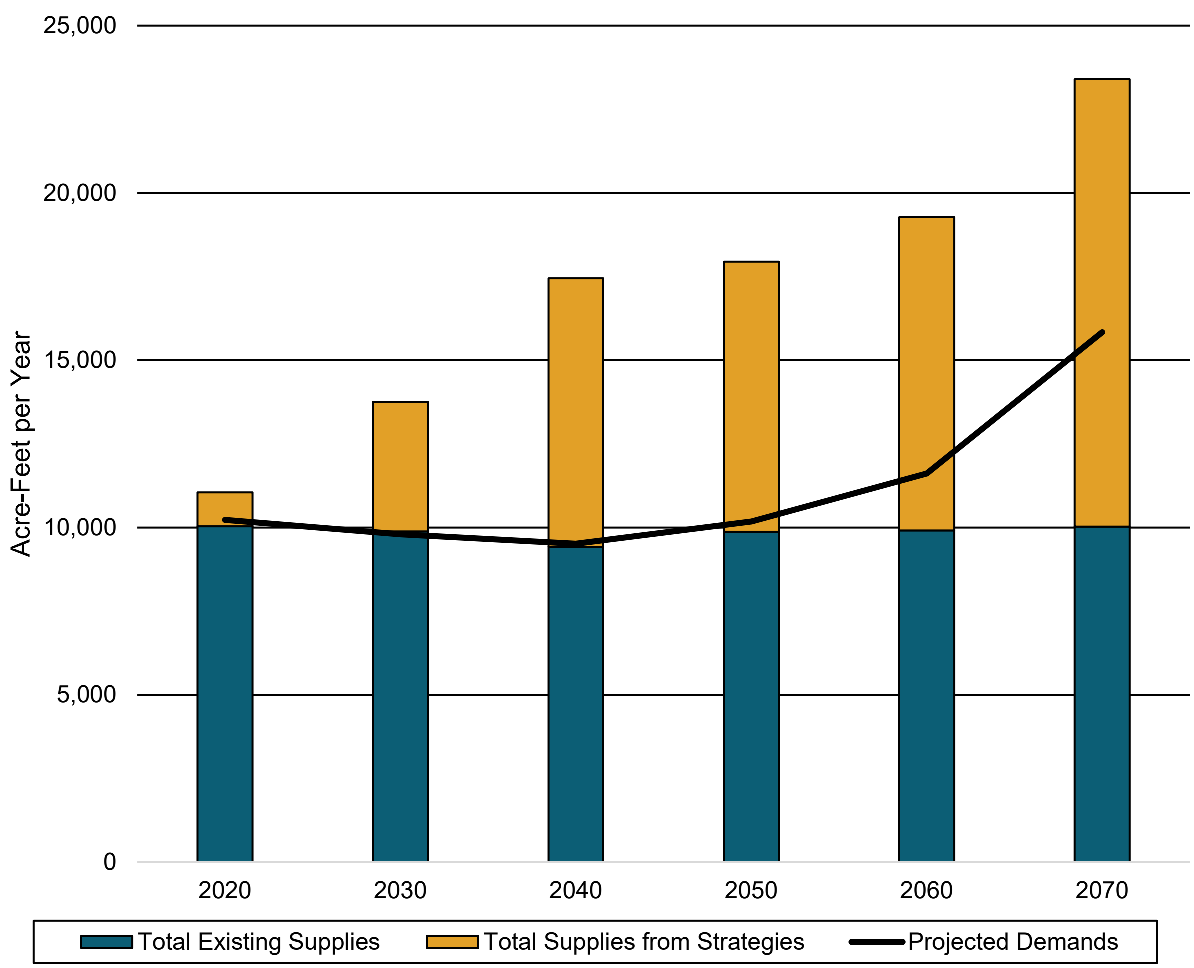
Economy: Oil, agribusiness, tourism, manufacturing

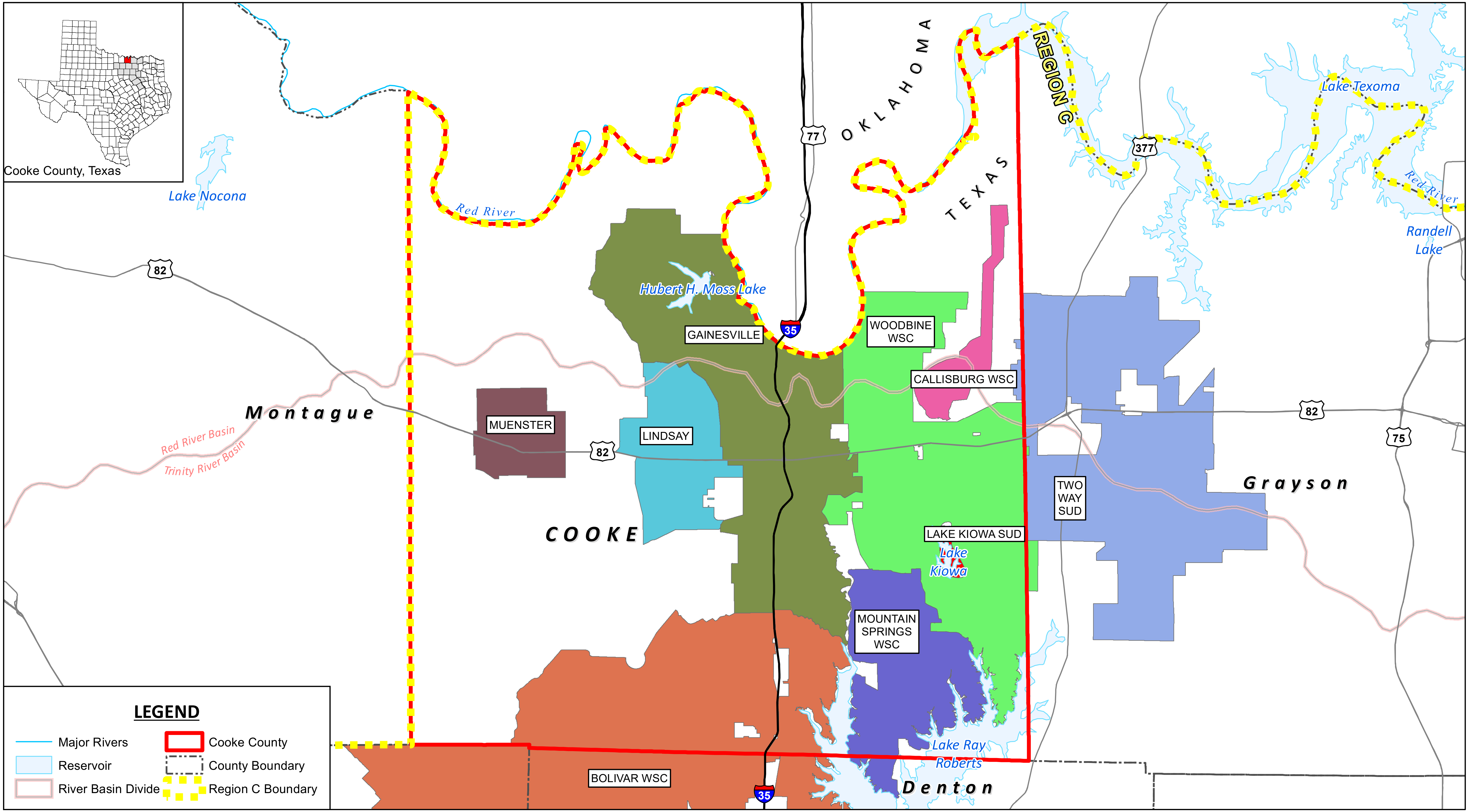
River Basins: Trinity (67%), Red (32%)

Table 5E.41 Summary of Cooke County

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**40,903**	**44,035**	**46,984**	**52,427**	**62,905**	**95,351**
Projected Demands	**10,226**	**9,797**	**9,515**	**10,180**	**11,610**	**15,837**
Municipal	6,092	6,334	6,574	7,171	8,536	12,688
Irrigation	1,100	1,100	1,100	1,100	1,100	1,100
Livestock	1,330	1,330	1,330	1,330	1,330	1,330
Manufacturing	116	128	128	128	128	128
Mining	1,583	900	378	446	511	586
Steam Electric	5	5	5	5	5	5
Total Existing Supplies	**10,035**	**9,884**	**9,421**	**9,876**	**9,907**	**10,027**
Need (Demand - Supply)	**191**	**0**	**94**	**304**	**1,703**	**5,810**
Total Supplies from Strategies	**1,010**	**3,871**	**8,031**	**8,067**	**9,365**	**13,371**
Reserve (Shortage)	**819**	**3,958**	**7,937**	**7,763**	**7,662**	**7,561**

Figure 5E.3 Summary of Cooke County





REGION C
Water Planning for North Texas

2021 Region C Water Plan

COOKE COUNTY, TEXAS

FIGURE 5E.4

1 in = 5 miles
0 1 2 4 6
Miles

Data Source(s): ESRI, USGS, TNRIS

TR116409: H:\WR_PLANNING\1 - Working\5E_County WMS\Cooke1.mxd

5E.2.1 Wholesale Water Providers and Water User Groups

Cooke County wholesale water providers (WWPs) and water user groups (WUGs) are discussed below (in alphabetical order). The costs for recommended and alternative water management strategies are presented in **Section 5E.2.2. Appendix H** has more detailed cost estimates.

Bolivar Water Supply Corporation

Bolivar WSC serves retail customers in southern Cooke County and in part of Denton and Wise Counties. Plans for Bolivar WSC are covered under Denton County in **Section 5E.4.**

Callisburg Water Supply Corporation

Callisburg WSC is located in northeastern Cooke County, north of Lake Kiowa SUD. The WSC gets its water supply from the Trinity aquifer, and the only water management strategy for Callisburg WSC is conservation. **Table 5E.42** shows the projected population and demand, the current supplies, and the water management strategies for Callisburg WSC.

Table 5E.42 Summary of Water User Group – Callisburg WSC

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**1,656**	**1,696**	**1,726**	**1,744**	**1,756**	**1,767**
Projected Demands						
Municipal Demand	150	146	144	143	144	145
Total Projected Demand	***150***	***146***	***144***	***143***	***144***	***145***
Currently Available Supplies						
Trinity Aquifer	150	150	150	150	150	150
Total Currently Available Supplies	***150***	***150***	***150***	***150***	***150***	***150***
Need (Demand – Supply)	***0***	***0***	***0***	***0***	***0***	***0***
Water Management Strategies						
Water Conservation	2	2	1	2	2	3
Total Supplies from Strategies	***2***	***2***	***1***	***2***	***2***	***3***
Reserve (Shortage)	**2**	**6**	**7**	**9**	**8**	**8**

Cooke County Irrigation

Irrigation demand projections include the water necessary for irrigation activities, including field crops, orchards, pasture, turf grass, vineyards, golf courses irrigated by raw water, and limited aquaculture operations. Cooke County Irrigation's currently available supplies include groundwater (Trinity aquifer and Woodbine aquifer), direct reuse and supplies from Gainesville (Moss Lake). The remaining need for Cooke County Irrigation is planned to be met through additional supplies from Gainesville. **Table 5E.43** shows the projected demand, the current supplies, and the water management strategies for Cooke County Irrigation.

Table 5E.43 Summary of Water User Group – Cooke County Irrigation

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Demands						
Total Projected Demands	**1,100**	**1,100**	**1,100**	**1,100**	**1,100**	**1,100**
Currently Available Supplies						
Trinity Aquifer	175	175	175	175	175	175
Woodbine Aquifer	49	49	49	49	49	49
Direct Reuse from Gainesville	4	4	4	4	4	4
Moss Lake through Gainesville	872	872	872	872	620	296
Total Currently Available Supplies	***1,100***	***1,100***	***1,100***	***1,100***	***848***	***524***
Need (Demand - Supply)	***0***	***0***	***0***	***0***	***252***	***576***
Water Management Strategies						
Water Conservation	0	0	0	1	24	47
Gainesville	0	0	0	0	228	529
Total Supplies from Strategies	***0***	***0***	***0***	***1***	***252***	***576***
Reserve (Shortage)	**0**	**0**	**0**	**1**	**0**	**0**

Cooke County Livestock

Livestock water use is defined as water used in the production of livestock, both for consumption and for cleaning and environmental purposes. Currently available supplies include groundwater from the Trinity and Woodbine aquifers as well as local supplies. These supplies are sufficient to meet the projected demand. There are no water management strategies for this WUG. **Table 5E.44** shows the projected demand, the current supplies, and the water management strategies for Cooke County Livestock.

Table 5E.44 Summary of Water User Group – Cooke County Livestock

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Demands						
Total Projected Demands	***1,330***	***1,330***	***1,330***	***1,330***	***1,330***	***1,330***
Currently Available Supplies						
Trinity Aquifer	180	180	180	180	180	180
Woodbine Aquifer	60	60	60	60	60	60
Local Supplies	1,187	1,187	1,187	1,187	1,187	1,187
Total Currently Available Supplies	***1,427***	***1,427***	***1,427***	***1,427***	***1,427***	***1,427***
Need (Demand - Supply)	***0***	***0***	***0***	***0***	***0***	***0***
Water Management Strategies						
None	0	0	0	0	0	0
Total Supplies from Strategies	***0***	***0***	***0***	***0***	***0***	***0***
Reserve (Shortage)	**97**	**97**	**97**	**97**	**97**	**97**

Cooke County Manufacturing

Manufacturing water use is defined as water used to produce manufactured goods. Cooke County manufacturing is currently supplied by groundwater from the Trinity aquifer and surface water provided through the City of Gainesville. Any need is planned to be met with additional supplies from Gainesville. **Table 5E.45** shows the projected demand, the current supplies, and the water management strategies for Cooke County Manufacturing.

Conservation was considered for this water user group, but it is not recommended because of the uncertainty in the ability to implement conservation measures given the multiple entities, facilities, and various manufacturing processes that make up this WUG.

Table 5E.45 Summary of Water User Group – Cooke County Manufacturing

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Demands						
Total Projected Demands	**116**	**128**	**128**	**128**	**128**	**128**
Currently Available Supplies						
Trinity Aquifer	4	4	4	4	4	4
Gainesville	112	124	124	124	88	42
Total Currently Available Supplies	***116***	***128***	***128***	***128***	***92***	***46***
Need (Demand - Supply)	***0***	***0***	***0***	***0***	***36***	***82***
Water Management Strategies						
Gainesville	0	0	0	0	36	82
Total Supplies from Strategies	***0***	***0***	***0***	***0***	***36***	***82***
Reserve (Shortage)	**0**	**0**	**0**	**0**	**0**	**0**

Cooke County Mining

Mining water demand includes water used for oil and gas development, as well as extraction of coal and lignite, sand aggregate, and other resources. Much of Cooke County Mining demand is for sand and gravel operations. Cooke County Mining demands are currently supplied by groundwater from the Trinity aquifer. Water management strategies to develop additional supplies for Cooke County Mining include direct reuse and system supplies from Gainesville. **Table 5E.46** shows the projected demand, the current supplies, and the water management strategies for Cooke County Mining.

Table 5E.46 Summary of Water User Group – Cooke County Mining

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Demands						
Total Projected Demands	**1,583**	**900**	**378**	**446**	**511**	**586**
Currently Available Supplies						
Trinity Aquifer	1,000	750	230	300	350	450
Total Currently Available Supplies	***1,000***	***750***	***230***	***300***	***350***	***450***
Need (Demand - Supply)	***583***	***150***	***148***	***146***	***161***	***136***
Water Management Strategies						
Connect to Gainesville	583	150	148	146	161	136
Total Supplies from Strategies	***583***	***150***	***148***	***146***	***161***	***136***
Reserve (Shortage)	**0**	**0**	**0**	**0**	**0**	**0**

Cooke County Other

Cooke County Other includes individual domestic and water suppliers too small to be classified as water user groups. In Cooke County these entities include Valley View, Oak Ridge and Moss Lake WSC. The entities included under Cooke County Other currently receive their water supplies from groundwater (Trinity and Woodbine aquifers) and the City of Gainesville. Water management strategies for these entities include conservation and additional supplies from Gainesville. **Table 5E.47** shows the projected population and demand, the current supplies, and the water management strategies for Cooke County Other.

Table 5E.47 Summary of Water User Group – Cooke County Other

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**5,627**	**6,063**	**6,714**	**9,849**	**12,444**	**29,307**
Projected Demands						
Municipal Demand	743	774	834	1,204	1,517	3,561
Total Projected Demands	***743***	***774***	***834***	***1,204***	***1,517***	***3,561***
Currently Available Supplies						
Trinity Aquifer	769	769	769	769	769	769
Woodbine Aquifer	45	45	45	45	45	45
Moss Lake through Gainesville	50	50	50	390	500	932
Total Currently Available Supplies	***864***	***864***	***864***	***1,204***	***1,314***	***1,746***
Need (Demand - Supply)	***0***	***0***	***0***	***0***	***203***	***1,815***
Water Management Strategies						
Water Conservation	6	9	8	16	25	71
Gainesville	0	0	0	0	178	1,744
Total Supplies from Strategies	***6***	***9***	***8***	***16***	***203***	***1,815***
Reserve (Shortage)	**127**	**99**	**38**	**16**	**0**	**0**

Cooke County Steam Electric Power

Steam electric power demands generally represent the cooling water needs during power generation. These demands do not include water that is used in cogeneration facilities (which is included in manufacturing projections), facilities which do not require water for production, or hydro-electric generation facilities. Cooke County's Steam Electric Power demand is attributed to the Cooke County Electric Co Op and is currently supplied fully by groundwater from the Trinity aquifer. There are no additional water management strategies needed. **Table 5E.48** shows the projected demand, the current supplies, and the water management strategies for Cooke County Steam Electric Power.

Table 5E.48 Summary of Water User Group – Cooke County SEP

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Demands						
Total Projected Demand	**5**	**5**	**5**	**5**	**5**	**5**
Currently Available Supplies						
Trinity Aquifer	5	5	5	5	5	5
Total Currently Available Supplies	***5***	***5***	***5***	***5***	***5***	***5***
Need (Demand – Supply)	***0***	***0***	***0***	***0***	***0***	***0***
Water Management Strategies						
None	0	0	0	0	0	0
Total Supplies from Strategies	***0***	***0***	***0***	***0***	***0***	***0***
Reserve (Shortage)	**0**	**0**	**0**	**0**	**0**	**0**

Gainesville

The City of Gainesville is located in central Cooke County and is the county seat. The city currently provides treated water supplies to entities included in Cooke County Other (such as Valley View). Current non-municipal demands include irrigation and manufacturing. The city plans to begin providing treated water supplies to Bolivar WSC, Lindsay, Mountain Springs WSC and some mining demand within the planning horizon. Infrastructure will need to be developed to deliver supplies to these future potential customers.

Gainesville's currently available supplies include groundwater from the Trinity aquifer, surface water from Moss Lake, and a small amount of direct reuse that is used specifically to meet the City's irrigation demand. The yield of Moss Lake is 7,410 acre-feet per year, but the supply from Moss Lake is currently limited by the City's treatment capacity of 2,242 acre-feet per year. Groundwater supplies are treated on-site.

Gainesville's recommended water management strategies include conservation, additional supplies from Moss Lake (including treatment plant expansions and additional infrastructure to deliver to customers), an expansion of the direct reuse system, and supplies from the GTUA Regional Water System.

The City of Gainesville holds water rights in Lake Texoma, but there is currently no infrastructure to move or treat the supplies. The City could either participate in the GTUA Regional Water System project and have the Lake Texoma supplies treated at the Sherman WTP or alternatively build an intake, transmission line and desalination/blending WTP independently. Participating in the GTUA Regional Water System project is included as a recommended water management strategy and pursuing Lake Texoma supplies independently is included as an alternative strategy for the City.

A summary of the recommended water plan for Gainesville is shown on **Table 5E.49**.

Table 5E.49 Summary of Wholesale Water Provider and Customers – Gainesville

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Demands						
Gainesville	2,656	2,758	2,833	2,935	3,557	4,969
Bolivar WSC	0	50	75	100	125	150
County Other, Cooke	50	50	50	390	703	2,747
Lindsay	0	7	15	33	72	195
Mountain Springs WSC	0	0	0	0	294	774
Irrigation, Cooke	876	876	876	876	876	876
Manufacturing, Cooke	112	124	124	124	124	124
Mining, Cooke	583	150	148	146	161	136
Total Projected Demands	***4,277***	***4,015***	***4,121***	***4,604***	***5,912***	***9,971***
Currently Available Supplies						
Moss Lake (Treatment Capacity)	2,242	2,242	2,242	2,242	2,242	2,242
Direct Reuse	4	4	4	4	4	4
Trinity Aquifer	2,104	2,104	2,104	2,104	2,104	2,104
Total Currently Available Supplies	***4,350***	***4,350***	***4,350***	***4,350***	***4,350***	***4,350***
Need (Demand - Supply)	***0***	***0***	***0***	***254***	***1,562***	***5,621***
Water Management Strategies						
Conservation (retail)	25	39	35	46	68	111
Conservation (wholesale)	12	17	16	29	104	220
Additional Moss Lake with WTP Expansions as below:	0	0	0	35	1,243	5,140
5 MGD WTP Expansion – 1	*0*	*0*	*0*	*35*	*1,243*	*2,803*
5 MGD WTP Expansion – 2	*0*	*0*	*0*	*0*	*0*	*2,337*
Infrastructure to Deliver to Customers	*0*	*0*	*0*	*35*	*1,243*	*5,140*
Expand Direct Reuse	169	137	141	144	147	150
GTUA Regional Water System	0	1,632	5,605	5,605	5,605	5,605
Total Supplies from Strategies	***206***	***1,825***	***5,797***	***5,859***	***7,167***	***11,226***
Total Supplies	***4,556***	***6,175***	***10,147***	***10,209***	***11,517***	***15,576***
Reserve (Shortage)	***279***	***2,160***	***6,026***	***5,605***	***5,605***	***5,605***
Alternative Strategy						
Lake Texoma	*0*	*0*	*0*	*0*	*5,140*	*5,140*

Lake Kiowa Special Utility District

Lake Kiowa SUD serves the area around Lake Kiowa in eastern Cooke County. The SUD currently gets its water supply from groundwater (Trinity aquifer). Water management strategies for Lake Kiowa SUD are conservation and supplies from the GTUA Regional Water System through Sherman. **Table 5E.50** shows the projected population and demand, the current supplies, and the water management strategies for Lake Kiowa SUD.

Table 5E.50 Summary of Water User Group – Lake Kiowa SUD

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**2,200**	**2,300**	**2,350**	**2,400**	**2,420**	**2,450**
Projected Demands						
Municipal Demand	891	921	938	957	964	976
Total Projected Demands	***891***	***921***	***938***	***957***	***964***	***976***
Currently Available Supplies						
Trinity Aquifer	985	985	985	985	985	985
Total Currently Available Supplies	***985***	***985***	***985***	***985***	***985***	***985***
Need (Demand - Supply)	***0***	***0***	***0***	***0***	***0***	***0***
Water Management Strategies						
Water Conservation	7	11	9	13	16	20
GTUA Regional Water System through Sherman	0	875	877	873	870	866
Total Supplies from Strategies	***7***	***886***	***886***	***886***	***886***	***886***
Reserve (Shortage)	**101**	**950**	**933**	**914**	**907**	**895**

Lindsay

Lindsay is in central Cooke County. The city currently receives its water supplies from the Trinity aquifer. Water management strategies for Lindsay include conservation and connecting to Gainesville. **Table 5E.51** shows the projected population and demand, the current supplies, and the water management strategies for Lindsay.

Table 5E.51 Summary of Water User Group – City of Lindsay

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**1,325**	**1,423**	**1,517**	**1,688**	**2,020**	**3,042**
Projected Demands						
Municipal Demand	173	180	188	206	245	368
Total Projected Demands	***173***	***180***	***188***	***206***	***245***	***368***
Currently Available Supplies						
Trinity Aquifer	173	173	173	173	173	173
Total Currently Available Supplies	***173***	***173***	***173***	***173***	***173***	***173***
Need (Demand - Supply)	***0***	***7***	***15***	***33***	***72***	***195***
Water Management Strategies						
Water Conservation	2	2	2	3	4	7
Connect to Gainesville	0	5	13	30	68	188
Total Supplies from Strategies	***2***	***7***	***15***	***33***	***72***	***195***
Reserve (Shortage)	**2**	**0**	**0**	**0**	**0**	**0**

Mountain Spring Water Supply Corporation

Mountain Spring WSC serves parts of Cooke and Denton Counties. The WSC currently receives its water supply from the Trinity aquifer. Water management strategies for Mountain Spring WSC include conservation and connecting to Gainesville. **Table 5E.52** shows the projected population and demand, the current supplies, and the recommended water management strategies for Mountain Spring WSC.

Table 5E.52 Summary of Water User Group – Mountain Spring WSC

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**2,709**	**2,909**	**3,066**	**3,220**	**5,084**	**8,093**
Projected Demands						
Municipal Demand	454	478	497	518	814	1,294
Total Projected Demands	***454***	***478***	***497***	***518***	***814***	***1,294***
Currently Available Supplies						
Trinity Aquifer	520	520	520	520	520	520
Total Currently Available Supplies	***520***	***520***	***520***	***520***	***520***	***520***
Need (Demand - Supply)	***0***	***0***	***0***	***0***	***294***	***774***
Water Management Strategies						
Water Conservation	4	5	5	7	48	91
Connect to Gainesville	0	0	0	0	246	683
Total Supplies from Strategies	***4***	***5***	***5***	***7***	***294***	***774***
Reserve (Shortage)	**70**	**47**	**28**	**9**	**0**	**0**

Muenster

The City of Muenster is located in western Cooke County. The city currently receives its water supply from the Trinity aquifer. Water management strategies for Muenster include conservation and construction of a water treatment plant at Muenster Lake in order to begin utilizing Muenster Lake supply. Connecting to Gainesville is included as an alternative water management strategy for Muenster. **Table 5E.53** shows the projected population and demand, the current supplies, and the recommended and alternative water management strategies for Muenster.

Table 5E.53 Summary of Water User Group – Muenster

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**1,564**	**1,564**	**1,614**	**1,614**	**1,665**	**1,665**
Projected Demands						
Municipal Demand	268	261	263	260	267	267
Total Projected Demands	***268***	***261***	***263***	***260***	***267***	***267***
Currently Available Supplies						
Trinity Aquifer	268	268	268	268	268	268
Total Currently Available Supplies	***268***	***268***	***268***	***268***	***268***	***268***
Need (Demand - Supply)	***0***	***0***	***0***	***0***	***0***	***0***
Water Management Strategies						
Water Conservation	2	3	3	3	4	5
New 0.5 MGD WTP at Muenster Lake	280	280	280	280	280	280
Total Supplies from Strategies	***282***	***283***	***283***	***283***	***284***	***285***
Reserve (Shortage)	**282**	**290**	**288**	**291**	**285**	**286**
Alternative Strategy						
Connect to Gainesville	*280*	*280*	*280*	*280*	*280*	*280*

Two Way Special Utility District

Two Way SUD serves eastern Cooke County and western Grayson County. Since most of the service area is in Grayson County, Two Way SUD is discussed under Grayson County in **Section 5E.8.**

Woodbine Water Supply Corporation

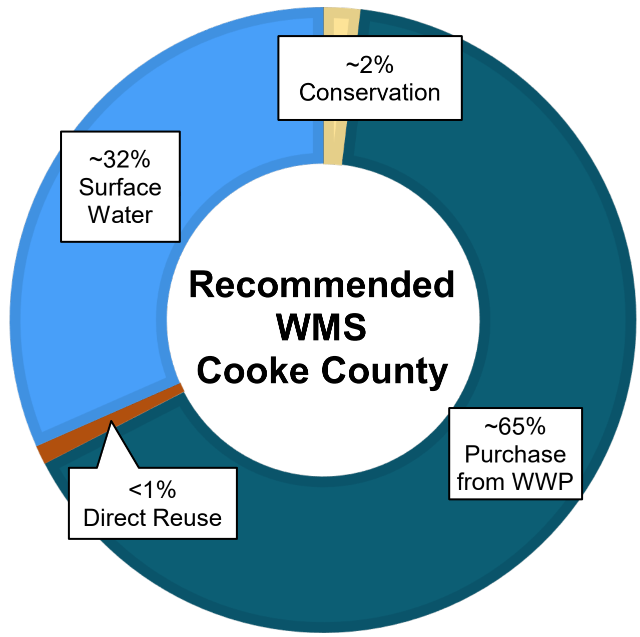
Woodbine WSC serves eastern Cooke County and western Grayson County. The WSC currently receives groundwater supplies from the Trinity aquifer. Water management strategies for Woodbine WSC include conservation and participation in the GTUA Regional Water Supply System through Sherman. **Table 5E.54** shows the projected population and demand, the current supplies, and the recommended water management strategies for Woodbine WSC.

Table 5E.54 Summary of Water User Group – Woodbine WSC

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**6,210**	**7,035**	**7,859**	**8,684**	**9,511**	**10,334**
Projected Demands						
Municipal Demand	659	716	777	845	923	1,002
Total Projected Demands	***659***	***716***	***777***	***845***	***923***	***1,002***
Currently Available Supplies						
Trinity Aquifer	654	654	654	654	654	654
Total Currently Available Supplies	***654***	***654***	***654***	***654***	***654***	***654***
Need (Demand - Supply)	***5***	***62***	***123***	***191***	***269***	***348***
Water Management Strategies						
Water Conservation	5	9	8	11	15	21
GTUA Regional Water System	0	716	942	942	942	942
Total Supplies from Strategies	***5***	***725***	***950***	***953***	***957***	***963***
Reserve (Shortage)	**0**	**663**	**827**	**762**	**688**	**615**

5E.2.2 Summary of Costs for Cooke County

Table 5E.55 summarizes the costs of the water management strategies recommended for the WUGs and WWPs who have the majority of their demand located in Cooke County. Total quantities from **Table 5E.55** will not necessarily match total county demands. This is due mainly to water users whose sum of strategies results in a reserve as well as due to water users located in multiple counties (or wholesale water providers who develop strategies and then sell water to users in other counties). Quantities from infrastructure projects needed to deliver and/or treat water (shown in *gray italics*) are not included since the supplies are associated with other strategies. To avoid double-counting quantities of supplies, the quantities in gray italics are **not** included in the total.



The majority of the future supplies needed to meet demands within Cooke County are projected to come through purchases from wholesale water providers. Other strategies include the infrastructure to utilize surface water (Muenster and Moss Lake), conservation and direct reuse.

Table 5E.56 summarizes the recommended water management strategies within Cooke County individually. Alternative strategies are also included. More detailed cost estimates are located in **Appendix H.**

Table 5E.55 Summary of Recommended Water Management Strategies for Cooke County

Type of Strategy	Quantity (Ac-Ft/Yr)	Capital Costs
Conservation[a]	376	$601,356
Purchase from WWP	11,233	$0
Additional Infrastructure	*10,280*	*$95,013,000*
Direct Reuse	169	$2,026,000
Surface Water	5,420	$9,998,000
Total	**17,198**	**$107,638,356**

[a]The conservation quantities represent the sum of the individual water user groups who have the majority of their service areas located in the county, not the total conservation in the county.

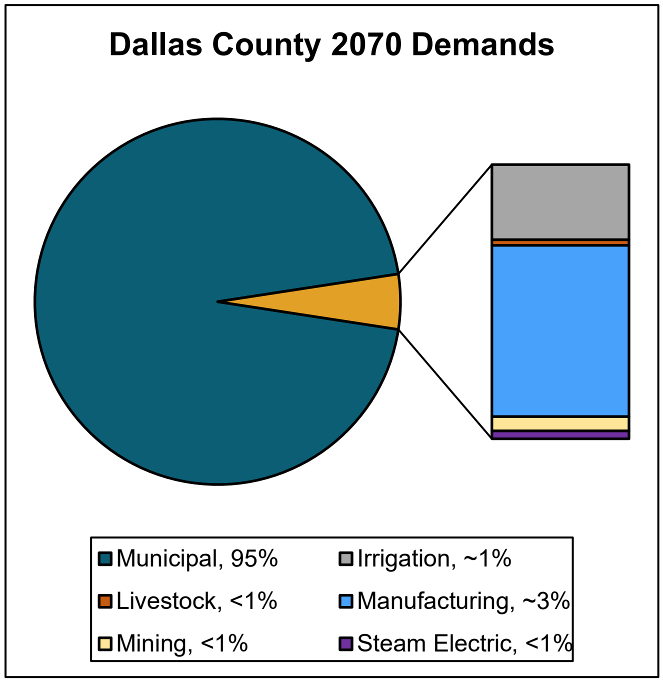
Table 5E.56 Summary of Costs for Cooke County

WWP or WUG	Strategy	Online by:	Quantity (Ac-Ft/Yr)[b]	Capital Costs[c]	Unit Cost ($/1000 gal) With Debt Service	Unit Cost ($/1000 gal) After Debt Service	Table
WWPs							
Gainesville	Conservation (retail)	2020	111	$339,073	$2.93	$0.00	H.11
	Conservation (wholesale)	2020	Included with WUGs				
	Lake Moss with WTP Expansions	2050	5,140	$0	$0.00	$0.00	None
	5 MGD WTP Expansion-1	*2050*	*2,803*	*$30,985,000*	*$4.21*	*$1.82*	*H.13*
	5 MGD WTP Expansion-2	*2070*	*2,337*	*$30,985,000*	*$4.21*	*$1.82*	*H.13*
	Infrastructure to Deliver to Customers	*2020*	*5,140*	*$33,043,000*	*$7.03*	*$0.96*	*H.87*
	Expand Direct Reuse	2020	169	$2,026,000	$7.41	$1.14	H.86
	GTUA Regional Water System	2030	5,605	$0	$4.75	$2.93	H.73
	ALTERNATIVE Lake Texoma	*2060*	*5,140*	*$125,017,000*	*$6.97*	*$2.15*	*H.88*
WUGs							
Bolivar WSC[a]	Conservation	See Denton County.					
	UTRWD						
	Connect to Gainesville						
Callisburg WSC	Conservation	2020	3	$2,975	$0.32	$0.00	H.11
Lake Kiowa SUD	Conservation	2020	20	$148,550	$4.58	$0.00	H.11
	GTUA Regional Water System	2030	877	$0	$5.72	$3.06	None
Lindsay	Conservation	2020	7	$15,743	$1.70	$0.00	H.11
	Gainesville	2030	188	$0	$4.52	$4.52	None
Mountain Springs WSC[a]	Conservation	2020	91	$24,567	$1.33	$0.89	H.11
	Gainesville	2060	683	$0	$4.52	$4.52	None
Muenster	Conservation	2020	5	$25,014	$2.70	$0.00	H.11
	Muenster Lake	2020	280	$9,998,000	$12.70	$5.00	H.90
	ALTERNATIVE Connect to Gainesville	*2020*	*280*	*$4,355,000*	*$8.31*	*$4.95*	*H.89*
Two Way SUD[a]	Conservation	See Grayson County.					
	GTUA Regional Water System						
	Conservation	2020	21	$27,709	$1.20	$0.05	H.11

WWP or WUG	Strategy	Online by:	Quantity (Ac-Ft/Yr)[b]	Capital Costs[c]	Unit Cost ($/1000 gal) With Debt Service	Unit Cost ($/1000 gal) After Debt Service	Table
Woodbine WSC[a]	GTUA Regional Water System	2030	942	$0	$4.75	$2.93	H.73
County Other and Non-Municipal							
County Other, Cooke	Conservation	2020	71	$17,725	$0.64	$0.00	H.11
	Gainesville	2050	1,744	$0	$4.52	$4.52	None
Irrigation, Cooke	Conservation	2050	47	$0	$0.94	$0.94	H.11
	Gainesville	2020	529	$0	$4.52	$4.52	None
Livestock, Cooke	None	None					
Manufacturing, Cooke	Gainesville	2060	82	$0	$4.52	$4.52	None
Mining, Cooke	Connect to Gainesville	2020	583	$0	$4.52	$4.52	None
Steam Electric Power, Cooke	None	None					

[a]*Water user groups extend into more than one county.*
[b]*Quantities listed are for the WUG only. They do not include the WUG's customers.*
[c]*Purchases from wholesale water providers that require no new infrastructure have no capital costs. The unit costs shown in the table represent the cost to purchase water from the WWP.*

5E.3 Dallas County



Dallas County is located in the central portion of Region C. **Figure 5E. 6** shows water service areas in Dallas County.

Dallas County's population is projected to increase by over a million people between 2020 and 2070.

Demands for the county are predominately municipal at over 90%. The second and third largest demands are manufacturing and irrigation. Livestock, mining and steam electric demands are all less than 1% of the total demand.

Dallas Water Utilities (DWU) provides the majority of the treated water supplies to water users within the county. Other major water providers include NTMWD and Fort Worth. Strategies for major water providers are discussed in **Chapter 5D**. In addition to purchasing water from major water providers and other WWPs, other water sources include surface water supplies (Joe Pool Lake and Lake Chapman), groundwater, local supplies and reuse.

An overall summary of the County's projections is shown in **Table 5E.57**, and water management strategies for individual WWPs and WUGs are discussed on the following pages.

Dallas County Quick Facts

2010 Population: 2,368,139

Projected 2070 Population: 3,770,858

Projected 2070 Demand: 679 MGD

County Seat: Dallas

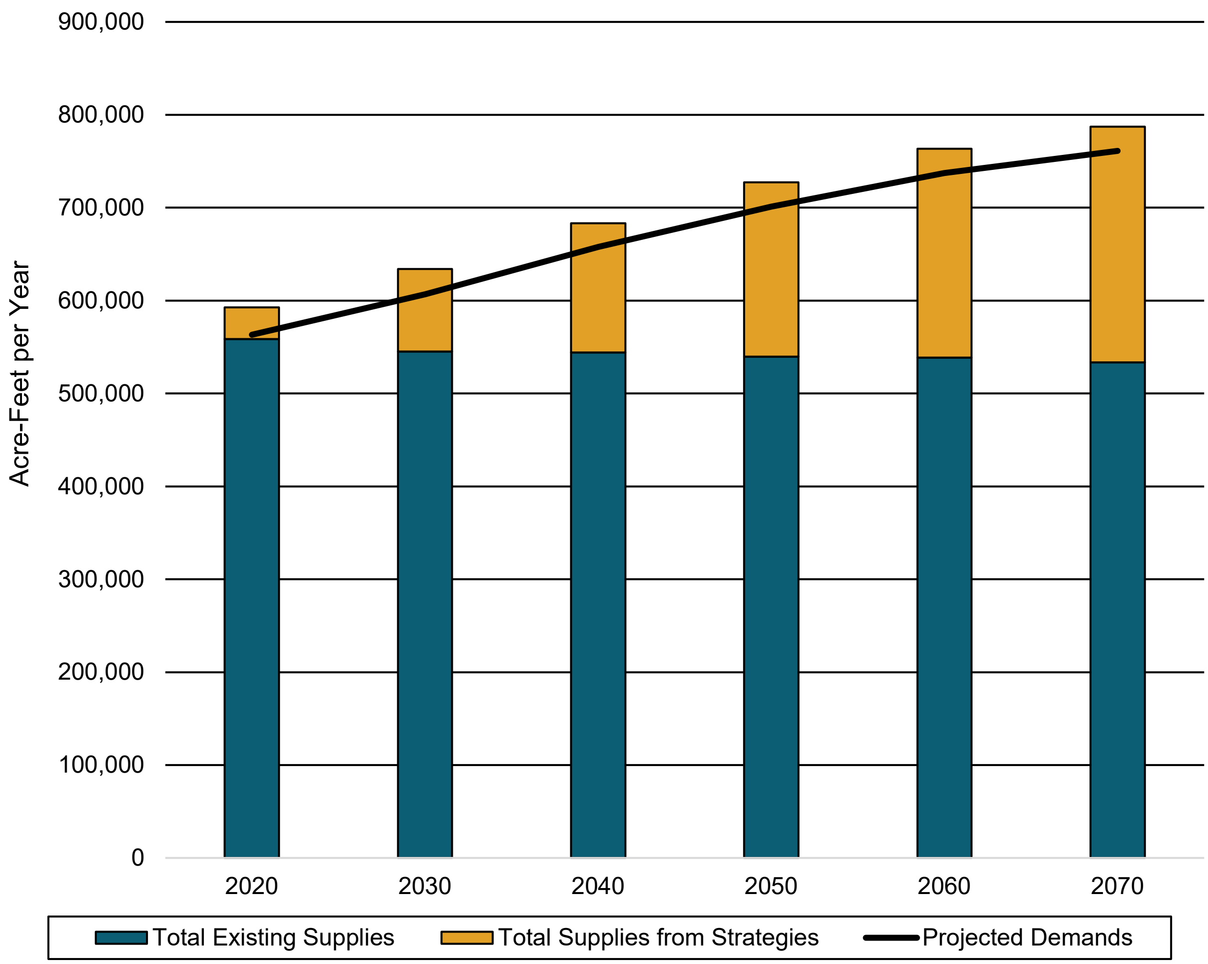
Economy: Telecommunications, transportation, manufacturing, government/services

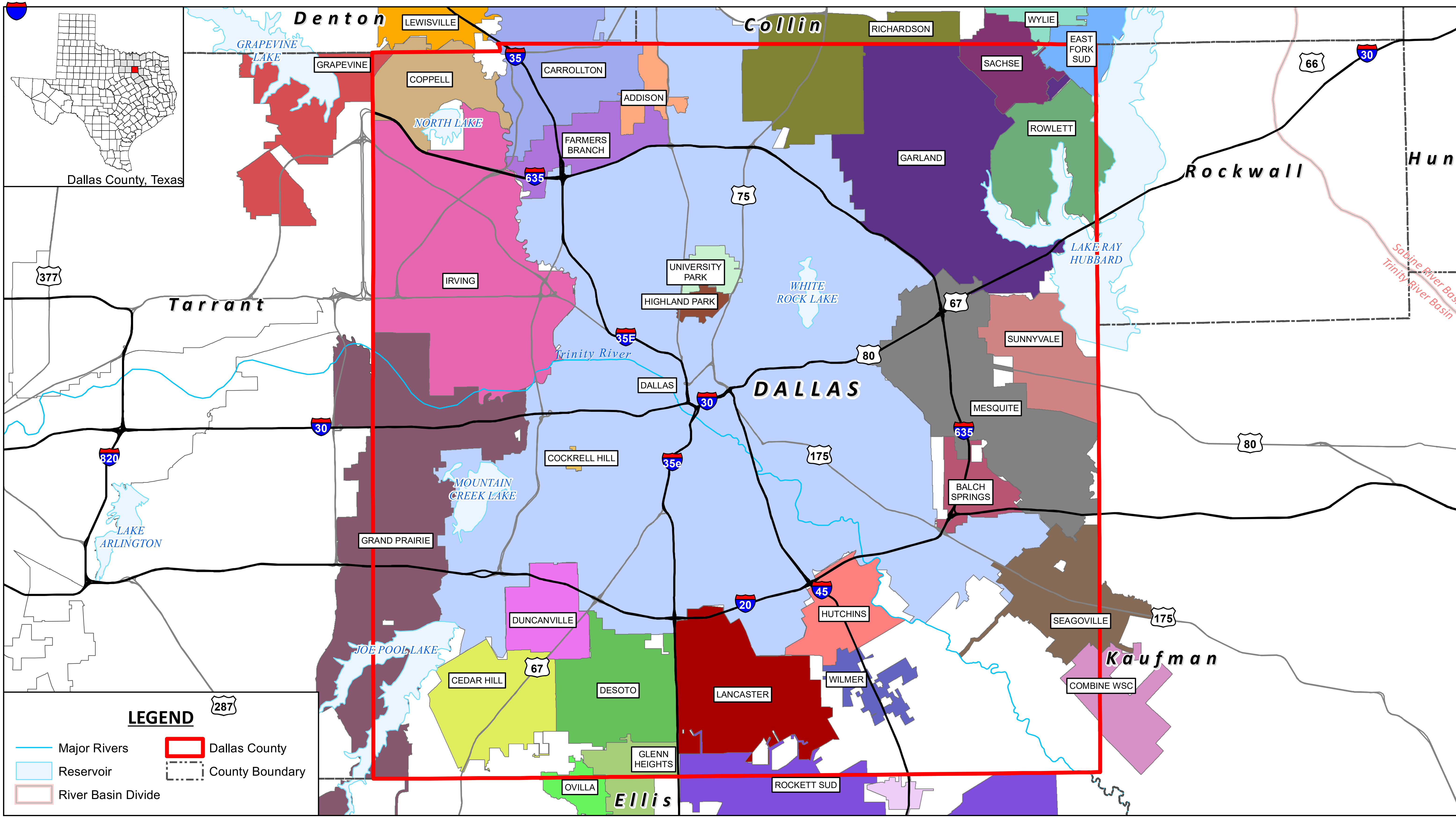
River Basins: Trinity (100%)

Table 5E.57 Summary of Dallas County

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**2,587,960**	**2,871,662**	**3,180,529**	**3,429,783**	**3,627,334**	**3,770,858**
Projected Demands	**563,223**	**606,936**	**657,666**	**701,225**	**737,409**	**761,162**
Municipal	526,406	569,262	620,369	664,277	700,469	724,228
Irrigation	10,122	10,122	10,122	10,122	10,122	10,122
Livestock	758	758	758	758	758	758
Manufacturing	21,834	23,073	23,073	23,073	23,073	23,073
Mining	3,038	2,656	2,279	1,930	1,922	1,916
Steam Electric	1,065	1,065	1,065	1,065	1,065	1,065
Total Existing Supplies	**558,730**	**545,266**	**544,101**	**539,610**	**538,786**	**533,486**
Need (Demand - Supply)	**4,493**	**61,670**	**113,565**	**161,615**	**198,623**	**227,676**
Total Supplies from Strategies	**34,053**	**88,847**	**139,196**	**187,697**	**224,676**	**253,687**
Reserve (Shortage)	**29,560**	**27,177**	**25,631**	**26,082**	**26,053**	**26,011**

Figure 5E.5 Summary of Dallas County





2021 Region C Water Plan

DALLAS COUNTY, TEXAS

FIGURE 5E.6

REGION C Water Planning for North Texas

1 in = 4 miles

0 1 2 4 6

Miles

Data Source(s): ESRI, USGS, TNRIS

TR116409: H:\WR_PLANNING\1 - Working\5E_County WMS\Dallas.mxd

5E.3.1 Wholesale Water Providers and Water User Groups

Water management strategies for Dallas County wholesale water providers (WWPs) and water user groups (WUGs) are discussed below (in alphabetical order). The costs for recommended and alternative water management strategies are presented in **Section 5E.3.2. Appendix H** has more detailed cost estimates.

Addison

The City of Addison is located in northern Dallas County. The city receives treated water supplies from DWU. Water management strategies for Addison include conservation and additional water from DWU. **Table 5E.58** shows the projected population and demand, the current supplies, and the recommended water management strategies for Addison.

Table 5E.58 Summary of Water User Group – City of Addison

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**14,869**	**15,895**	**16,921**	**17,947**	**18,973**	**20,000**
Projected Demands						
Municipal Demand	6,137	6,486	6,856	7,248	7,657	8,069
Total Projected Demands	***6,137***	***6,486***	***6,856***	***7,248***	***7,657***	***8,069***
Currently Available Supplies						
DWU	5,890	5,923	5,673	5,532	5,562	5,634
Total Currently Available Supplies	***5,890***	***5,923***	***5,673***	***5,532***	***5,562***	***5,634***
Need (Demand - Supply)	***247***	***563***	***1,183***	***1,716***	***2,095***	***2,435***
Water Management Strategies						
Water Conservation	324	401	421	475	535	598
DWU	0	162	762	1,241	1,560	1,837
Total Supplies from Strategies	***324***	***563***	***1,183***	***1,716***	***2,095***	***2,435***
Reserve (Shortage)	**77**	**0**	**0**	**0**	**0**	**0**

Balch Springs

The City of Balch Springs currently receives treated water supplies from DWU. Water management strategies for Balch Springs include conservation and additional water from DWU. **Table 5E.59** shows the projected population and demand, the current supplies, and the recommended water management strategies for Balch Springs.

Table 5E.59 Summary of Water User Group – City of Balch Springs

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**26,418**	**28,974**	**31,600**	**34,449**	**37,226**	**40,010**
Projected Demands						
Municipal Demand	2,749	2,894	3,066	3,293	3,546	3,808
Total Projected Demands	***2,749***	***2,894***	***3,066***	***3,293***	***3,546***	***3,808***
Currently Available Supplies						
DWU	2,639	2,643	2,536	2,511	2,572	2,656
Total Currently Available Supplies	***2,639***	***2,643***	***2,536***	***2,511***	***2,572***	***2,656***
Need (Demand - Supply)	***110***	***251***	***530***	***782***	***974***	***1,152***
Water Management Strategies						
Water Conservation	95	112	116	134	157	181
DWU	15	139	414	648	817	971
Total Supplies from Strategies	***110***	***251***	***530***	***782***	***974***	***1,152***
Reserve (Shortage)	**0**	**0**	**0**	**0**	**0**	**0**

Carrollton

Carrollton is located in southern Denton County, Dallas County and Collin County. The water supply for Carrollton is discussed under Denton County in **Section 5E.4.**

Cedar Hill

The City of Cedar Hill is located in southwest Dallas County, with a small part in Ellis County. Cedar Hill currently receives water supplies from the Trinity aquifer and DWU. Water management strategies for Cedar Hill include conservation and additional water from DWU. **Table 5E.60** shows the projected population and demand, the current supplies, and the recommended water management strategies for Cedar Hill.

Table 5E.60 Summary of Water User Group – City of Cedar Hill

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**53,938**	**66,017**	**78,092**	**85,000**	**85,000**	**85,000**
Projected Demands						
Municipal Demand	10,799	12,984	15,209	16,476	16,461	16,459
Total Projected Demands	***10,799***	***12,984***	***15,209***	***16,476***	***16,461***	***16,459***
Currently Available Supplies						
Trinity Aquifer	180	180	180	180	180	180
DWU	10,192	11,696	12,440	12,441	11,834	11,375
Total Currently Available Supplies	***10,372***	***11,876***	***12,620***	***12,621***	***12,014***	***11,555***
Need (Demand - Supply)	***427***	***1,108***	***2,589***	***3,855***	***4,447***	***4,904***
Water Management Strategies						
Water Conservation	760	1,023	1,177	1,356	1,410	1,465
DWU	0	85	1,412	2,499	3,037	3,439
Total Supplies from Strategies	***760***	***1,108***	***2,589***	***3,855***	***4,447***	***4,904***
Reserve (Shortage)	**333**	**0**	**0**	**0**	**0**	**0**

Cockrell Hill

The City of Cockrell Hill is in western Dallas County. The city receives treated water supplies from DWU. The recommended water management strategies for Cockrell Hill are conservation and additional water from DWU. **Table 5E.61** shows the projected population and demand, the current supplies, and the recommended water management strategies for Cockrell Hill.

Table 5E.61 Summary of Water User Group – City of Cockrell Hill

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**4,787**	**5,250**	**5,250**	**5,250**	**6,999**	**14,997**
Projected Demands						
Municipal Demand	417	431	415	405	536	1,140
Total Projected Demands	***417***	***431***	***415***	***405***	***536***	***1,140***
Currently Available Supplies						
DWU	400	394	343	310	389	797
Total Currently Available Supplies	***400***	***394***	***343***	***310***	***389***	***797***
Need (Demand - Supply)	***17***	***37***	***72***	***95***	***147***	***343***
Water Management Strategies						
Water Conservation	29	31	7	5	9	24
DWU	0	6	65	90	138	319
Total Supplies from Strategies	***29***	***37***	***72***	***95***	***147***	***343***
Reserve (Shortage)	**12**	**0**	**0**	**0**	**0**	**0**

Combine WSC

Combine WSC serves parts of Kaufman and Dallas Counties. Water management strategies for Combine WSC are discussed under Kaufman County in **Section 5E.11**.

Coppell

The City of Coppell is located in northwest Dallas County with a small area in Denton County. Coppell currently receives treated water supplies from DWU. Water management strategies for Coppell include conservation and water from DWU. **Table 5E.62** shows the projected population and demand, the current supplies, and the recommended water management strategies for Coppell.

Table 5E.62 Summary of Water User Group – City of Coppell

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**41,982**	**42,881**	**42,943**	**42,943**	**42,943**	**42,943**
Projected Demands						
Municipal Demand	11,129	11,225	11,142	11,086	11,071	11,071
Total Projected Demands	***11,129***	***11,225***	***11,142***	***11,086***	***11,071***	***11,071***
Currently Available Supplies						
DWU	10,682	10,255	9,223	8,464	8,047	7,736
Total Currently Available Supplies	***10,682***	***10,255***	***9,223***	***8,464***	***8,047***	***7,736***
Need (Demand - Supply)	***447***	***970***	***1,919***	***2,622***	***3,024***	***3,335***
Water Management Strategies						
Water Conservation	770	868	842	874	910	946
DWU	0	102	1,077	1,748	2,114	2,389
Total Supplies from Strategies	***770***	***970***	***1,919***	***2,622***	***3,024***	***3,335***
Reserve (Shortage)	**323**	**0**	**0**	**0**	**0**	**0**

Dallas

Dallas is a major wholesale water provider that supplies water in Dallas, Collin, Denton, Kaufman, and Rockwall Counties. The plan for Dallas is discussed under Dallas Water Utilities (DWU) in **Chapter 5D**.

Dallas County Irrigation

> ***The Texas Water Development Board classifies the use of potable water for golf course irrigation as a part of municipal use. The use of raw water or reuse of treated wastewater effluent for golf course irrigation is classified as irrigation use.***

Irrigation demand projections include the water necessary for irrigation activities, including field crops, orchards, pasture, turf grass, vineyards, golf courses irrigated by raw water, and limited aquaculture operations. Golf course irrigation is the largest part of the irrigation water use in Dallas County. **Table 5E.63** shows the projected demand and the current supplies for Dallas County Irrigation. Dallas County Irrigation currently receives water from DWU, direct reuse (through DWU and from TRA through Las Colinas and Ten Mile WWTP), Joe Pool Lake, local supplies, and groundwater (Trinity and Woodbine aquifers). There are no needs for Dallas County Irrigation and therefore no recommended water management strategies.

Table 5E.63 Summary of Water User Group – Dallas County Irrigation

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Demands						
Total Projected Demands	***10,122***	***10,122***	***10,122***	***10,122***	***10,122***	***10,122***
Currently Available Supplies						
DWU	2,574	2,574	2,574	2,574	2,574	2,574
Direct Reuse from DWU	1,121	1,121	1,121	1,121	1,121	1,121
Direct Reuse from TRA through Las Colinas	8,000	8,000	8,000	8,000	8,000	8,000
Direct Reuse from TRA through Ten Mile WWTP	125	125	125	125	125	125
Joe Pool Lake through Grand Prairie	300	300	300	300	300	300
Local Supplies	791	791	791	791	791	791
Trinity Aquifer	700	700	700	700	700	700
Woodbine Aquifer	700	700	700	700	700	700
Total Currently Available Supplies	***14,311***	***14,311***	***14,311***	***14,311***	***14,311***	***14,311***
Need (Demand - Supply)	***0***	***0***	***0***	***0***	***0***	***0***
Water Management Strategies						
None	0	0	0	0	0	0
Total Supplies from Strategies	***0***	***0***	***0***	***0***	***0***	***0***
Reserve (Shortage)	**4,189**	**4,189**	**4,189**	**4,189**	**4,189**	**4,189**

Dallas County Livestock

Livestock water use is defined as water used in the production of livestock, both for consumption and for cleaning and environmental purposes. **Table 5E.64** shows the projected demand and the current supplies for Dallas County Livestock. The current supplies for Dallas County Livestock are local surface water supplies and Woodbine aquifer supplies. The current sources are sufficient to meet future demands, and there are no water management strategies.

Table 5E.64 Summary of Water User Group – Dallas County Livestock

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Demands						
Total Projected Demands	***758***	***758***	***758***	***758***	***758***	***758***
Currently Available Supplies						
Local Supplies	198	198	198	198	198	198
Woodbine Aquifer	658	658	658	658	658	658
Total Currently Available Supplies	***856***	***856***	***856***	***856***	***856***	***856***
Need (Demand - Supply)	***0***	***0***	***0***	***0***	***0***	***0***
Water Management Strategies						
None	0	0	0	0	0	0
Total Supplies from Strategies	***0***	***0***	***0***	***0***	***0***	***0***
Reserve (Shortage)	**98**	**98**	**98**	**98**	**98**	**98**

Dallas County Manufacturing

Manufacturing water use is defined as water used to produce manufactured goods. **Table 5E.65** shows the projected demand, the current supplies, and the water management strategies for Dallas County Manufacturing. Most manufacturing in Dallas County is supplied by DWU and NTMWD, with additional supplies from Irving and groundwater (Trinity and Woodbine aquifers). Additional supplies from DWU, NTMWD, and Grand Prairie are the water management strategies to meet projected demands. Conservation was considered for this water user group, but it is not recommended because of the uncertainty in the ability to implement conservation measures given the multiple entities, facilities, and various manufacturing processes that make up this WUG.

Table 5E.65 Summary of Water User Group – Dallas County Manufacturing

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Demands						
Total Projected Demands	***21,834***	***23,073***	***23,073***	***23,073***	***23,073***	***23,073***
Currently Available Supplies						
DWU	14,642	14,784	13,397	12,356	11,764	11,309
DWU through Grand Prairie	991	835	769	708	674	648
NTMWD through Garland	2,932	2,632	2,433	2,202	1,986	1,821
NTMWD through Mesquite	325	292	270	245	221	202
Lake Chapman through Irving	2,183	2,307	2,307	2,307	2,307	2,307
Trinity Aquifer	530	530	530	530	530	530
Woodbine Aquifer	43	43	43	43	43	43
Total Currently Available Supplies	***21,646***	***21,423***	***19,749***	***18,391***	***17,525***	***16,860***
Need (Demand - Supply)	***188***	***1,650***	***3,324***	***4,682***	***5,548***	***6,213***
Water Management Strategies						
DWU	743	1,686	3,139	4,241	4,867	5,348
NTMWD	16	537	758	1,014	1,254	1,438
Total Supplies from Strategies	***759***	***2,223***	***3,897***	***5,255***	***6,121***	***6,786***
Reserve (Shortage)	**571**	**573**	**573**	**573**	**573**	**573**

Dallas County Mining

Mining water demand includes water used for oil and gas development, as well as extraction of coal and lignite, sand aggregate, and other resources. **Table 5E.66** shows the projected demand and the current supplies for Dallas County Mining. Dallas County Mining is supplied from local supplies and groundwater (Trinity and Woodbine aquifers). The current sources are sufficient to meet future demands, and there are no water management strategies.

Table 5E.66 Summary of Water User Group – Dallas County Mining

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Demands						
Total Projected Demands	***3,038***	***2,656***	***2,279***	***1,930***	***1,922***	***1,916***
Currently Available Supplies						
Local Supplies	1,525	1,525	1,525	1,525	1,525	1,525
Trinity Aquifer	1,800	1,800	1,800	1,800	1,800	1,800
Woodbine Aquifer	253	253	253	253	253	253
Total Currently Available Supplies	***3,578***	***3,578***	***3,578***	***3,578***	***3,578***	***3,578***
Need (Demand - Supply)	***0***	***0***	***0***	***0***	***0***	***0***
Water Management Strategies						
None	0	0	0	0	0	0
Total Supplies from Strategies	***0***	***0***	***0***	***0***	***0***	***0***
Reserve (Shortage)	**540**	**922**	**1,299**	**1,648**	**1,656**	**1,662**

Dallas County Other

Dallas County Other includes individual domestic supplies and water suppliers too small to be classified as water user groups. Dallas County Other also includes the Dallas-Fort Worth International Airport. The municipal entities included under Dallas County Other currently receive their water supply from either groundwater (Trinity and Woodbine aquifers), DWU, Tarrant Regional Water District, or Fort Worth reuse sources. The Dallas-Fort Worth International Airport is supplied by both Fort Worth and Dallas (DWU). Water management strategies for these entities, including Dallas-Fort Worth International Airport, include conservation, additional supplies from DWU, and additional supplies from Fort Worth and TRWD. **Table 5E.67** shows the projected population and demand, the current supplies, and the water management strategies for Dallas County Other.

Table 5E.67 Summary of Water User Group – Dallas County Other

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**1,092**	**798**	**862**	**917**	**1,318**	**1,617**
Projected Demands						
Municipal Demand	2,229	2,168	2,180	2,191	2,274	2,335
Total Projected Demands	***2,229***	***2,168***	***2,180***	***2,191***	***2,274***	***2,335***
Currently Available Supplies						
Trinity Aquifer	50	50	50	50	50	50
Woodbine Aquifer	50	50	50	50	50	50
DWU	121	59	64	67	124	162
DWU for DFW Airport	1,282	1,220	1,105	1,019	971	932
TRWD (through Fort Worth) for DFW Airport	634	559	443	401	369	341
Reuse through Fort Worth for DFW Airport	33	33	100	100	100	100
Total Currently Available Supplies	***2,170***	***1,971***	***1,812***	***1,687***	***1,664***	***1,635***
Need (Demand - Supply)	***59***	***197***	***368***	***504***	***610***	***700***
Water Management Strategies						
Water Conservation	78	90	87	95	106	117
DWU	0	6	13	21	47	70
DWU for DFW Airport	0	26	143	221	258	286
TRWD through Fort Worth for DFW Airport	0	75	125	167	199	227
Total Supplies from Strategies	***78***	***197***	***368***	***504***	***610***	***700***
Reserve (Shortage)	**19**	**0**	**0**	**0**	**0**	**0**

Dallas County Steam Electric Power

Steam electric power demands generally represent the cooling water needs during power generation. These demands do not include water that is used in cogeneration facilities (which is included in manufacturing projections), facilities which do not require water for production, or hydro-electric generation facilities. **Table 5E.68** shows the projected demand, the current supplies, and the water management strategies for Dallas County Steam Electric Power. Dallas County Steam Electric Power is currently supplied by DWU, Mountain Creek Lake, and run-of-the-river supplies. The only water management strategy for this water user group is additional supplies from DWU. Conservation was considered for this water user group, but it is not recommended because the steam electric demand projections themselves considered items such as future efficiency programs.

Table 5E.68 Summary of Water User Group – Dallas County Steam Electric Power

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Demands						
Total Projected Demands	**1,065**	**1,065**	**1,065**	**1,065**	**1,065**	**1,065**
Currently Available Supplies						
DWU	960	914	828	763	727	699
Mountain Creek Lake	6,400	6,400	6,400	6,400	6,400	6,400
Run-of-River	368	368	368	368	368	368
Total Currently Available Supplies	***7,728***	***7,682***	***7,596***	***7,531***	***7,495***	***7,467***
Need (Demand - Supply)	***0***	***0***	***0***	***0***	***0***	***0***
Water Management Strategies						
DWU	40	86	172	237	273	301
Total Supplies from Strategies	***40***	***86***	***172***	***237***	***273***	***301***
Reserve (Shortage)	**6,703**	**6,703**	**6,703**	**6,703**	**6,703**	**6,703**

Dallas County Park Cities Municipal Utility District

Dallas County Park Cities MUD is a wholesale water provider that supplies treated water to Highland Park and University Park and plans to continue doing so through the planning period. The MUD also sells reuse water from Lake Grapevine to the City of Grapevine for municipal and irrigation purposes. The only strategy proposed for the MUD is the implementation of water conservation measures by its wholesale customers. **Table 5E.69** shows the projected demand, the current supplies, and the water management strategies for Dallas County Park Cities MUD.

Table 5E.69 Summary of Wholesale Water Provider and Customers – Dallas County Park Cities MUD

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Demands						
Grapevine	2,174	2,538	2,577	2,562	2,559	2,558
Irrigation, Tarrant	1,121	1,121	1,121	1,121	1,121	1,121
Highland Park	4,055	4,139	4,105	4,090	4,087	4,087
University Park	7,612	7,506	7,418	7,370	7,361	7,361
Total Projected Demands	***14,962***	***15,304***	***15,221***	***15,143***	***15,128***	***15,127***
Currently Available Supplies						
Lake Grapevine (Potable)	16,900	16,900	16,808	16,639	16,469	16,300
Reuse	3,295	3,659	3,698	3,683	3,680	3,679
Total Currently Available Supplies	***20,195***	***20,559***	***20,506***	***20,322***	***20,149***	***19,979***
Need (Demand - Supply)	***0***	***0***	***0***	***0***	***0***	***0***
Water Management Strategies						
Conservation (Wholesale)	564	612	584	619	657	695
Total Supplies from Strategies	***564***	***612***	***584***	***619***	***657***	***695***
Reserve (Shortage)	**5,797**	**5,867**	**5,869**	**5,798**	**5,678**	**5,547**

DeSoto

DeSoto is in southwestern Dallas County and receives treated water supplies from DWU. Water management strategies for DeSoto include conservation and additional water from DWU. **Table 5E.70** shows the projected population and demand, the current supplies, and the water management strategies for DeSoto.

Table 5E.70 Summary of Water User Group – City of DeSoto

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**54,505**	**58,941**	**64,281**	**70,078**	**75,727**	**78,033**
Projected Demands						
Municipal Demand	9,422	9,965	10,703	11,575	12,483	12,856
Total Projected Demands	***9,422***	***9,965***	***10,703***	***11,575***	***12,483***	***12,856***
Currently Available Supplies						
DWU	9,043	9,103	8,860	8,836	9,073	8,983
Total Currently Available Supplies	***9,043***	***9,103***	***8,860***	***8,836***	***9,073***	***8,983***
Need (Demand - Supply)	***379***	***862***	***1,843***	***2,739***	***3,410***	***3,873***
Water Management Strategies						
Water Conservation	538	750	792	896	1,010	1,087
DWU	0	112	1,051	1,843	2,400	2,786
Total Supplies from Strategies	***538***	***862***	***1,843***	***2,739***	***3,410***	***3,873***
Reserve (Shortage)	**159**	**0**	**0**	**0**	**0**	**0**

Duncanville

Duncanville is located in southwestern Dallas County. The city receives its water supply from DWU. Water management strategies for Duncanville are conservation and additional water from DWU. **Table 5E.71** shows the projected population and demand, the current supplies, and the water management strategies for Duncanville.

Table 5E.71 Summary of Water User Group – City of Duncanville

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**43,110**	**47,307**	**47,307**	**47,307**	**47,307**	**47,307**
Projected Demands						
Municipal Demand	6,091	6,464	6,322	6,244	6,230	6,229
Total Projected Demands	***6,091***	***6,464***	***6,322***	***6,244***	***6,230***	***6,229***
Currently Available Supplies						
DWU	5,846	5,899	5,227	4,761	4,523	4,351
Total Currently Available Supplies	***5,846***	***5,899***	***5,227***	***4,761***	***4,523***	***4,351***
Need (Demand - Supply)	***245***	***565***	***1,095***	***1,483***	***1,707***	***1,878***
Water Management Strategies						
Water Conservation	241	280	212	225	243	264
DWU	4	285	883	1,258	1,464	1,614
Total Supplies from Strategies	***245***	***565***	***1,095***	***1,483***	***1,707***	***1,878***
Reserve (Shortage)	**0**	**0**	**0**	**0**	**0**	**0**

East Fork Special Utility District

East Fork SUD is located in southern Collin County and extends into Dallas and Rockwall Counties. The water management strategies for East Fork SUD are described under Collin County in **Section 5E.1**.

Farmers Branch

Farmers Branch is in northwestern Dallas County. The city receives its treated water supplies from DWU. The water management strategies for Farmers Branch include conservation and additional water from DWU. **Table 5E.72** shows the projected population and demand, the current supplies, and the water management strategies for Farmers Branch.

Table 5E.72 Summary of Water User Group – City of Farmers Branch

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**30,582**	**32,477**	**34,420**	**36,531**	**38,586**	**40,648**
Projected Demands						
Municipal Demand	9,031	9,448	9,901	10,446	11,020	11,606
Total Projected Demands	***9,031***	***9,448***	***9,901***	***10,446***	***11,020***	***11,606***
Currently Available Supplies						
DWU	8,668	8,631	8,195	7,975	8,010	8,109
Total Currently Available Supplies	***8,668***	***8,631***	***8,195***	***7,975***	***8,010***	***8,109***
Need (Demand - Supply)	***363***	***817***	***1,706***	***2,471***	***3,010***	***3,497***
Water Management Strategies						
Water Conservation	669	775	749	820	906	996
DWU	0	42	957	1,651	2,104	2,501
Total Supplies from Strategies	***669***	***817***	***1,706***	***2,471***	***3,010***	***3,497***
Reserve (Shortage)	**306**	**0**	**0**	**0**	**0**	**0**

Ferris

Ferris is located in northern Ellis and southern Dallas Counties. The water management strategies for Ferris are discussed under Ellis County in **Section 5E.5**.

Garland

The City of Garland is located in northeastern Dallas County as well as parts of Collin and Rockwall Counties. Garland is a wholesale water provider that currently purchases treated water from the NTMWD. Garland sells water for Dallas and Collin County Manufacturing and Collin County Steam Electric Power (Ray Olinger Power Plant). The City of Garland sells some of its treated wastewater effluent to Forney for Kaufman County Steam Electric Power. The recommended strategy for Garland is to implement water conservation measures and receive additional water from NTMWD. A summary of the recommended water plan for Garland is shown in **Table 5E.73**.

Table 5E.73 Summary of Wholesale Water Provider and Customers – Garland

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Demands						
Garland	41,106	43,868	45,346	45,444	45,644	45,644
Manufacturing, Collin	*22*	*26*	*26*	*26*	*26*	*26*
Manufacturing, Dallas	*2,948*	*3,115*	*3,115*	*3,115*	*3,115*	*3,115*
Steam Electric, Collin	*40*	*40*	*40*	*40*	*40*	*40*
Forney (reuse sales)	*9,196*	*9,196*	*9,196*	*9,196*	*9,196*	*9,196*
Total Projected Demands	***53,312***	***56,245***	***57,723***	***57,821***	***58,021***	***58,021***
Currently Available Supplies						
NTMWD	43,878	39,751	37,910	34,389	31,131	28,570
Total Currently Available Treated Water Supplies	***43,878***	***39,751***	***37,910***	***34,389***	***31,131***	***28,570***
Need (Demand - Supply)	***238***	***7,298***	***10,617***	***14,236***	***17,694***	***20,255***
Water Management Strategies						
Conservation (retail)	2,757	3,083	2,797	2,939	3,100	3,252
NTMWD	0	4,215	7,820	11,297	14,594	17,003
Total Supplies from Strategies	***2,757***	***7,298***	***10,617***	***14,236***	***17,694***	***20,255***
Reserve (Shortage)	**2,519**	**0**	**0**	**0**	**0**	**0**

Glenn Heights

Glenn Heights is located in southern Dallas and northern Ellis Counties. Glenn Heights provides water for in-city municipal demand. Glenn Heights gets treated water supplies from DWU and groundwater from the Trinity and Woodbine aquifers. Water management strategies for Glenn Heights include conservation and additional water from DWU, including additional delivery infrastructure from Dallas. **Table 5E.74** shows the projected population and demand, the current supplies, and the water management strategies for Glenn Heights.

Table 5E.74 Summary of Water User Group – City of Glenn Heights

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**17,696**	**23,760**	**30,126**	**37,485**	**44,723**	**60,834**
Projected Demands						
Municipal Demand	1,937	2,526	3,162	3,910	4,657	6,327
Total Projected Demands	***1,937***	***2,526***	***3,162***	***3,910***	***4,657***	***6,327***
Currently Available Supplies						
Trinity Aquifer	68	68	68	68	68	68
DWU	1,751	2,204	2,523	2,899	3,302	4,342
Woodbine Aquifer	45	45	45	45	45	45
Total Currently Available Supplies	***1,864***	***2,317***	***2,636***	***3,012***	***3,415***	***4,455***
Need (Demand - Supply)	***73***	***209***	***526***	***898***	***1,242***	***1,872***
Water Management Strategies						
Water Conservation	18	36	40	62	90	143
DWU	55	173	486	836	1,152	1,729
Additional Delivery Infrastructure	*0*	*0*	*0*	*0*	*112*	*1,729*
Total Supplies from Strategies	***73***	***209***	***526***	***898***	***1,242***	***1,872***
Reserve (Shortage)	**0**	**0**	**0**	**0**	**0**	**0**

Grand Prairie

Grand Prairie is located in western Dallas County, eastern Tarrant County, and northwestern Ellis County. Grand Prairie currently gets most of its supplies from DWU. The city also purchases treated water from Fort Worth, Midlothian, and Mansfield. The city has groundwater wells that can be used if needed, but the wells have not been used since 2011. The city is planning to phase out its groundwater supplies.

Grand Prairie meets irrigation demands (golf course irrigation) through raw water supplies from Joe Pool Lake. County Other demands in Johnson and Ellis County are from the Prairie Ridge development which is split between the two counties.

Grand Prairie's recommended water management strategies include conservation, additional supplies from DWU, Midlothian, and Mansfield, and new supplies from Arlington. A summary of the recommended water plan for Grand Prairie is shown in **Table 5E.75**.

Table 5E.75 Summary of Wholesale Water Provider and Customers – Grand Prairie

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Demands						
Grand Prairie	35,186	40,806	44,154	43,901	43,842	43,837
Irrigation, Dallas	*300*	*300*	*300*	*300*	*300*	*300*
Manufacturing, Dallas	*1,121*	*1,121*	*1,121*	*1,121*	*1,121*	*1,121*
Manufacturing, Tarrant	*85*	*93*	*93*	*93*	*93*	*93*
County Other, Ellis	*448*	*897*	*897*	*897*	*897*	*897*
County Other, Johnson	*673*	*1,345*	*1,345*	*1,345*	*1,345*	*1,345*
Total Projected Demands	***37,813***	***44,562***	***47,910***	***47,657***	***47,598***	***47,593***
Currently Available Supplies						
Groundwater	303	0	0	0	0	0
Joe Pool Raw Water	300	300	300	300	300	300
Fort Worth (TRWD)	1,401	1,234	1,095	988	910	842
Midlothian (TRWD)	1,392	1,416	1,566	1,613	1,536	1,435
Mansfield (TRWD)	627	2,577	1,834	1,571	1,412	1,282
DWU	32,110	31,238	31,040	28,434	27,029	25,980
Total Currently Available Supplies	***36,133***	***36,765***	***35,835***	***32,906***	***31,187***	***29,839***
Need (Demand - Supply)	***1,680***	***7,797***	***12,075***	***14,751***	***16,411***	***17,754***
Water Management Strategies						
Conservation (retail)	2,061	2,578	2,276	2,408	2,552	2,698
Conservation (wholesale)	2	4	4	11	15	18
DWU	1,344	2,957	6,459	8,812	10,158	11,202
Midlothian (TRWD)	290	1,387	2,077	2,030	2,107	2,208
Mansfield (TRWD)	46	1,044	1,159	1,422	1,581	1,711
Arlington (TRWD)	0	2,242	2,074	2,074	2,074	2,074
Total Supplies from Strategies	***3,743***	***10,212***	***14,049***	***16,757***	***18,487***	***19,911***
Reserve (Shortage)	**2,063**	**2,415**	**1,974**	**2,006**	**2,076**	**2,157**

Highland Park

Highland Park is located in central Dallas County and receives its water supply from Grapevine Lake through Dallas County Park Cities MUD. The only water management strategy for Highland Park is conservation. **Table 5E.76** shows the projected population and demand, the current supplies, and the water management strategies for Highland Park.

Table 5E.76 Summary of Water User Group – City of Highland Park

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**9,023**	**9,311**	**9,311**	**9,311**	**9,311**	**9,311**
Projected Demands						
Municipal Demand	4,055	4,139	4,105	4,090	4,087	4,087
Total Projected Demands	***4,055***	***4,139***	***4,105***	***4,090***	***4,087***	***4,087***
Currently Available Supplies						
Grapevine Lake through Dallas County Park Cities MUD	4,055	4,139	4,105	4,090	4,087	4,087
Total Currently Available Supplies	***4,055***	***4,139***	***4,105***	***4,090***	***4,087***	***4,087***
Need (Demand - Supply)	***0***	***0***	***0***	***0***	***0***	***0***
Water Management Strategies						
Water Conservation	202	219	210	224	237	251
Total Supplies from Strategies	***202***	***219***	***210***	***224***	***237***	***251***
Reserve (Shortage)	**202**	**219**	**210**	**224**	**237**	**251**

Hutchins

Hutchins is located in southern Dallas County. The city receives treated water supplies from DWU. Water management strategies for Hutchins include conservation and additional water from DWU. **Table 5E.77** shows the projected population and demand, the current supplies, and the water management strategies for Hutchins.

Table 5E.77 Summary of Water User Group - City of Hutchins

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**9,901**	**13,919**	**17,937**	**21,956**	**25,974**	**29,994**
Projected Demands						
Municipal Demand	2,186	3,033	3,888	4,748	5,612	6,479
Total Projected Demands	***2,186***	***3,033***	***3,888***	***4,748***	***5,612***	***6,479***
Currently Available Supplies						
DWU	2,098	2,770	3,219	3,625	4,079	4,527
Total Currently Available Supplies	***2,098***	***2,770***	***3,219***	***3,625***	***4,079***	***4,527***
Need (Demand - Supply)	***88***	***263***	***669***	***1,123***	***1,533***	***1,952***
Water Management Strategies						
Water Conservation	99	162	202	262	328	400
DWU	0	101	467	861	1,205	1,552
Total Supplies from Strategies	***99***	***263***	***669***	***1,123***	***1,533***	***1,952***
Reserve (Shortage)	**11**	**0**	**0**	**0**	**0**	**0**

Irving

Irving is located in northwestern Dallas County. The city provides water for in-city municipal demand and for Dallas County Manufacturing use in the city. Irving gets its water supply from Chapman Lake, TRA Central Reuse Project, and DWU. The TRA Central Reuse Project is currently used to irrigate the Twin Wells Golf Course. Under full development, the reuse project will supply up to 25 MGD. Irving plans to develop infrastructure to utilize the remaining portion of the 25 MGD within the next five years.

Recommended water management strategies for Irving include conservation, additional water from DWU, and additional water from TRA Central Reuse Project. Alternative water management strategies for Irving include joint strategies: the Marvin Nichols Reservoir, Wright Patman Reallocation, Oklahoma supplies (Lake Hugo), and Mainstem Balancing Reservoir. **Table 5E.78** shows the projected population and demand, the current supplies, and the water management strategies for Irving.

Table 5E.78 Summary of Water User Group - City of Irving

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**259,186**	**294,623**	**301,541**	**301,541**	**301,541**	**301,541**
Projected Demands						
Municipal Demand	55,798	62,288	63,021	62,619	62,535	62,524
Manufacturing, Dallas	*2,183*	*2,307*	*2,307*	*2,307*	*2,307*	*2,307*
Total Projected Demands	***57,981***	***64,595***	***65,328***	***64,926***	***64,842***	***64,831***
Currently Available Supplies						
Lake Chapman	40,369	40,140	39,911	39,681	39,452	39,223
TRA Central Reuse Project	486	486	486	486	486	486
DWU	16,367	4,568	4,139	3,817	3,634	3,493
Total Currently Available Supplies	***56,736***	***44,708***	***44,050***	***43,498***	***43,086***	***42,716***
Need (Demand - Supply)	***1,245***	***19,887***	***21,278***	***21,428***	***21,756***	***22,115***
Water Management Strategies						
Water Conservation	3,428	3,993	3,853	4,029	4,230	4,438
TRA Central Reuse Project	0	27,539	27,539	27,539	27,539	27,539
Total Supplies from Strategies	***3,428***	***31,532***	***31,392***	***31,568***	***31,769***	***31,977***
Reserve (Shortage)	**2,183**	**11,645**	**10,114**	**10,140**	**10,013**	**9,862**
Alternative Strategies						
Marvin Nichols Reservoir	*0*	*0*	*0*	*0*	*0*	*18,680*
Wright Patman Reallocation	*0*	*0*	*0*	*6,320*	*6,320*	*6,320*
Oklahoma Supplies	*0*	*25,000*	*25,000*	*25,000*	*25,000*	*25,000*
Main Stem Balancing Reservoir	*0*	*25,000*	*25,000*	*25,000*	*25,000*	*25,000*

Lancaster

Lancaster is in southern Dallas County and receives treated water supplies from DWU. Beginning in 2020 some amount of the City of Wilmer's Dallas supply will be delivered through Lancaster. Water management strategies for Lancaster include conservation and additional water from DWU for both Lancaster and Wilmer. **Table 5E.79** shows the projected population and demand, the current supplies, and the water management strategies for Lancaster.

Table 5E.79 Summary of Water User Group - City of Lancaster

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**45,097**	**58,781**	**69,582**	**77,498**	**85,417**	**93,333**
Projected Demands						
Municipal Demand	7,670	9,755	11,407	12,634	13,905	15,186
Wilmer	*406*	*450*	*695*	*1,274*	*1,988*	*3,468*
Total Projected Demands	***8,076***	***10,205***	***12,102***	***13,908***	***15,893***	***18,654***
Currently Available Supplies						
DWU	7,768	9,327	10,023	10,632	11,580	13,182
Total Currently Available Supplies	***7,768***	***9,327***	***10,023***	***10,632***	***11,580***	***13,182***
Need (Demand - Supply)	***308***	***878***	***2,079***	***3,276***	***4,313***	***5,472***
Water Management Strategies						
Water Conservation	388	575	652	766	892	1,026
DWU	0	303	1,427	2,510	3,421	4,446
Total Supplies from Strategies	***388***	***878***	***2,079***	***3,276***	***4,313***	***5,472***
Reserve (Shortage)	**80**	**0**	**0**	**0**	**0**	**0**

Lewisville

Lewisville is located in southeastern Denton County with a small area in Dallas County. The water management strategies for Lewisville are described under Denton County in **Section 5E.4.**

Mesquite

Mesquite is located in eastern Dallas County extending into western Kaufman County. Mesquite provides water to Dallas County Manufacturing and to Kaufman County Other (specifically Kaufman County MUD #11). The city receives treated water supplies from NTMWD, and water management strategies for Mesquite include conservation and additional water from NTMWD for the city and its customers. **Table 5E.80** shows the projected population and demand, the current supplies, and the water management strategies for Mesquite.

Table 5E.80 Summary of Water User Group - Mesquite

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**149,936**	**164,928**	**186,249**	**203,079**	**219,484**	**235,935**
Projected Demands						
Municipal Demand	22,334	23,847	26,347	28,428	30,653	32,932
Kaufman County MUD 11	*608*	*730*	*883*	*1,077*	*1,318*	*1,616*
Manufacturing, Dallas	*327*	*346*	*346*	*346*	*346*	*346*
Total Projected Demands	***23,269***	***24,923***	***27,576***	***29,851***	***32,317***	***34,894***
Currently Available Supplies						
NTMWD	23,142	21,054	21,537	21,105	20,595	20,407
Total Currently Available Supplies	***23,142***	***21,054***	***21,537***	***21,105***	***20,595***	***20,407***
Need (Demand - Supply)	***127***	***3,869***	***6,039***	***8,746***	***11,722***	***14,487***
Water Management Strategies						
Water Conservation	1,334	1,545	1,650	1,884	2,148	2,435
NTMWD	0	2,324	4,389	6,862	9,574	12,052
Total Supplies from Strategies	***1,334***	***3,869***	***6,039***	***8,746***	***11,722***	***14,487***
Reserve (Shortage)	**1,207**	**0**	**0**	**0**	**0**	**0**

Ovilla

Ovilla is located in northern Ellis County and southern Dallas County. The water management strategies for Ovilla are described under Ellis County in **Section 5E.5**.

Richardson

Richardson is located in northern Dallas County and southern Collin County. The city provides water for in-city municipal demand and for a portion of Collin County Manufacturing. The city receives treated water supplies from NTMWD, and water management strategies for Richardson include conservation and additional water from NTMWD. **Table 5E.81** shows the projected population and demand, the current supplies, and the water management strategies for Richardson.

Table 5E.81 Summary of Water User Group – City of Richardson

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**109,516**	**112,539**	**115,592**	**118,914**	**120,585**	**124,068**
Projected Demands						
Municipal Demand	27,459	27,744	28,115	28,719	29,084	29,923
Manufacturing, Collin	*1,506*	*1,744*	*1,744*	*1,744*	*1,744*	*1,744*
Total Projected Demands	***28,965***	***29,488***	***29,859***	***30,463***	***30,828***	***31,667***
Currently Available Supplies						
NTMWD	28,809	24,909	23,321	21,537	19,645	18,520
Total Currently Available Supplies	***28,809***	***24,909***	***23,321***	***21,537***	***19,645***	***18,520***
Need (Demand - Supply)	***156***	***4,579***	***6,538***	***8,926***	***11,183***	***13,147***
Water Management Strategies						
Water Conservation	1,325	1,468	1,442	1,568	1,683	1,828
NTMWD	0	3,111	5,096	7,358	9,500	11,319
Total Supplies from Strategies	***1,325***	***4,579***	***6,538***	***8,926***	***11,183***	***13,147***
Reserve (Shortage)	**1,169**	**0**	**0**	**0**	**0**	**0**

Rockett Special Utility District

Rockett SUD has a large service area in northern Ellis County extending into Dallas County. Rockett SUD is a wholesale water provider, and there is a discussion of the SUD's water supply plans in **Section 5E.5.**

Rowlett

Rowlett is located in northeastern Dallas County and Rockwall County. The city currently receives treated water supplies from NTMWD, and water management strategies for Rowlett include conservation and additional water from NTMWD. **Table 5E.82** shows the projected population and demand, the current supplies, and the water management strategies for Rowlett.

Table 5E.82 Summary of Water User Group – City of Rowlett

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**67,523**	**73,029**	**78,535**	**83,041**	**86,547**	**91,053**
Projected Demands						
Municipal Demand	10,331	10,936	11,608	12,182	12,671	13,328
Total Projected Demands	***10,331***	***10,936***	***11,608***	***12,182***	***12,671***	***13,328***
Currently Available Supplies						
NTMWD	10,275	9,238	9,067	8,613	8,075	7,795
Total Currently Available Supplies	***10,275***	***9,238***	***9,067***	***8,613***	***8,075***	***7,795***
Need (Demand - Supply)	***56***	***1,698***	***2,541***	***3,569***	***4,596***	***5,533***
Water Management Strategies						
Water Conservation	409	483	493	557	623	700
NTMWD	0	1,215	2,048	3,012	3,973	4,833
Total Supplies from Strategies	***409***	***1,698***	***2,541***	***3,569***	***4,596***	***5,533***
Reserve (Shortage)	**353**	**0**	**0**	**0**	**0**	**0**

Sachse

Sachse is located in northeastern Dallas County and southern Collin County. Sachse receives treated water supplies from NTMWD, and water management strategies include conservation and additional water from NTMWD. **Table 5E.83** shows the projected population and demand, the current supplies, and the water management strategies for Sachse.

Table 5E.83 Summary of Water User Group – Sachse

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**28,704**	**28,704**	**28,704**	**29,037**	**29,131**	**29,131**
Projected Demands						
Municipal Demand	5,215	5,159	5,127	5,166	5,175	5,174
Total Projected Demands	***5,215***	***5,159***	***5,127***	***5,166***	***5,175***	***5,174***
Currently Available Supplies						
NTMWD	5,179	4,325	3,983	3,652	3,298	3,026
Total Currently Available Supplies	***5,179***	***4,325***	***3,983***	***3,652***	***3,298***	***3,026***
Need (Demand - Supply)	***36***	***834***	***1,144***	***1,514***	***1,877***	***2,148***
Water Management Strategies						
Water Conservation	389	407	397	416	433	447
NTMWD	0	427	747	1,098	1,444	1,701
Total Supplies from Strategies	***389***	***834***	***1,144***	***1,514***	***1,877***	***2,148***
Reserve (Shortage)	**353**	**0**	**0**	**0**	**0**	**0**

Seagoville

Seagoville is located in southeastern Dallas County with some area in Kaufman County as well. Seagoville is a wholesale water provider that provides water to Combine WSC. Seagoville currently obtains its treated water supplies from DWU and plans to continue doing so. **Table 5E.84** shows projected demand, the current supplies, and the water management strategies for Seagoville.

Table 5E.84 Summary of Wholesale Water Provider and Customers – City of Seagoville

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Demands						
Seagoville	2,064	2,416	2,783	3,167	3,576	3,575
Combine WSC	*352*	*408*	*470*	*565*	*671*	*786*
Total Projected Demands	***2,416***	***2,824***	***3,253***	***3,732***	***4,247***	***4,361***
Currently Available Supplies						
DWU	*2,242*	*2,242*	*2,242*	*2,242*	*2,242*	*2,242*
Total Currently Available Supplies	***2,242***	***2,242***	***2,242***	***2,242***	***2,242***	***2,242***
Need (Demand - Supply)	***174***	***582***	***1,011***	***1,490***	***2,005***	***2,119***
Water Management Strategies						
Conservation (retail)	72	94	104	129	158	170
Conservation (wholesale)	3	5	5	8	11	16
DWU	99	483	902	1,353	1,836	1,933
Total Supplies from Strategies	***174***	***582***	***1,011***	***1,490***	***2,005***	***2,119***
Reserve (Shortage)	**0**	**0**	**0**	**0**	**0**	**0**

Sunnyvale

Sunnyvale located in eastern Dallas County and receives treated water supplies from NTMWD. The water management strategies are conservation and additional water from NTMWD, including an increase in infrastructure. **Table 5E.85** shows the projected population and demand, the current supplies, and the water management strategies for Sunnyvale.

Table 5E.85 Summary of Water User Group – City of Sunnyvale

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**6,637**	**9,481**	**12,326**	**14,222**	**14,222**	**14,222**
Projected Demands						
Municipal Demand	2,234	3,159	4,089	4,710	4,707	4,706
Total Projected Demands	***2,234***	***3,159***	***4,089***	***4,710***	***4,707***	***4,706***
Currently Available Supplies						
NTMWD	2,222	2,669	3,166	3,285	2,989	2,752
Total Currently Available Supplies	***2,222***	***2,669***	***3,166***	***3,285***	***2,989***	***2,752***
Need (Demand - Supply)	***12***	***490***	***923***	***1,425***	***1,718***	***1,954***
Water Management Strategies						
Water Conservation	89	148	189	240	255	271
NTMWD	0	342	734	1,185	1,463	1,683
Additional Delivery Infrastructure	*0*	*342*	*734*	*1,185*	*1,463*	*1,683*
Total Supplies from Strategies	***89***	***490***	***923***	***1,425***	***1,718***	***1,954***
Reserve (Shortage)	**77**	**0**	**0**	**0**	**0**	**0**

University Park

University Park is located in central Dallas County and receives its water supply from Grapevine Lake through Dallas County Park Cities MUD. The only water management strategy for the city is conservation. **Table 5E.86** shows the projected population and demand, the current supplies, and the water management strategy for University Park.

Table 5E.86 Summary of Water User Group – City of University Park

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**25,656**	**25,656**	**25,656**	**25,656**	**25,656**	**25,656**
Projected Demands						
Municipal Demand	7,612	7,506	7,418	7,370	7,361	7,361
Total Projected Demands	***7,612***	***7,506***	***7,418***	***7,370***	***7,361***	***7,361***
Currently Available Supplies						
Grapevine Lake through Dallas County Park Cities MUD	7,612	7,506	7,418	7,370	7,361	7,361
Total Currently Available Supplies	***7,612***	***7,506***	***7,418***	***7,370***	***7,361***	***7,361***
Need (Demand - Supply)	***0***	***0***	***0***	***0***	***0***	***0***
Water Management Strategies						
Water Conservation	362	393	374	395	420	444
Total Supplies from Strategies	***362***	***393***	***374***	***395***	***420***	***444***
Reserve (Shortage)	**362**	**393**	**374**	**395**	**420**	**444**

Wilmer

Wilmer is located in southeastern Dallas County. The city receives treated water supplies from DWU (through Lancaster). Water management strategies for Wilmer include conservation, additional water from DWU (through Lancaster), and a direct connection to Dallas' 36-inch transmission line. **Table 5E.87** shows the projected population and demand, the current supplies, and the water management strategies for Wilmer.

Table 5E.87 Summary of Water User Group – Wilmer

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**4,111**	**4,595**	**7,336**	**13,692**	**21,517**	**39,121**
Projected Demands						
Municipal Demand	423	455	702	1,293	2,027	3,680
Total Projected Demands	***423***	***455***	***702***	***1,293***	***2,027***	***3,680***
Currently Available Supplies						
DWU through Lancaster	406	416	581	987	1,474	2,571
Total Currently Available Supplies	***406***	***416***	***581***	***987***	***1,474***	***2,571***
Need (Demand - Supply)	***17***	***39***	***121***	***306***	***553***	***1,109***
Water Management Strategies						
Water Conservation	3	5	7	19	39	83
DWU through Lancaster	0	34	114	287	514	897
Direct Connection to Dallas	14	0	0	0	0	129
Total Supplies from Strategies	***17***	***39***	***121***	***306***	***553***	***1,109***
Reserve (Shortage)	**0**	**0**	**0**	**0**	**0**	**0**

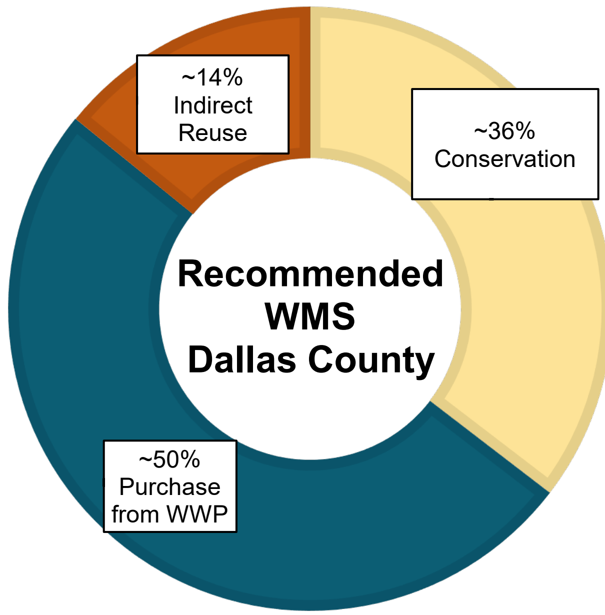
Wylie

Wylie is located in southern Collin County with small areas in Dallas and Rockwall Counties. Wylie's water supply plans are discussed under Collin County in **Section 5E.1**.

5E.3.2 Summary of Costs for Dallas County

Costs for Dallas County

Table 5E.88 summarizes the costs of the water management strategies recommended for the WUGs and WWPs who have the majority of their demand located in Dallas County. Total quantities from **Table 5E.88** will not necessarily match total county demands. This is due mainly to water users whose sum of strategies results in a reserve as well as due to water users located in multiple counties (or wholesale water providers who develop strategies and then sell water to users in other counties). Quantities from infrastructure projects needed to deliver and/or treat water (shown in *gray italics*) are not included since the supplies are associated with other strategies. To avoid double-counting quantities of supplies, the quantities in gray italics are **not** included in the total.



The majority of the future supplies needed to meet demands within Dallas County are projected to come through purchases from wholesale water providers. Other strategies include conservation and indirect reuse.

Table 5E.89 summarizes the recommended water management strategies within Dallas County individually. Alternative strategies are also included. More detailed cost estimates are located in **Appendix H.**

Table 5E.88 Summary of Recommended Water Management Strategies for Dallas County

Type of Strategy	Quantity (Ac-Ft/Yr)	Capital Costs
Conservation[a]	72,097	$45,899,797
Purchase from WWP	97,844	$0
Additional Infrastructure	*22,715*	*$132,627,000*
Indirect Reuse	27,539	$46,730,000
Total	**197,480**	**$225,256,797**

[a]The conservation quantities represent the sum of the individual water user groups who have the majority of their service areas located in the county, not the total conservation in the county.

Table 5E.89 Costs for Recommended Water Management Strategies for Dallas County

WUG or WWP	Strategy	Online by:	Quantity (Ac-Ft/Yr)[b]	Capital Costs[c]	Unit Cost ($/1000 gal) With Debt Service	Unit Cost ($/1000 gal) After Debt Service	Table
WWPs							
Dallas County Park Cities MUD	Conservation	2020	Included with WUGs				
Garland	Conservation (retail)	2020	3,252	$6,779,585	$0.61	$0.00	H.11
	Conservation (wholesale)	2030	Included with WUGs.				
	NTMWD	2020	17,003	$0	$2.78	$2.78	None
Grand Prairie	Conservation (retail)	2020	2,698	$1,521,652	$0.26	$0.00	H.11
	Conservation (wholesale)	2020	Included with WUGs.				
	DWU	2020	11,202	$0	$4.05	$4.05	None
	Additional Delivery Infrastructure	*2020*	*11,202*	*$72,782,000*	*$1.73*	*$0.33*	*H.93*
	TRWD through Midlothian	2020	2,208	$0	$3.95	$3.95	None
	TRWD through Mansfield	2020	1,711	$0	$3.00	$3.00	None
	TRWD through Arlington	2030	2,242	$0	$3.38	$3.38	None
	Connect to Arlington (TRWD)	*2030*	*2,242*	*$5,679,000*	*$0.70*	*$0.15*	*H.92*
Seagoville	Conservation (retail)	2020	170	$311,822	$0.94	$0.00	H.11
	Conservation (wholesale)	2020	Included with WUGs				
	DWU	2020	1,933	$0	$4.05	$4.05	None
WUGs							
Addison	Conservation	2020	598	$1,315,440	$1.03	$0.11	H.11
	DWU	2030	1,837	$0	$4.05	$4.05	None
Balch Springs	Conservation	2020	181	$229,772	$0.52	$0.00	H.11
	DWU	2020	971	$0	$4.05	$4.05	None
Carrollton[a]	Conservation	See Denton County.					
	DWU						
Cedar Hill[a]	Conservation	2020	1,465	$673,056	$0.49	$0.22	H.11
	DWU	2030	3,439	$0	$4.05	$4.05	None
Cockrell Hill	Conservation	2020	24	$13,114	$0.10	$0.04	H.11
	DWU	2020	319	$0	$4.05	$4.05	None

WUG or WWP	Strategy	Online by:	Quantity (Ac-Ft/Yr)[b]	Capital Costs[c]	Unit Cost ($/1000 gal) With Debt Service	Unit Cost ($/1000 gal) After Debt Service	Table
Combine WSC[a]	Conservation	See Kaufman County.					
	DWU through Seagoville						
Coppell[a]	Conservation	2020	946	$1,367,318	$0.55	$0.13	H.11
	DWU	2030	2,389	$0	$4.05	$4.05	None
Dallas[a]	Conservation	2020	47,947	$16,933,907	$0.26	$0.48	H.11
	Other WMSs	See DWU in **Chapter 5D**.					
DeSoto	Conservation	2020	1,087	$263,044	$1.78	$1.11	H.11
	DWU	2030	2,786	$0	$4.05	$4.05	None
Duncanville	Conservation	2020	264	$615,654	$0.55	$0.00	H.11
	DWU	2020	1,614	$0	$4.05	$4.05	None
East Fork SUD[a]	Conservation	See Collin County.					
	NTMWD						
Farmers Branch	Conservation	2020	996	$744,659	$0.45	$0.17	H.11
	DWU	2030	2,501	$0	$4.05	$4.05	None
Ferris	Conservation	See Ellis County.					
	Rockett SUD						
Glenn Heights[a]	Conservation	2020	143	$86,942	$1.04	$0.00	H.11
	DWU	2020	1,729	$0	$4.05	$4.05	None
	Additional Delivery Infrastructure	*2060*	*1,729*	*$1,926,000*	*$0.32*	*$0.08*	*H.91*
Highland Park	Conservation	2020	251	$411,107	$0.44	$0.00	H.11
Hutchins	Conservation	2020	400	$415,355	$1.57	$0.43	H.11
	DWU	2030	1,552	$0	$4.05	$4.05	None
Irving	Conservation	2020	4,438	$2,126,293	$0.20	$0.06	H.11
	TRA Central Reuse Project	2030	27,539	$46,730,000	$1.71	$0.90	H.95
	Lake Chapman Booster Pump Station	2020	0	$21,659,000	$0.00	$0.00	H.26
	ALTERNATIVE Marvin Nichols Reservoir	*2050*	*18,680*	*$180,439,000*	*$3.01*	*$1.35*	*H.21*
	ALTERNATIVE Wright Patman Reallocation	*2070*	*6,320*	*$49,834,000*	*$4.27*	*$3.18*	*H.24*

WUG or WWP	Strategy	Online by:	Quantity (Ac-Ft/Yr)[b]	Capital Costs[c]	Unit Cost ($/1000 gal) With Debt Service	Unit Cost ($/1000 gal) After Debt Service	Table
	ALTERNATIVE Main Stem Balancing Reservoir	*2030*	*25,000*	*$127,849,000*	*$1.91*	*$0.81*	*H.94*
	ALTERNATIVE Oklahoma	*2030*	*25,000*	*$272,248,000*	*$2.12*	*$0.30*	*H.96*
Lancaster	Conservation	2020	1,026	$1,308,675	$1.07	$0.23	H.11
	DWU	2030	3,549	$0	$4.05	$4.05	None
Lewisville[a]	Conservation	See Denton County.					
	Other WMSs						
Mesquite[a]	Conservation	2020	2,321	$3,709,960	$0.62	$0.00	H.11
	NTMWD	2030	11,351	$0	$2.78	$2.78	None
Ovilla[a]	Conservation	See Ellis County.					
	DWU						
	Additional Delivery Infrastructure						
Richardson[a]	Conservation	2020	1,828	$1,093,469	$0.27	$0.07	H.11
	NTMWD	2020	10,595	$0	$2.78	$2.78	None
Rockett SUD[a]	Conservation	See Ellis County.					
	Other WMSs						
Rowlett[a]	Conservation	2020	700	$792,959	$0.42	$0.00	H.11
	NTMWD	2030	4,833	$0	$2.78	$2.78	None
	Additional Delivery Infrastructure	*2030*	*4,833*	*$4,105,000*	*$0.28*	*$0.09*	*H.97*
Sachse[a]	Conservation	2020	447	$348,028	$0.33	$0.12	H.11
	NTMWD	2030	1,701	$0	$2.78	$2.78	None
Sunnyvale	Conservation	2020	271	$89,962	$0.50	$0.22	H.11
	NTMWD	2030	1,683	$0	$2.78	$2.78	None
	Additional Delivery Infrastructure	*2030*	*1,683*	*$2,575,000*	*$0.41*	*$0.08*	*H.98*
University Park	Conservation	2020	444	$4,677,554	$2.79	$0.00	H.11
Wilmer	Conservation	2020	83	$13,132	$0.95	$0.11	H.11
	DWU	2020	1,026	$0	$4.05	$4.05	None

WUG or WWP	Strategy	Online by:	Quantity (Ac-Ft/Yr)[b]	Capital Costs[c]	Unit Cost ($/1000 gal) With Debt Service	Unit Cost ($/1000 gal) After Debt Service	Table
	Increase Capacity of Connection with Lancaster	*2020*	*897*	*$5,280,000*	*$1.42*	*$0.15*	*H.100*
	Direct Connection to Dallas 36" Transmission Line	*2020*	*129*	*$18,621,000*	*$21.17*	*$2.03*	*H.99*
Wylie[a]	Conservation	See Collin County.					
	NTMWD						
County Other and Non-Municipal							
County Other, Dallas	Conservation	2020	117	$57,338	$0.20	$0.02	H.11
	DWU	2020	356	$0	$4.05	$4.05	None
	TRWD through Fort Worth	2030	227	$0	$1.63	$1.63	None
Irrigation, Dallas	None	None					
Livestock, Dallas	None	None					
Manufacturing, Dallas	DWU	2020	4,875	$0	$4.05	$4.05	None
	NTMWD	2020	1,438	$0	$2.78	$2.78	None
	Grand Prairie	2020	473	$0	$3.00	$3.00	None
Mining, Dallas	None	None					
Steam Electric Power, Dallas	DWU	2020	301	$0	$2.03	$2.03	None

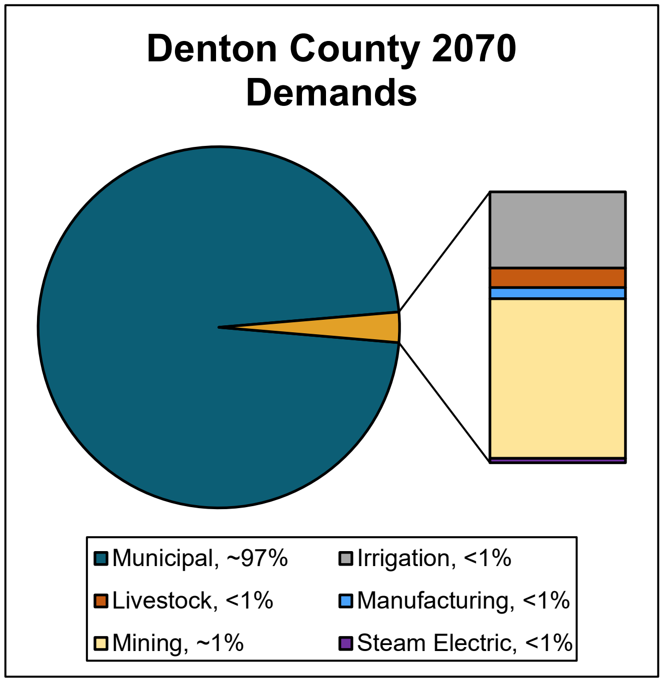
[a]*Water user groups extend into more than one county.*
[b]*Quantities listed are for the WUG only. They do not include the WUG's customers.*
[c]*Purchases from wholesale water providers that require no new infrastructure have no capital costs. The unit costs shown in the table represent the cost to purchase water from the WWP.*

5E.4 Denton County

Denton County is located in the north central portion of Region C. **Figure 5E.8** shows water service areas in Denton County.

Denton County is growing rapidly, and the county's population is projected to more than double between 2020 and 2070.

Demands for the county are predominately municipal. Mining and Irrigation Demands are the next largest categories. Livestock, Manufacturing and Steam Electric demands are all less than 1 percent of the overall county demand.



Dallas Water Utilities (DWU), Upper Trinity Regional Water District (UTRWD), North Texas Municipal Water District (NTMWD), and Tarrant Regional Water District (TRWD) are the major water providers that provide supplies to Denton County. Upper Trinity Regional Water District (UTRWD) and Denton also provide significant supplies in the county.

An overall summary of the County's projections is shown in **Table 5E.90,** and water management strategies for individual WWPs and WUGs are discussed on the following pages.

Denton County Quick Facts

2010 Population: 662,614

Projected 2070 Population: 2,113,136

Projected 2070 Demand: 351 MGD

County Seat: Denton

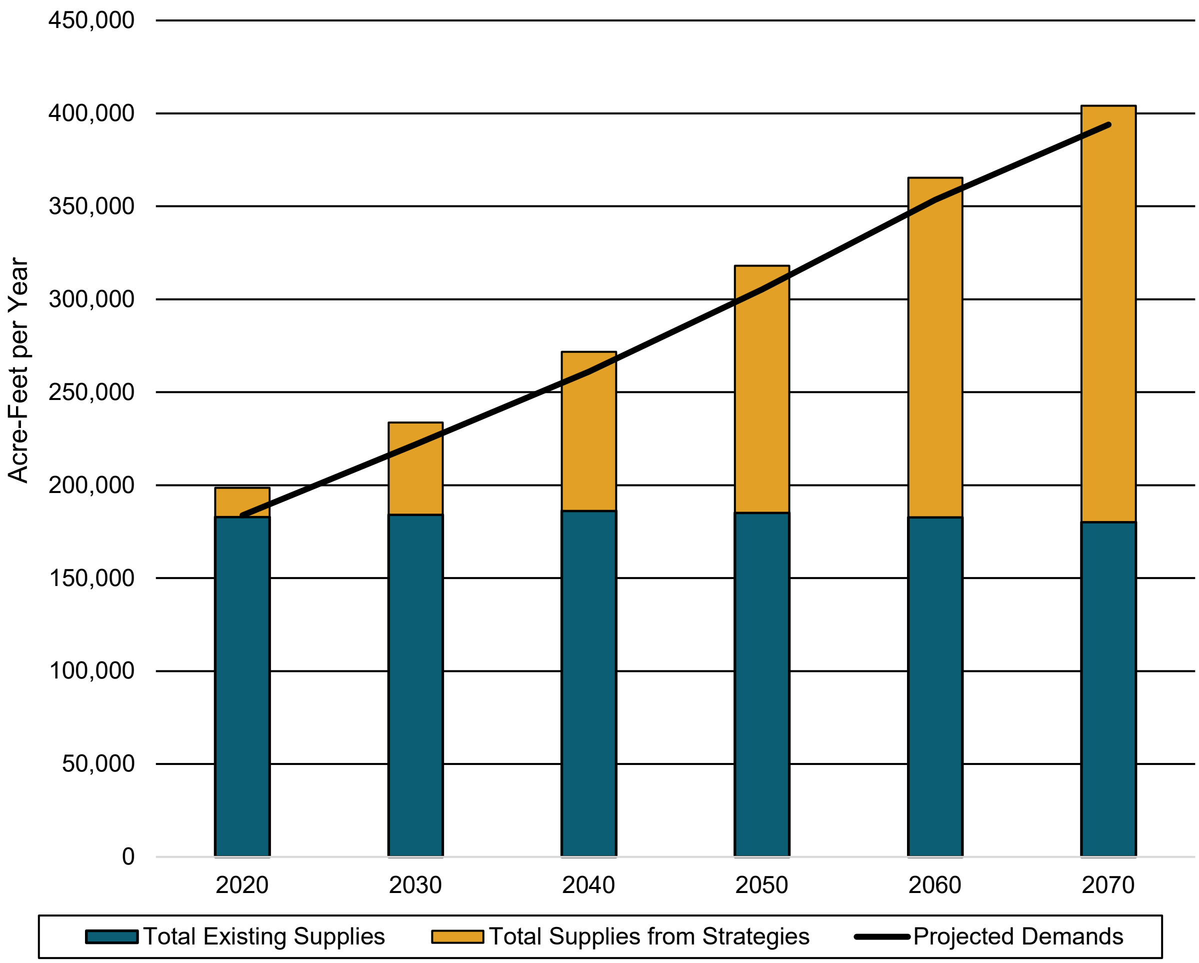
Economy: Industry; tourism; government/services

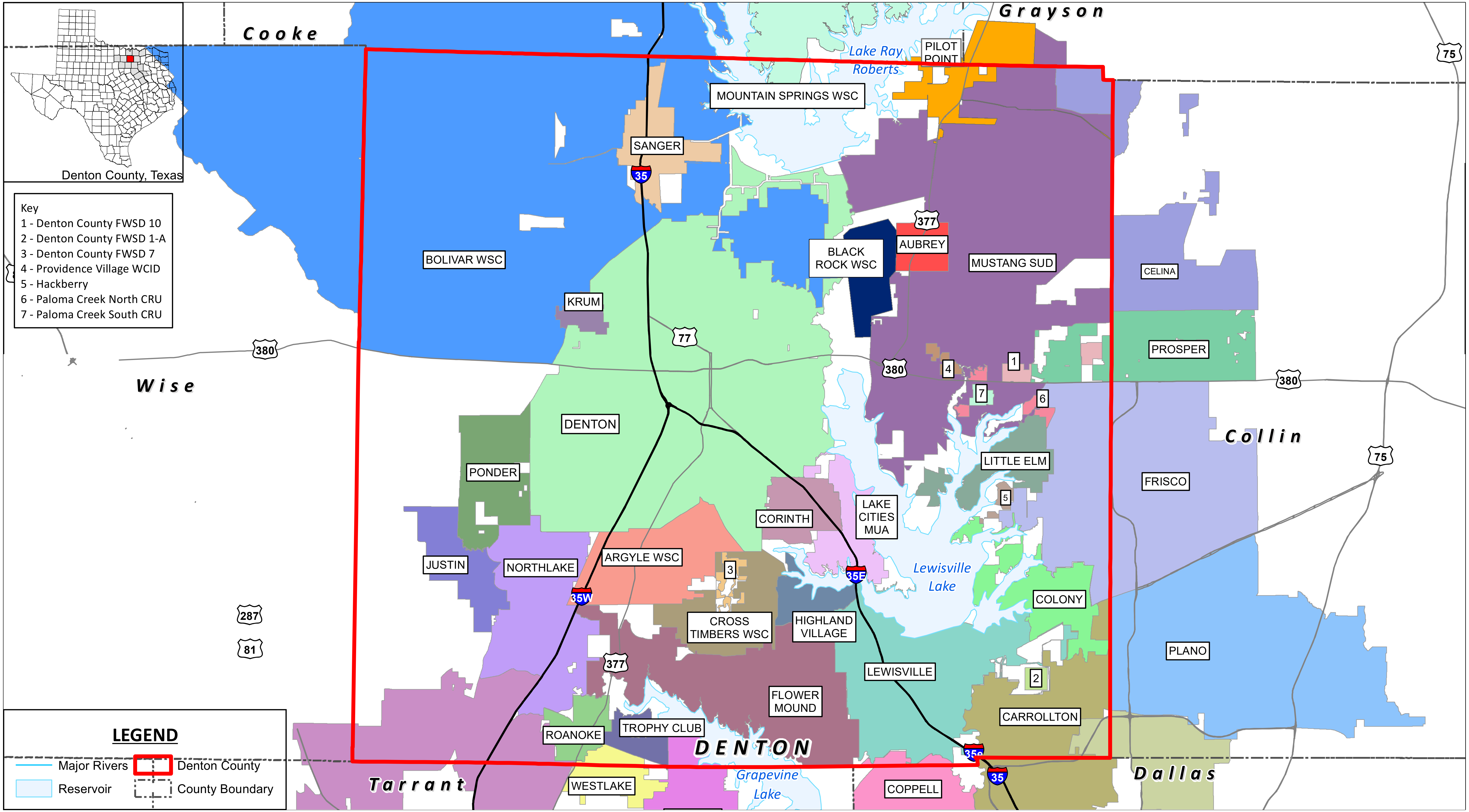
River Basins: Trinity (100%)

Table 5E.90 Summary of Denton County

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**891,063**	**1,115,119**	**1,329,551**	**1,584,015**	**1,866,215**	**2,113,136**
Projected Demands	**183,755**	**222,033**	**260,976**	**305,248**	**353,543**	**393,966**
Municipal	175,110	214,919	253,246	296,557	343,954	383,290
Irrigation	3,003	3,003	3,003	3,003	3,003	3,003
Livestock	769	769	769	769	769	769
Manufacturing	374	440	440	440	440	440
Mining	4,326	2,729	3,345	4,306	5,204	6,291
Steam Electric	173	173	173	173	173	173
Total Existing Supplies	**184,263**	**185,978**	**188,642**	**188,572**	**187,010**	**185,558**
Need (Demand - Supply)	**0**	**36,055**	**72,334**	**116,676**	**166,533**	**208,408**
Total Supplies from Strategies	**15,630**	**49,563**	**85,464**	**132,798**	**182,719**	**223,944**
Reserve (Shortage)	**16,138**	**13,508**	**13,130**	**16,122**	**16,186**	**15,536**

Figure 5E.7 Summary of Denton County





REGION C
Water Planning for North Texas

2021 Region C Water Plan

DENTON COUNTY, TEXAS

FIGURE 5E.8

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5E.4.1 Wholesale Water Providers and Water User Groups

Water management strategies for Denton County wholesale water providers (WWPs) and water user groups (WUGs) are discussed below (in alphabetical order). The costs for recommended and alternative water management strategies are presented in **Section 5E.4.2. Appendix H** has more detailed cost estimates.

Argyle Water Supply Corporation

Argyle WSC supplies water to Denton County. The WSC gets treated water supplies from the Trinity Aquifer and UTRWD. The water management strategies for the WSC include conservation, new groundwater well(s) in the Trinity aquifer, and additional supplies from UTRWD. **Table 5E.91** shows the projected population and demand, the current supplies, and the water management strategies for Argyle WSC.

Table 5E.91 Summary of Water User Group – Argyle WSC

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**13,466**	**17,126**	**22,005**	**22,005**	**22,005**	**22,005**
Projected Demands						
Municipal Demand	2,659	3,365	4,322	4,319	4,317	4,314
Total Projected Demand	***2,659***	***3,365***	***4,322***	***4,319***	***4,317***	***4,314***
Currently Available Supplies						
Trinity Aquifer	683	683	683	683	683	683
UTRWD	1,976	1,917	2,159	1,908	1,701	1,490
Total Currently Available Supplies	***2,659***	***2,600***	***2,842***	***2,591***	***2,384***	***2,173***
Need (Demand – Supply)	***0***	***765***	***1,480***	***1,728***	***1,933***	***2,141***
Water Management Strategies						
Water Conservation	25	260	436	451	465	478
New Well(s) in Trinity Aquifer	250	250	250	250	250	250
UTRWD	0	573	1,180	1,484	1,742	1,937
Total Supplies from Strategies	***275***	***1,083***	***1,866***	***2,185***	***2,457***	***2,665***
Reserve (Shortage)	**275**	**318**	**386**	**457**	**524**	**524**

Aubrey

Aubrey is located in northeast Denton County. The city receives its water supply from the Trinity aquifer. Water management strategies for Aubrey include conservation and connection to UTRWD. Any infrastructure needed to treat and deliver water from UTRWD to Aubrey is the responsibility of UTRWD and is included in UTRWD's strategies in this plan. **Table 5E.92** shows the projected population and demand, the current supplies, and the water management strategies for Aubrey.

Table 5E.92 Summary of Water User Group – City of Aubrey

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**4,597**	**6,112**	**7,148**	**8,475**	**10,173**	**12,346**
Projected Demands						
Municipal Demand	547	711	823	972	1,164	1,412
Total Projected Demands	***547***	***711***	***823***	***972***	***1,164***	***1,412***
Currently Available Supplies						
Trinity Aquifer	559	559	559	559	559	559
Total Currently Available Supplies	***559***	***559***	***559***	***559***	***559***	***559***
Need (Demand - Supply)	***0***	***152***	***264***	***413***	***605***	***853***
Water Management Strategies						
Water Conservation	5	9	8	13	20	32
Connection to UTRWD	0	255	457	673	915	1,151
Total Supplies from Strategies	***5***	***264***	***465***	***686***	***935***	***1,183***
Reserve (Shortage)	**17**	**112**	**201**	**273**	**330**	**330**

Black Rock Water Supply Corporation

Black Rock WSC is located in Denton County. The WSC gets its water supply from the Trinity aquifer. The water management strategies include conservation and new groundwater wells in the Trinity aquifer. **Table 5E.93** shows the projected population and demand, the current supplies, and the water management strategies for Black Rock WSC.

Table 5E.93 Summary of Water User Group – Black Rock WSC

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**1,570**	**1,977**	**2,347**	**2,745**	**3,215**	**3,639**
Projected Demands						
Municipal Demand	296	368	433	505	590	668
Total Projected Demand	***296***	***368***	***433***	***505***	***590***	***668***
Currently Available Supplies						
Trinity Aquifer	468	468	468	468	468	468
Total Currently Available Supplies	***468***	***468***	***468***	***468***	***468***	***468***
Need (Demand – Supply)	***0***	***0***	***0***	***37***	***122***	***200***
Water Management Strategies						
Water Conservation	2	4	4	29	40	46
New Well(s) in Trinity Aquifer	0	0	0	8	82	154
Total Supplies from Strategies	***2***	***4***	***4***	***37***	***122***	***200***
Reserve (Shortage)	**174**	**104**	**39**	**0**	**0**	**0**

Bolivar Water Supply Corporation

Bolivar WSC serves retail customers in northeastern Wise County and in Denton and Cooke Counties. The WSC currently gets its water from the Trinity aquifer. Water management strategies for Bolivar WSC include conservation, new groundwater well(s) in the Trinity aquifer, connecting to and purchasing water from Upper Trinity Regional Water District, and connecting to and purchasing water from Gainesville. **Table 5E.94** shows the projected population and demand, the current supplies, and the water management strategies for Bolivar WSC.

Table 5E.94 Summary of Water User Group – Bolivar Water Supply Corporation

(Values in AC-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**11,956**	**14,323**	**17,091**	**20,174**	**23,745**	**27,792**
Projected Demands						
Municipal Demand	1,068	1,222	1,417	1,649	1,934	2,262
Total Projected Demands	***1,068***	***1,222***	***1,417***	***1,649***	***1,934***	***2,262***
Currently Available Supplies						
Trinity Aquifer	1,264	1,264	1,264	1,264	1,264	1,264
Total Currently Available Supplies	***1,264***	***1,264***	***1,264***	***1,264***	***1,264***	***1,264***
Need (Demand - Supply)	***0***	***0***	***153***	***385***	***670***	***998***
Water Management Strategies						
Water Conservation	10	17	18	26	37	51
New Well(s) in Trinity Aquifer	250	250	250	250	250	250
Connect to UTRWD	0	975	1,119	1,280	1,477	1,700
Connect to Gainesville	0	49	74	98	122	146
Total Supplies from Strategies	***260***	***1,291***	***1,461***	***1,654***	***1,886***	***2,147***
Reserve (Shortage)	**456**	**1,333**	**1,308**	**1,269**	**1,216**	**1,149**

Carrollton

Carrollton is located in southern Denton, northwestern Dallas and southwestern Collin Counties. The City of Carrollton receives most of its water supply from DWU and a small amount of groundwater from the Trinity aquifer. Water management strategies for Carrollton include conservation and additional water from DWU. **Table 5E.95** shows the projected population and demand, the current supplies, and the water management strategies for Carrollton.

Table 5E.95 Summary of Water User Group – City of Carrollton

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**130,481**	**132,965**	**132,968**	**132,971**	**132,974**	**132,978**
Projected Demands						
Municipal Demand	24,256	24,191	23,788	23,565	23,521	23,518
Total Projected Demands	***24,256***	***24,191***	***23,788***	***23,565***	***23,521***	***23,518***
Currently Available Supplies						
Trinity Aquifer	25	25	25	25	25	25
DWU	23,281	22,098	19,691	17,990	17,096	16,432
Total Currently Available Supplies	***23,306***	***22,123***	***19,716***	***18,015***	***17,121***	***16,457***
Need (Demand - Supply)	***950***	***2,068***	***4,072***	***5,550***	***6,400***	***7,061***
Water Management Strategies						
Water Conservation	1,195	1,376	1,314	1,382	1,459	1,537
DWU	0	717	2,783	4,193	4,966	5,549
Total Supplies from Strategies	***1,195***	***2,093***	***4,097***	***5,575***	***6,425***	***7,086***
Reserve (Shortage)	**245**	**25**	**25**	**25**	**25**	**25**

Celina

The City of Celina is located in northwest Collin County and northeast Denton County. Water supply plans for Celina are discussed under Collin County in **Section 5E.1**.

Coppell

Coppell is located in northwest Dallas County with a small population in Denton County. Water supply plans for Coppell are discussed under Dallas County in **Section 5E.3**.

Corinth

Corinth is located in central Denton County. The city gets treated water supplies from UTRWD. Water management strategies for Corinth include conservation and additional water from UTRWD. **Table 5E.96** shows the projected population and demand, the current supplies, and the water management strategies for Corinth.

Table 5E.96 Summary of Water User Group – City of Corinth

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**24,928**	**29,520**	**29,520**	**29,520**	**29,520**	**29,520**
Projected Demands						
Municipal Demand	4,269	4,986	4,959	4,942	4,935	4,934
Total Projected Demands	***4,269***	***4,986***	***4,959***	***4,942***	***4,935***	***4,934***
Currently Available Supplies						
UTRWD	4,269	3,475	2,836	2,454	2,148	1,883
Total Currently Available Supplies	***4,269***	***3,475***	***2,836***	***2,454***	***2,148***	***1,883***
Need (Demand - Supply)	***0***	***1,511***	***2,123***	***2,488***	***2,787***	***3,051***
Water Management Strategies						
Water Conservation	41	330	365	380	396	413
UTRWD	0	1,181	1,758	2,108	2,391	2,638
Total Supplies from Strategies	***41***	***1,511***	***2,123***	***2,488***	***2,787***	***3,051***
Reserve (Shortage)	**41**	**0**	**0**	**0**	**0**	**0**

Cross Timbers Water Supply Corporation

Cross Timbers WSC is located in Denton County. The WSC gets its water supply from the Trinity aquifer and UTRWD. The water management strategies for Cross Timbers WSC include conservation, new groundwater well(s) in the Trinity aquifer and additional supplies from UTRWD. **Table 5E.97** shows the projected population and demand, the current supplies, and the water management strategies for Cross Timbers WSC.

Table 5E.97 Summary of Water User Group – Cross Timbers WSC

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**7,500**	**9,523**	**9,647**	**9,785**	**9,947**	**10,131**
Projected Demands						
Municipal Demand	1,642	2,060	2,073	2,096	2,128	2,166
Total Projected Demand	***1,642***	***2,060***	***2,073***	***2,096***	***2,128***	***2,166***
Currently Available Supplies						
Trinity Aquifer	649	584	520	452	389	389
UTRWD	993	1,028	873	810	757	678
Total Currently Available Supplies	***1,642***	***1,612***	***1,393***	***1,262***	***1,146***	***1,067***
Need (Demand – Supply)	***0***	***448***	***680***	***834***	***982***	***1,099***
Water Management Strategies						
Water Conservation	13	111	124	133	145	156
New Well(s) in Trinity Aquifer	250	250	250	250	250	250
UTRWD	0	337	556	701	837	943
Infrastructure Improvements	*0*	*337*	*556*	*701*	*837*	*943*
Total Supplies from Strategies	***263***	***698***	***930***	***1,084***	***1,232***	***1,349***
Reserve (Shortage)	**263**	**250**	**250**	**250**	**250**	**250**

Dallas

Dallas is a major wholesale water provider that supplies water to Dallas, Collin, Denton, Kaufman, and Rockwall Counties. The plans for Dallas are discussed under Dallas Water Utilities (DWU) in **Chapter 5D**.

Denton

The City of Denton is located in central Denton County. Denton is a wholesale water provider (WWP) that currently provides treated water to its retail customers and manufacturing in Denton County. The city also provides treated wastewater effluent to irrigation users in Denton County. In the past, the city has provided treated wastewater effluent to a steam electric power facility located near its wastewater treatment plant. This power plant is currently mothballed but could become operational at any time. For the purpose of this Plan, the demands for this steam electric facility have been included.

Denton's current sources of water supply include Ray Roberts Lake, Lewisville Lake, and direct and indirect reuse. Denton intends to purchase raw water from Dallas Water Utilities (DWU) in the future. Denton's available supply in Ray Roberts Lake and Lewisville Lake is the city's share of the firm yield of the reservoirs. The yields of the reservoirs decrease over time due to sedimentation. The currently available supplies are constrained by Denton's current treatment capacity. The City of Denton has two water treatment plants, the Ray Roberts WTP and the Lewisville WTP. The Ray Roberts WTP has a current peak capacity of 20 MGD and the Lewisville WTP has a peak capacity of 28 MGD. A peaking factor of 2 is assumed in the *Region C Regional Water Plan* for determining average-day treatment capacity constraints.

The proposed future strategies for Denton are to implement water conservation measures, expand water treatment plant capacity, and purchase additional water from DWU. A summary of the recommended water plan for Denton is shown on **Table 5E.98**.

Table 5E.98 Summary of Wholesale Water Provider and Customers – Denton

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Demands						
Denton	26,174	33,012	40,885	56,228	80,557	99,143
Manufacturing, Denton	*277*	*326*	*312*	*312*	*312*	*312*
Steam Electric, Denton	*173*	*173*	*173*	*173*	*173*	*173*
Irrigation, Denton	*265*	*265*	*265*	*265*	*265*	*265*
Total Projected Demands	***26,889***	***33,776***	***41,635***	***56,978***	***81,307***	***99,893***
Currently Available Supplies						
Lake Lewisville	7,817	7,817	7,817	7,817	7,698	7,550
Lake Ray Roberts	18,902	18,853	18,676	18,500	18,324	18,148
Direct Reuse for Steam Electric	173	173	173	173	173	173
Direct Reuse for Irrigation	265	265	265	265	265	265
Indirect Reuse	5,740	7,291	9,063	12,515	12,818	12,683
Total Currently Available Supplies (Limited by WTP Capacity)	***27,342***	***27,342***	***27,342***	***27,342***	***27,342***	***27,342***
Need (Demand - Supply)	***0***	***6,434***	***14,293***	***29,636***	***53,965***	***72,551***
Water Management Strategies						
Conservation (retail)	1,548	2,358	2,799	4,001	5,980	7,685
Conservation (wholesale)	0	0	0	0	0	0
DWU	0	0	2,842	13,707	36,049	53,389
Additional Denton Supplies	0	4,076	8,652	11,928	11,936	11,477
Additional Treatment[a]						
30 MGD WTP Expansion		*4,076*	*11,494*	*16,815*	*16,815*	*16,815*
20 MGD WTP Expansion			*0*	*8,821*	*11,210*	*11,210*
30 MGD WTP Expansion				*0*	*16,815*	*16,815*
25 MGD WTP Expansion					*3,145*	*14,013*
20 MGD WTP Expansion						*6,013*
Total Supplies from Strategies	***1,548***	***6,434***	***14,293***	***29,636***	***53,965***	***72,551***
Reserve (Shortage)	**2,001**	**0**	**0**	**0**	**0**	**0**

[a]This additional supply includes Denton's own supplies and purchased raw water from DWU that becomes available with additional treatment capacity.

Denton County Fresh Water Supply District 1-A

Denton County FWSD 1-A is located in southeastern Denton County. The District currently receives its water supply from UTRWD and from DWU through Lewisville. Water management strategies for Denton County FWSD 1-A include conservation, additional water from UTRWD, and additional water from Lewisville. **Table 5E.99** shows the projected population and demand, the current supplies, and the water management strategies for Denton County FWSD 1-A.

Table 5E.99 Summary of Water User Group – Denton County FWSD 1-A

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**14,000**	**25,021**	**30,000**	**30,000**	**30,000**	**30,000**
Projected Demands						
Municipal Demand	3,659	6,493	7,776	7,773	7,771	7,769
Total Projected Demands	***3,659***	***6,493***	***7,776***	***7,773***	***7,771***	***7,769***
Currently Available Supplies						
UTRWD	2,452	3,032	2,978	2,585	2,266	1,986
DWU through Lewisville	1,158	1,876	1,980	1,766	1,598	1,598
Total Currently Available Supplies	***3,610***	***4,908***	***4,958***	***4,351***	***3,864***	***3,584***
Need (Demand - Supply)	***49***	***1,585***	***2,818***	***3,422***	***3,907***	***4,185***
Water Management Strategies						
Water Conservation	200	416	486	511	537	562
UTRWD	0	1,039	1,906	2,281	2,581	2,842
DWU through Lewisville	0	130	426	630	789	781
Total Supplies from Strategies	***200***	***1,585***	***2,818***	***3,422***	***3,907***	***4,185***
Reserve (Shortage)	**151**	**0**	**0**	**0**	**0**	**0**

Denton County Fresh Water Supply District 7

Denton County FWSD 7 is located in south-central Denton County. The District currently receives all of its treated water supplies from UTRWD. Water management strategies for Denton County FWSD 7 include conservation and additional water from UTRWD. **Table 5E.100** shows the projected population and demand, the current supplies, and the water management strategies for Denton County FWSD 7.

Table 5E.100 Summary of Water User Group – Denton County FWSD 7

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**13,500**	**13,500**	**13,500**	**13,500**	**13,500**	**13,500**
Projected Demands						
Municipal Demand	3,418	3,405	3,403	3,401	3,399	3,397
Total Projected Demands	***3,418***	***3,405***	***3,403***	***3,401***	***3,399***	***3,397***
Currently Available Supplies						
UTRWD	3,418	2,373	1,946	1,688	1,479	1,296
Total Currently Available Supplies	***3,418***	***2,373***	***1,946***	***1,688***	***1,479***	***1,296***
Need (Demand - Supply)	***0***	***1,032***	***1,457***	***1,713***	***1,920***	***2,101***
Water Management Strategies						
Water Conservation	32	234	260	271	282	293
UTRWD	0	798	1,197	1,442	1,638	1,808
Total Supplies from Strategies	***32***	***1,032***	***1,457***	***1,713***	***1,920***	***2,101***
Reserve (Shortage)	**32**	**0**	**0**	**0**	**0**	**0**

Denton County Fresh Water Supply District 10

Denton County FWSD 10 is located in eastern Denton County. The District currently receives treated water supplies from Upper Trinity Regional Water District, with a portion of that supply being provided through Mustang SUD. Water management strategies for Denton County FWSD 10 include conservation, additional water from UTRWD through Mustang SUD, and additional water directly from Upper Trinity Regional Water District. **Table 5E.101** shows the projected population and demand, the current supplies, and the water management strategies for Denton County FWSD 10.

Table 5E.101 Summary of Water User Group – Denton County FWSD 10

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**7,884**	**16,750**	**19,770**	**19,770**	**19,770**	**19,770**
Projected Demands						
Municipal Demand	1,485	3,128	3,690	3,689	3,687	3,686
Total Projected Demands	***1,485***	***3,128***	***3,690***	***3,689***	***3,687***	***3,686***
Currently Available Supplies						
UTRWD through Mustang SUD	1,069	1,569	1,520	1,319	1,156	1,013
UTRWD	416	611	591	513	449	394
Total Currently Available Supplies	***1,485***	***2,180***	***2,111***	***1,832***	***1,605***	***1,407***
Need (Demand - Supply)	***0***	***948***	***1,579***	***1,857***	***2,082***	***2,279***
Water Management Strategies						
Water Conservation	12	208	278	290	302	315
UTRWD through Mustang SUD	0	533	937	1,128	1,282	1,414
UTRWD	0	207	364	439	498	550
Total Supplies from Strategies	***12***	***948***	***1,579***	***1,857***	***2,082***	***2,279***
Reserve (Shortage)	**12**	**0**	**0**	**0**	**0**	**0**

Denton County Irrigation

> ***The Texas Water Development Board classifies the use of potable water for golf course irrigation as a part of municipal use. The use of raw water or reuse of treated wastewater effluent for golf course irrigation is classified as irrigation use.***

Irrigation demand projections include the water necessary for irrigation activities, including field crops, orchards, pasture, turf grass, vineyards, golf courses irrigated by raw water, and limited aquaculture operations. Most irrigation in Collin County is for golf course irrigation. **Table 5E.102** shows the projected demand, the current supplies, and the water management strategies for Denton County Irrigation. As shown in **Table 5E.102**, direct reuse from several sources, DWU and groundwater (Woodbine and Trinity aquifers) all provide water for irrigation in Denton County. These sources are sufficient to meet the water needs for Denton County Irrigation. However, it is expected that irrigation demands will increase over time with growth and development of new golf courses. To meet these anticipated needs, water management strategies include additional direct reuse water from UTRWD and additional water from DWU.

Table 5E.102 Summary of Water User Group – Denton County Irrigation

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Demands						
Total Projected Demands	***3,003***	***3,003***	***3,003***	***3,003***	***3,003***	***3,003***
Currently Available Supplies						
DWU	1,516	1,443	1,307	1,205	1,148	1,103
Direct Reuse through Denton	265	265	265	265	265	265
Direct Reuse through Trophy Club MUD #1	800	800	800	800	800	800
Direct Reuse through UTRWD	897	897	897	897	897	897
Trinity Aquifer	400	400	400	400	400	400
Woodbine Aquifer	1,000	1,000	1,000	1,000	1,000	1,000
Total Currently Available Supplies	***4,878***	***4,805***	***4,669***	***4,567***	***4,510***	***4,465***
Need (Demand - Supply)	***0***	***0***	***0***	***0***	***0***	***0***
Water Management Strategies						
Direct Reuse Supplies from UTRWD	0	1,120	2,242	4,480	4,480	4,480
DWU	63	136	272	374	431	476
Total Supplies from Strategies	***63***	***1,256***	***2,514***	***4,854***	***4,911***	***4,956***
Reserve (Shortage)	**1,938**	**3,058**	**4,180**	**6,418**	**6,418**	**6,418**

Denton County Livestock

Livestock water use is defined as water used in the production of livestock, both for consumption and for cleaning and environmental purposes. **Table 5E.103** shows the projected demand, current supplies, and water management strategies for Denton County Livestock. The current supplies for Denton County Livestock are local surface water supplies and groundwater (Trinity and Woodbine aquifers). The sources are sufficient to meet future demands, and there are no water management strategies.

Table 5E.103 Summary of Water User Group – Denton County Livestock

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Demands						
Total Projected Demands	**769**	**769**	**769**	**769**	**769**	**769**
Currently Available Supplies						
Local Supplies	622	622	622	622	622	622
Trinity Aquifer	240	240	240	240	240	240
Woodbine Aquifer	490	490	490	490	490	490
Total Currently Available Supplies	***1,352***	***1,352***	***1,352***	***1,352***	***1,352***	***1,352***
Need (Demand - Supply)	***0***	***0***	***0***	***0***	***0***	***0***
Water Management Strategies						
None	0	0	0	0	0	0
Total Supplies from Strategies	***0***	***0***	***0***	***0***	***0***	***0***
Reserve (Shortage)	**583**	**583**	**583**	**583**	**583**	**583**

Denton County Manufacturing

Manufacturing water use is defined as water used to produce manufactured goods. **Table 5E.104** shows the projected demand, the current supplies, and the water management strategies for Denton County Manufacturing. Current supplies include UTRWD, Denton, DWU, NTMWD, and Northlake (TRWD). Additional supplies from all the current sources are the water management strategies to meet demands. Conservation was considered for this water user group, but it is not recommended because of the uncertainty in the ability to implement conservation measures given the multiple entities, facilities, and various manufacturing processes that make up this WUG.

Table 5E.104 Summary of Water User Group – Denton County Manufacturing

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Demands						
Total Projected Demands	**374**	**440**	**440**	**440**	**440**	**440**
Currently Available Supplies						
UTRWD	19	25	28	25	22	19
Lake Ray Roberts through Denton	161	146	107	71	49	40
Lake Lewisville through Denton	67	61	45	30	21	17
Indirect Reuse through Denton	49	56	52	47	34	27
DWU	25	24	21	20	19	18
NTMWD through Frisco	26	22	20	18	17	15
TRWD through Northlake	26	23	20	18	17	15
Total Currently Available Supplies	***373***	***357***	***293***	***229***	***179***	***151***
Need (Demand - Supply)	***1***	***83***	***147***	***211***	***261***	***289***
Water Management Strategies						
UTRWD	0	11	22	25	28	31
DWU	1	2	5	6	7	8
NTMWD	0	4	6	8	9	11
Denton	0	63	108	164	208	228
Northlake	0	3	6	8	9	11
Total Supplies from Strategies	***1***	***83***	***147***	***211***	***261***	***289***
Reserve (Shortage)	**0**	**0**	**0**	**0**	**0**	**0**

Denton County Mining

Mining water demand includes water used for oil and gas development, as well as extraction of coal and lignite, sand aggregate, and other resources. **Table 5E.105** shows the projected demand, the current supplies, and the water management strategies for Denton County Mining. Denton County Mining is supplied from UTRWD, local supplies, and groundwater (Trinity aquifer). The water management strategies for this water user group are additional supplies from UTRWD. Conservation was considered for this water user group, but it is not recommended because of the uncertainty in the ability to implement conservation measures given the multiple companies, industries, facilities, and types of processes that make up this WUG.

Table 5E.105 Summary of Water User Group – Denton County Mining

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Demands						
Total Projected Demands	**4,326**	**2,729**	**3,345**	**4,306**	**5,204**	**6,291**
Currently Available Supplies						
UTRWD through Multiple Suppliers	1,388	161	653	1,189	1,561	1,840
Local Supplies	1,366	1,366	1,366	1,366	1,366	1,366
Trinity Aquifer	1,572	1,572	1,572	1,572	1,572	1,572
Total Currently Available Supplies	***4,326***	***3,099***	***3,591***	***4,127***	***4,499***	***4,778***
Need (Demand - Supply)	***0***	***0***	***0***	***179***	***705***	***1,513***
Water Management Strategies						
UTRWD	0	71	489	1,207	2,027	2,982
Total Supplies from Strategies	***0***	***71***	***489***	***1,207***	***2,027***	***2,982***
Reserve (Shortage)	**0**	**441**	**735**	**1,028**	**1,322**	**1,469**

Denton County Other

Denton County Other includes individual domestic supplies and water suppliers too small to be classified as water user groups. The entities included under Denton County Other include individual properties as well as numerous Denton County Fresh Water Supply Districts not named as individual WUGs. The entities included under Denton County Other currently receive their water supply from UTRWD and groundwater (Trinity and Woodbine aquifers). Water management strategies for these entities include conservation, additional supplies from UTRWD, and new wells in the Trinity and Woodbine aquifers. **Table 5E.106** shows the projected population and demand, the current supplies, and the water management strategies for Denton County Other. The reserve shown is equivalent to the groundwater water management strategies. Although UTRWD includes all of Denton County Other's projected need within their own demand projections, some entities might wish to pursue groundwater instead.

Table 5E.106 Summary of Water User Group – Denton County Other

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**9,573**	**12,431**	**15,289**	**33,673**	**59,607**	**112,763**
Projected Demands						
Municipal Demand	1,199	1,537	1,878	4,108	7,241	13,671
Total Projected Demands	***1,199***	***1,537***	***1,878***	***4,108***	***7,241***	***13,671***
Currently Available Supplies						
UTRWD	899	804	912	1,734	2,678	4,643
Trinity Aquifer	1,004	1,004	1,004	1,004	1,004	1,004
Woodbine Aquifer	500	500	500	500	500	500
Total Currently Available Supplies	***2,403***	***2,308***	***2,416***	***3,238***	***4,182***	***6,147***
Need (Demand - Supply)	***0***	***0***	***0***	***870***	***3,059***	***7,524***
Water Management Strategies						
Water Conservation	10	18	19	55	121	273
UTRWD	0	331	665	1,703	3,356	7,251
New Well(s) in Trinity Aquifer	504	504	504	504	504	504
New Well(s) in Woodbine Aquifer	817	817	817	817	817	817
Total Supplies from Strategies	***1,331***	***1,670***	***2,005***	***3,079***	***4,798***	***8,845***
Reserve (Shortage)	**2,535**	**2,441**	**2,543**	**2,209**	**1,739**	**1,321**

Denton County Steam Electric Power

Steam electric power demands generally represent the cooling water needs during power generation. These demands do not include water that is used in cogeneration facilities (which is included in manufacturing projections), facilities which do not require water for production, or hydro-electric generation facilities. **Table 5E.107** shows the projected demand, the current supplies, and the water management strategies for Denton County Steam Electric Power. Denton County Steam Electric Power is currently supplied by direct reuse from Denton. This source is sufficient to meet future demands, and there are no water management strategies.

Table 5E.107 Summary of Water User Group – Denton County SEP

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Demands						
Total Projected Demands	**173**	**173**	**173**	**173**	**173**	**173**
Currently Available Supplies						
Direct Reuse through Denton	173	173	173	173	173	173
Total Currently Available Supplies	***173***	***173***	***173***	***173***	***173***	***173***
Need (Demand - Supply)	***0***	***0***	***0***	***0***	***0***	***0***
Water Management Strategies						
None	0	0	0	0	0	0
Total Supplies from Strategies	***0***	***0***	***0***	***0***	***0***	***0***
Reserve (Shortage)	**0**	**0**	**0**	**0**	**0**	**0**

East Fork Special Utility District

East Fork SUD is located in southern Collin County and extends into Dallas and Rockwall Counties. The water management strategies for East Fork SUD are described under Collin County in **Section 5E.1**.

Flower Mound

Flower Mound is located in southern Denton County with a small area in northern Tarrant County. The city obtains its water supply from DWU and UTRWD. Water management strategies for Flower Mound are conservation, additional water from DWU, additional water from UTRWD, and the Alliance Corridor Direct Reuse. The Alliance Corridor Direct Reuse Project involves a partnership of Fort Worth, TRA, and Hillwood Corporation to serve developments in the Alliance Airport area using effluent from TRA's Denton Creek Regional Wastewater System. **Table 5E.108** shows the projected population and demand, the current supplies, and the water management strategies for Flower Mound.

Table 5E.108 Summary of Water User Group – City of Flower Mound

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**75,555**	**84,470**	**86,270**	**88,270**	**90,270**	**93,000**
Projected Demands						
Municipal Demand	19,049	21,023	21,355	21,781	22,251	22,922
Total Projected Demands	***19,049***	***21,023***	***21,355***	***21,781***	***22,251***	***22,922***
Currently Available Supplies						
UTRWD	12,340	9,964	8,366	7,476	6,758	6,182
DWU	5,918	5,623	5,091	4,691	4,460	4,294
Total Currently Available Supplies	***18,258***	***15,587***	***13,457***	***12,167***	***11,218***	***10,476***
Need (Demand - Supply)	***791***	***5,436***	***7,898***	***9,614***	***11,033***	***12,446***
Water Management Strategies						
Water Conservation	791	1,034	1,015	1,106	1,206	1,318
UTRWD	0	3,615	5,553	6,798	7,908	9,063
DWU	0	231	774	1,154	1,363	1,509
Alliance Corridor Direct Reuse	0	556	556	556	556	556
Total Supplies from Strategies	***791***	***5,436***	***7,898***	***9,614***	***11,033***	***12,446***
Reserve (Shortage)	**0**	**0**	**0**	**0**	**0**	**0**

Fort Worth

Fort Worth is a major wholesale water provider. Plans for Fort Worth are presented in **Chapter 5D**.

Frisco

The City of Frisco is a rapidly growing community in west Collin County and east Denton County. Water supply strategies are discussed under Collin County in **Section 5E.1**.

Hackberry

Hackberry is located in eastern Denton County. The city receives treated water supplies from NTMWD. Water management strategies for Hackberry include conservation and additional water from NTMWD, including additional delivery infrastructure from NTWMD. **Table 5E.109** shows the projected population and demand, the current supplies, and the water management strategies for Hackberry.

Table 5E.109 Summary of Water User Group – City of Hackberry

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**1,870**	**2,415**	**3,065**	**3,792**	**4,642**	**5,612**
Projected Demands						
Municipal Demand	452	578	730	902	1,103	1,332
Total Projected Demands	***452***	***578***	***730***	***902***	***1,103***	***1,332***
Currently Available Supplies						
NTMWD	449	489	571	638	703	779
Total Currently Available Supplies	***449***	***489***	***571***	***638***	***703***	***779***
Need (Demand - Supply)	***3***	***89***	***159***	***264***	***400***	***553***
Water Management Strategies						
Water Conservation	27	42	53	67	86	111
NTMWD	0	47	106	197	314	442
Additional Delivery Infrastructure	*0*	*0*	*0*	*56*	*238*	*442*
Total Supplies from Strategies	***27***	***89***	***159***	***264***	***400***	***553***
Reserve (Shortage)	**24**	**0**	**0**	**0**	**0**	**0**

Highland Village

The City of Highland Village is located in southern Denton County. The city receives its water supply from groundwater and UTRWD. Water management strategies for Highland Village include conservation and additional water from UTRWD. **Table 5E.110** shows the projected population and demand, the current supplies, and the water management strategies for Highland Village.

Table 5E.110 Summary of Water User Group – City of Highland Village

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**17,119**	**18,020**	**18,020**	**18,020**	**18,020**	**18,020**
Projected Demands						
Municipal Demand	3,835	3,972	3,927	3,902	3,897	3,897
Total Projected Demands	***3,835***	***3,972***	***3,927***	***3,902***	***3,897***	***3,897***
Currently Available Supplies						
Trinity Aquifer	1,411	1,411	1,411	1,411	1,411	1,411
UTRWD	2,424	1,882	1,579	1,449	1,328	1,164
Total Currently Available Supplies	***3,835***	***3,293***	***2,990***	***2,860***	***2,739***	***2,575***
Need (Demand - Supply)	***0***	***679***	***937***	***1,042***	***1,158***	***1,322***
Water Management Strategies						
Water Conservation	260	450	472	482	495	508
UTRWD	0	370	746	988	1,229	1,380
Total Supplies from Strategies	***260***	***820***	***1,218***	***1,470***	***1,724***	***1,888***
Reserve (Shortage)	**260**	**141**	**281**	**428**	**566**	**566**

Justin

Justin is located in southwest Denton County. The city receives its water supply from groundwater (Trinity aquifer) and UTRWD. Water management strategies for Justin include conservation, new groundwater well(s), and additional water from UTRWD. **Table 5E.111** shows the projected population and demand, the current supplies, and the water management strategies for Justin.

Table 5E.111 Summary of Water User Group – City of Justin

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**4,766**	**8,532**	**12,298**	**12,298**	**12,298**	**12,298**
Projected Demands						
Municipal Demand	712	1,242	1,775	1,771	1,770	1,770
Total Projected Demands	***712***	***1,242***	***1,775***	***1,771***	***1,770***	***1,770***
Currently Available Supplies						
UTRWD	226	561	792	711	643	565
Trinity Aquifer	242	242	242	242	242	242
Total Currently Available Supplies	***468***	***803***	***1,034***	***953***	***885***	***807***
Need (Demand - Supply)	***244***	***439***	***741***	***818***	***885***	***963***
Water Management Strategies						
Water Conservation	10	20	20	28	34	39
New Well(s) in Trinity Aquifer	244	244	244	244	244	244
UTRWD	0	224	574	694	802	875
Total Supplies from Strategies	***254***	***488***	***838***	***966***	***1,080***	***1,158***
Reserve (Shortage)	**10**	**49**	**97**	**148**	**195**	**195**

Krum

The City of Krum is located in central Denton County. The city receives its water supply from groundwater (Trinity aquifer) and UTRWD. Water management strategies for Krum include conservation, additional water from UTRWD, and additional groundwater through new wells (Trinity aquifer). **Table 5E.112** shows the projected population and demand, the current supplies, and the water management strategies for Krum.

Table 5E.112 Summary of Water User Group – City of Krum

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**5,110**	**6,347**	**7,827**	**9,479**	**11,413**	**13,621**
Projected Demands						
Municipal Demand	1,135	1,391	1,703	2,055	2,471	2,947
Total Projected Demands	***1,135***	***1,391***	***1,703***	***2,055***	***2,471***	***2,947***
Currently Available Supplies						
UTRWD	485	561	644	708	795	852
Trinity Aquifer	448	448	448	448	448	448
Total Currently Available Supplies	***933***	***1,009***	***1,092***	***1,156***	***1,243***	***1,300***
Need (Demand - Supply)	***202***	***382***	***611***	***899***	***1,228***	***1,647***
Water Management Strategies						
Water Conservation	58	86	102	130	167	213
UTRWD	0	159	436	764	1,119	1,492
New Well(s) in Trinity Aquifer	202	202	202	202	202	202
Total Supplies from Strategies	***260***	***447***	***740***	***1,096***	***1,488***	***1,907***
Reserve (Shortage)	**58**	**65**	**129**	**197**	**260**	**260**

Lake Cities Municipal Utilities Authority

Lake Cities Municipal Utility Authority is located in Denton County and provides retail treated water service to Hickory Creek, Lake Dallas and Shady Shores. The MUA currently gets treated water supplies from UTRWD. The water management strategies include conservation and additional supplies from UTRWD. **Table 5E.113** shows the projected population and demand, the current supplies, and the water management strategies for Lake Cities MUA.

Table 5E.113 Summary of Water User Group – Lake Cities MUA

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**15,312**	**17,649**	**20,200**	**21,810**	**21,810**	**21,810**
Projected Demands						
Municipal Demand	2,153	2,435	2,758	2,962	2,956	2,955
Total Projected Demand	***2,153***	***2,435***	***2,758***	***2,962***	***2,956***	***2,955***
Currently Available Supplies						
UTRWD	2,153	1,697	1,577	1,470	1,287	1,128
Total Currently Available Supplies	***2,153***	***1,697***	***1,577***	***1,470***	***1,287***	***1,128***
Need (Demand – Supply)	***0***	***738***	***1,181***	***1,492***	***1,669***	***1,827***
Water Management Strategies						
Water Conservation	21	34	35	46	56	66
UTRWD	0	704	1,146	1,446	1,613	1,761
Total Supplies from Strategies	***21***	***738***	***1,181***	***1,492***	***1,669***	***1,827***
Reserve (Shortage)	**21**	**0**	**0**	**0**	**0**	**0**

Lewisville

Lewisville is located in southern Denton County, with a small area in Dallas County. Lewisville provides wholesale supplies to a portion of Denton County Freshwater Supply District 1A. Lewisville receives raw water supplies from DWU and operates its own water treatment plant. Its water management strategies include conservation and additional water from DWU with future treatment plant expansions. **Table 5E.114** shows the projected population and demand, the current supplies, and the water management strategies for Lewisville.

Table 5E.114 Summary of Water User Group – City of Lewisville

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**107,326**	**121,923**	**139,367**	**158,855**	**177,354**	**177,354**
Projected Demands						
Municipal Demand	20,142	22,440	25,329	28,688	31,973	31,969
Denton County FWSD 1-A	*1,207*	*2,143*	*2,566*	*2,565*	*2,564*	*2,564*
Total Projected Demands	***21,349***	***24,583***	***27,895***	***31,253***	***34,537***	***34,533***
Currently Available Supplies						
DWU	20,491	21,523	21,523	21,523	21,523	21,523
Total Currently Available Supplies	***20,491***	***21,523***	***21,523***	***21,523***	***21,523***	***21,523***
Need (Demand - Supply)	***858***	***3,060***	***6,372***	***9,730***	***13,014***	***13,010***
Water Management Strategies						
Water Conservation	924	1,267	1,397	1,669	1,957	2,071
DWU	0	1,793	4,975	8,061	11,057	10,939
6 MGD WTP Expansion – 1		*896*	*3,363*	*3,363*	*3,363*	*3,363*
6 MGD WTP Expansion – 2			*715*	*3,363*	*3,363*	*3,363*
6.5 MGD WTP Expansion				*438*	*3,434*	*3,316*
Total Supplies from Strategies	***924***	***3,060***	***6,372***	***9,730***	***13,014***	***13,010***
Reserve (Shortage)	**66**	**0**	**0**	**0**	**0**	**0**

Little Elm

The Town of Little Elm is located in eastern Denton County. The town receives treated water supplies from NTMWD. Water management strategies for Little Elm include conservation and additional water from NTMWD. **Table 5E.115** shows the projected population and demand, the current supplies, and the water management strategies for Little Elm.

Table 5E.115 Summary of Water User Group – Town of Little Elm

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**29,627**	**33,557**	**33,557**	**33,557**	**33,557**	**33,557**
Projected Demands						
Municipal Demand	4,075	4,564	4,550	4,538	4,528	4,528
Total Projected Demands	***4,075***	***4,564***	***4,550***	***4,538***	***4,528***	***4,528***
Currently Available Supplies						
NTMWD	4,047	3,808	3,502	3,183	2,886	2,648
Total Currently Available Supplies	***4,047***	***3,808***	***3,502***	***3,183***	***2,886***	***2,648***
Need (Demand - Supply)	***28***	***756***	***1,048***	***1,355***	***1,642***	***1,880***
Water Management Strategies						
Water Conservation	201	238	231	245	259	275
NTMWD	0	518	817	1,110	1,383	1,605
Total Supplies from Strategies	***201***	***756***	***1,048***	***1,355***	***1,642***	***1,880***
Reserve (Shortage)	**173**	**0**	**0**	**0**	**0**	**0**

Mountain Spring Water Supply Corporation

Mountain Spring WSC is located in northern Denton County and southern Cooke County. Since most of the population is in Cooke County, its water supply plans are discussed in **Section 5E.2** under Cooke County.

Mustang Special Utility District

Mustang Special Utility District (SUD) is a wholesale water provider (WWP) and a customer of Upper Trinity Regional Water District (UTRWD). The SUD provides retail water service to customers within its service area. In addition to providing retail service to its customers, Mustang SUD is the contract operator for the WUGs of Paloma Creek North, Paloma Creek South, and Denton County FWSD No. 10. These special districts own their respective retail water systems and are wholesale water customers of UTRWD. Mustang SUD simply provides the general operational functions (billing, operations and maintenance, etc). Over time, the special districts will transfer ownership of the retail systems to Mustang SUD, but the demand projections in this plan have maintained separate amounts for each of the special districts.

The SUD is currently supplied from the Trinity and Woodbine aquifers and treated surface water purchased from UTRWD. The recommended water management strategies for Mustang SUD include implementing water conservation measures and purchasing additional water from the UTRWD. A summary of the recommended water plan for Mustang SUD is shown on **Table 5E.116**.

Table 5E.116 Summary of Wholesale Water Provider and Customers – Mustang SUD

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Demands						
Mustang SUD	4,588	8,400	12,241	16,089	19,945	23,803
Denton County FWSD No. 10	*1,069*	*2,252*	*2,657*	*2,656*	*2,655*	*2,654*
Paloma Creek North	*1,700*	*2,303*	*2,302*	*2,301*	*2,299*	*2,298*
Paloma Creek South	*854*	*1,165*	*1,165*	*1,165*	*1,165*	*1,165*
Total Projected Demands	***8,211***	***14,120***	***18,365***	***22,211***	***26,064***	***29,920***
Currently Available Supplies						
Groundwater	1,675	1,675	1,675	1,675	1,675	1,675
UTRWD	6,536	8,790	9,734	10,447	10,907	11,036
Total Currently Available Supplies	***8,211***	***10,465***	***11,409***	***12,122***	***12,582***	***12,711***
Need (Demand - Supply)	***0***	***3,655***	***6,956***	***10,089***	***13,482***	***17,209***
Water Management Strategies						
Conservation (retail)	44	119	153	255	382	536
Conservation (wholesale)	31	381	460	481	499	521
UTRWD	0	3,322	6,676	9,860	13,272	16,823
Total Supplies from Strategies	***75***	***3,822***	***7,289***	***10,596***	***14,153***	***17,880***
Reserve (Shortage)	**75**	**167**	**333**	**507**	**671**	**671**

Northlake

Northlake is located in southwestern Denton County and is supplied from groundwater (Woodbine aquifer), Fort Worth (TRWD), and UTRWD. Northlake supplies a small amount of Denton County Manufacturing demand. Water management strategies for Northlake include conservation and additional water from Fort Worth and UTRWD. **Table 5E.117** shows the projected population and demand, the current supplies, and the water management strategies for Northlake.

Table 5E.117 Summary of Water User Group – City of Northlake

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**9,500**	**22,000**	**31,010**	**43,005**	**55,000**	**55,000**
Projected Demands						
Municipal Demand	1,923	4,402	6,197	8,591	10,986	10,985
Manufacturing, Denton	*26*	*26*	*26*	*26*	*26*	*26*
Total Projected Demands	***1,949***	***4,428***	***6,223***	***8,617***	***11,012***	***11,011***
Currently Available Supplies						
Woodbine Aquifer	95	95	95	95	95	95
TRWD through Fort Worth	635	1,288	1,610	2,015	2,374	2,196
UTRWD	1,219	2,001	2,326	2,812	3,160	2,771
Total Currently Available Supplies	***1,949***	***3,384***	***4,031***	***4,922***	***5,629***	***5,062***
Need (Demand - Supply)	***0***	***1,044***	***2,192***	***3,695***	***5,383***	***5,949***
Water Management Strategies						
Water Conservation	16	198	294	437	595	632
Fort Worth	0	108	352	697	1,084	1,249
UTRWD	0	738	1,546	2,561	3,704	4,068
Total Supplies from Strategies	***16***	***1,044***	***2,192***	***3,695***	***5,383***	***5,949***
Reserve (Shortage)	**16**	**0**	**0**	**0**	**0**	**0**

Paloma Creek North

Paloma Creek North is located in Denton County. The entity currently gets its water supply from UTRWD through Mustang SUD. The water management strategies include conservation and additional supplies from UTRWD. **Table 5E.118** shows the projected population and demand, the current supplies, and the water management strategies for Paloma Creek North.

Table 5E.118 Summary of Water User Group – Paloma Creek North

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**8,194**	**11,174**	**11,174**	**11,174**	**11,174**	**11,174**
Projected Demands						
Municipal Demand	1,700	2,303	2,302	2,301	2,299	2,298
Total Projected Demand	***1,700***	***2,303***	***2,302***	***2,301***	***2,299***	***2,298***
Currently Available Supplies						
UTRWD through Mustang SUD	1,700	1,605	1,316	1,142	1,001	877
Total Currently Available Supplies	***1,700***	***1,605***	***1,316***	***1,142***	***1,001***	***877***
Need (Demand – Supply)	***0***	***698***	***986***	***1,159***	***1,298***	***1,421***
Water Management Strategies						
Water Conservation	15	154	173	181	188	196
UTRWD through Mustang SUD	0	544	813	978	1,110	1,225
Total Supplies from Strategies	***15***	***698***	***986***	***1,159***	***1,298***	***1,421***
Reserve (Shortage)	**15**	**0**	**0**	**0**	**0**	**0**

Paloma Creek South

Paloma Creek South is located in Denton County. The entity currently gets its water supply from UTRWD through Mustang SUD. The water management strategies include conservation and additional supplies from UTRWD. **Table 5E.119** shows the projected population and demand, the current supplies, and the water management strategies for Paloma Creek South.

Table 5E.119 Summary of Water User Group - Paloma Creek South

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**4,154**	**5,665**	**5,665**	**5,665**	**5,665**	**5,665**
Projected Demands						
Municipal Demand	854	1,165	1,165	1,165	1,165	1,165
Total Projected Demand	***854***	***1,165***	***1,165***	***1,165***	***1,165***	***1,165***
Currently Available Supplies						
UTRWD through Mustang SUD	854	812	666	578	507	445
Total Currently Available Supplies	***854***	***812***	***666***	***578***	***507***	***445***
Need (Demand – Supply)	***0***	***353***	***499***	***587***	***658***	***720***
Water Management Strategies						
Water Conservation	7	77	87	91	94	98
UTRWD through Mustang SUD	0	276	412	496	564	622
Total Supplies from Strategies	***7***	***353***	***499***	***587***	***658***	***720***
Reserve (Shortage)	**7**	**0**	**0**	**0**	**0**	**0**

Pilot Point

Pilot Point is located in northern Denton County. The city receives its water supply from groundwater (Trinity aquifer). Water management strategies for Pilot Point include conservation, additional water from Trinity Aquifer (new wells), supply from the GTUA Regional Water System through Sherman, establishing a direct connection to UTRWD and purchasing water from UTRWD. **Table 5E.120** shows the projected population and demand, the current supplies, and the water management strategies for Pilot Point.

Table 5E.120 Summary of Water User Group – City of Pilot Point

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**6,500**	**8,000**	**11,000**	**15,000**	**20,000**	**27,000**
Projected Demands						
Municipal Demand	891	1,069	1,449	1,964	2,614	3,527
Total Projected Demands	***891***	***1,069***	***1,449***	***1,964***	***2,614***	***3,527***
Currently Available Supplies						
Trinity Aquifer	571	571	571	571	571	571
Total Currently Available Supplies	***571***	***571***	***571***	***571***	***571***	***571***
Need (Demand - Supply)	***320***	***498***	***878***	***1,393***	***2,043***	***2,956***
Water Management Strategies						
Water Conservation	7	12	16	31	51	80
New Well(s) in Trinity Aquifer	313	313	313	313	313	313
GTUA Regional Water System	0	975	1,256	1,256	1,256	1,256
Connect to UTRWD	0	301	760	1,347	2,059	2,943
Total Supplies from Strategies	***320***	***1,601***	***2,345***	***2,947***	***3,679***	***4,592***
Reserve (Shortage)	**0**	**1,103**	**1,467**	**1,554**	**1,636**	**1,636**

Plano

Plano is located in southwest Collin County and southeast Denton County. The water supply plans for Plano are discussed under Collin County in **Section 5E.1**.

Ponder

Ponder is located in western Denton County. The city receives its water supply from groundwater (Trinity aquifer). Water management strategies for Ponder include conservation, establishing a direct connection to UTRWD and purchasing water from UTRWD. **Table 5E.121** shows the projected population and demand, the current supplies, and the water management strategies for Ponder.

Table 5E.121 Summary of Water User Group – City of Ponder

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**3,117**	**4,305**	**5,725**	**7,311**	**9,169**	**11,289**
Projected Demands						
Municipal Demand	388	524	690	878	1,099	1,352
Total Projected Demands	***388***	***524***	***690***	***878***	***1,099***	***1,352***
Currently Available Supplies						
Trinity Aquifer	385	385	385	385	385	385
Total Currently Available Supplies	***385***	***385***	***385***	***385***	***385***	***385***
Need (Demand - Supply)	***3***	***139***	***305***	***493***	***714***	***967***
Water Management Strategies						
Water Conservation	3	6	7	12	18	29
Connect to UTRWD	0	171	374	597	850	1,092
Total Supplies from Strategies	***3***	***177***	***381***	***609***	***868***	***1,121***
Reserve (Shortage)	**0**	**38**	**76**	**116**	**154**	**154**

Prosper

The City of Prosper is located in western Collin County and eastern Denton County. Water management strategies for Prosper are described under Collin County in **Section 5E.1**.

Providence Village Water Control and Improvement District (WCID)

Providence Village WCID is located in central/eastern Denton County, and receives treated water supplies from UTRWD. Water management strategies for Providence Village WCID include conservation and additional water from UTRWD. **Table 5E.122** shows the projected population and demand, the current supplies, and the water management strategies for Providence Village WCID.

Table 5E.122 Summary of Water User Group – Providence Village WCID

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**7,235**	**7,235**	**7,235**	**7,235**	**7,235**	**7,235**
Projected Demands						
Municipal Demand	938	930	929	927	925	925
Total Projected Demands	***938***	***930***	***929***	***927***	***925***	***925***
Currently Available Supplies						
UTRWD	938	648	531	460	403	353
Total Currently Available Supplies	***938***	***648***	***531***	***460***	***403***	***353***
Need (Demand - Supply)	***0***	***282***	***398***	***467***	***522***	***572***
Water Management Strategies						
Water Conservation	8	11	9	12	15	19
UTRWD	0	271	389	455	507	553
Total Supplies from Strategies	***8***	***282***	***398***	***467***	***522***	***572***
Reserve (Shortage)	**8**	**0**	**0**	**0**	**0**	**0**

Roanoke

Roanoke is located in southwestern Denton County. The city receives treated water supplies from Fort Worth (TRWD). Water management strategies for Roanoke include conservation and additional water from Fort Worth. **Table 5E.123** shows the projected population and demand, the current supplies, and the water management strategies for Roanoke.

Table 5E.123 Summary of Water User Group – City of Roanoke

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**7,949**	**9,956**	**11,961**	**11,961**	**11,961**	**11,961**
Projected Demands						
Municipal Demand	2,255	2,797	3,345	3,339	3,337	3,336
Total Projected Demands	***2,255***	***2,797***	***3,345***	***3,339***	***3,337***	***3,336***
Currently Available Supplies						
TRWD through Fort Worth	2,255	2,424	2,539	2,354	2,167	2,004
Total Currently Available Supplies	***2,255***	***2,424***	***2,539***	***2,354***	***2,167***	***2,004***
Need (Demand - Supply)	***0***	***373***	***806***	***985***	***1,170***	***1,332***
Water Management Strategies						
Water Conservation	19	150	192	204	215	226
TRWD through Fort Worth	0	229	614	781	955	1,106
Total Supplies from Strategies	***19***	***379***	***806***	***985***	***1,170***	***1,332***
Reserve (Shortage)	**19**	**6**	**0**	**0**	**0**	**0**

Sanger

Sanger is located in northern Denton County. The city gets its water supply from groundwater (Trinity aquifer) and from Upper Trinity Regional Water District. Water management strategies for Sanger include conservation and additional water from UTRWD. **Table 5E.124** shows the projected population and demand, the current supplies, and the water management strategies for Sanger.

Table 5E.124 Summary of Water User Group – City of Sanger

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**8,190**	**10,164**	**12,522**	**15,158**	**18,243**	**21,765**
Projected Demands						
Municipal Demand	1,140	1,377	1,672	2,010	2,414	2,878
Total Projected Demands	***1,140***	***1,377***	***1,672***	***2,010***	***2,414***	***2,878***
Currently Available Supplies						
Trinity Aquifer	825	825	825	825	825	825
UTRWD	315	441	551	634	733	794
Total Currently Available Supplies	***1,140***	***1,266***	***1,376***	***1,459***	***1,558***	***1,619***
Need (Demand - Supply)	***0***	***111***	***296***	***551***	***856***	***1,259***
Water Management Strategies						
Water Conservation	44	59	71	92	118	151
UTRWD	0	134	389	709	1,068	1,438
Total Supplies from Strategies	***44***	***193***	***460***	***801***	***1,186***	***1,589***
Reserve (Shortage)	**44**	**82**	**164**	**250**	**330**	**330**

Southlake

Southlake is located in northwestern Tarrant County, with some area in southern Denton County. Water management strategies for Southlake are described under Tarrant County in **Section 5E.15.**

The Colony

The Colony is located in southeastern Denton County. The city receives its water supply from groundwater (Trinity aquifer), DWU, and Plano (NTWMD). Water management strategies for The Colony include conservation, additional water from DWU, and additional water from Plano. **Table 5E.125** shows the projected population and demand, the current supplies, and the water management strategies for The Colony.

Table 5E.125 Summary of Water User Group – City of The Colony

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**53,029**	**58,000**	**62,000**	**67,600**	**67,600**	**67,600**
Projected Demands						
Municipal Demand	8,071	8,631	9,105	9,857	9,844	9,841
Total Projected Demands	***8,071***	***8,631***	***9,105***	***9,857***	***9,844***	***9,841***
Currently Available Supplies						
Trinity Aquifer	1,015	1,015	1,015	1,015	1,015	1,015
DWU	5,621	5,126	4,871	5,062	4,809	4,625
NTMWD through Plano	1,194	1,689	1,718	1,556	1,402	1,286
Total Currently Available Supplies	***7,830***	***7,830***	***7,604***	***7,633***	***7,226***	***6,926***
Need (Demand - Supply)	***241***	***801***	***1,501***	***2,224***	***2,618***	***2,915***
Water Management Strategies						
Water Conservation	124	175	169	214	247	280
DWU	132	361	896	1,419	1,635	1,791
NTMWD through Plano	0	265	436	591	736	844
Total Supplies from Strategies	***256***	***801***	***1,501***	***2,224***	***2,618***	***2,915***
Reserve (Shortage)	**15**	**0**	**0**	**0**	**0**	**0**

Trophy Club Municipal Utility District #1

Trophy Club MUD #1 provides retail service to the city of Trophy Club in southern Denton County. The MUD currently receives its water supply from groundwater (Trinity aquifer) and Fort Worth (TRWD). Water management strategies for Trophy Club include conservation and additional water from Fort Worth. **Table 5E.126** shows the projected population and demand, the current supplies, and the water management strategies for Trophy Club.

Table 5E.126 Summary of Water User Group – Trophy Club MUD #1

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**12,750**	**12,750**	**12,750**	**12,750**	**12,750**	**12,750**
Projected Demands						
Municipal Demand	4,863	4,829	4,811	4,802	4,798	4,797
Total Projected Demands	***4,863***	***4,829***	***4,811***	***4,802***	***4,798***	***4,797***
Currently Available Supplies						
Trinity Aquifer	555	555	555	555	555	555
TRWD through Fort Worth	4,308	3,766	3,326	2,995	2,754	2,549
Total Currently Available Supplies	***4,863***	***4,321***	***3,881***	***3,550***	***3,309***	***3,104***
Need (Demand - Supply)	***0***	***508***	***930***	***1,252***	***1,489***	***1,693***
Water Management Strategies						
Water Conservation	241	286	277	293	309	325
Fort Worth	0	222	653	959	1,180	1,368
Total Supplies from Strategies	***241***	***508***	***930***	***1,252***	***1,489***	***1,693***
Reserve (Shortage)	**241**	**0**	**0**	**0**	**0**	**0**

Westlake

Westlake is located in northern Tarrant County and southern Denton County. Since most of the population is in Tarrant County, its water supply plans are discussed under Tarrant County in **Section 5E.15.**

5E.4.2 Summary of Costs for Denton County

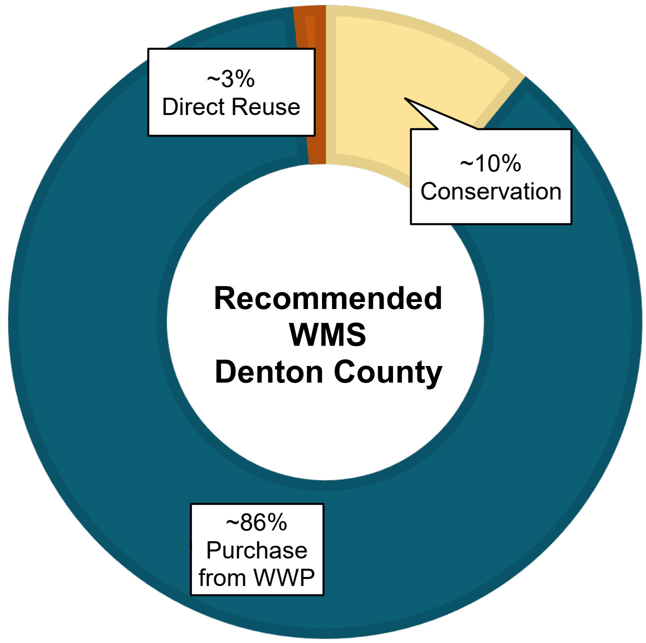


Table 5E.127 summarizes the costs of the water management strategies recommended for the WUGs and WWPs who have the majority of their demand located in Denton County. Total quantities from **Table 5E.127** will not necessarily match total county demands. This is due mainly to water users whose sum of strategies results in a reserve as well as due to water users located in multiple counties (or wholesale water providers who develop strategies and then sell water to users in other counties). Quantities from infrastructure projects needed to deliver and/or treat water (shown in *gray italics*) are not included since the supplies are associated with other strategies. To avoid double-counting quantities of supplies, the quantities in gray italics are **not** included in the total.

The majority of the future supplies needed to meet demands within Denton County are projected to come through purchases from wholesale water providers. Other strategies include conservation, direct reuse and groundwater.

Table 5E.128 summarizes the recommended water management strategies within Denton County individually. Alternative strategies are also included. More detailed cost estimates are located in **Appendix H.**

Table 5E.127 Summary of Recommended Water Management Strategies for Denton County

Type of Strategy	Quantity (Ac-Ft/Yr)	Capital Costs
Conservation[a]	18,829	$18,815,508
Purchase from WWP	151,416	$0
Additional Infrastructure	*76,411*	*$731,276,000*
Direct Reuse	2,796	$1,638,000
Groundwater	2,984	$33,374,000
Total	**176,025**	**$785,103,508**

[a]The conservation quantities represent the sum of the individual water user groups who have the majority of their service areas located in the county, not the total conservation in the county.

Table 5E.128 *Costs for Recommended Water Management Strategies for Denton County*

WWP or WUG	Strategy	Online by:	Quantity (Ac-Ft/Yr)[b]	Capital Costs[c]	Unit Cost ($/1000 gal) With Debt Service	Unit Cost ($/1000 gal) After Debt Service	Table
WWPs							
Denton	Conservation (retail)	2020	7,685	$4,636,961	$1.16	$0.41	H.11
	Conservation (wholesale)	2020	Included with WUGs.				
	DWU	2040	53,389	$0.00	$4.05	$4.05	None
	30 MGD WTP Expansion	*2030*	*16,815*	*$150,569,000*	*$3.32*	*$1.39*	*H.13*
	20 MGD WTP Expansion	*2040*	*11,210*	*$104,736,000*	*$3.46*	*$1.45*	*H.13*
	30 MGD WTP Expansion	*2050*	*16,815*	*$150,569,000*	*$3.32*	*$1.39*	*H.13*
	25 MGD WTP Expansion	*2060*	*14,013*	*$127,652,000*	*$3.38*	*$1.41*	*H.13*
	20 MGD WTP Expansion	*2070*	*6,013*	*$104,736,000*	*$3.46*	*$1.45*	*H.13*
Mustang SUD	Conservation (retail)	2020	536	$674,034	$3.31	$0.00	H.11
	Conservation (wholesale)	2020	Included with WUGs.				
	UTRWD	2030	16,823	$0	$3.00	$3.00	None
WUGs							
Argyle WSC	Conservation	2020	478	$310,357	$2.68	$1.20	H.11
	UTRWD	2030	1,937	$0	$3.00	$3.00	None
	New Well(s) in Trinity Aquifer	2020	250	$2,955,000	$4.03	$1.48	H.14
Aubrey	Conservation	2020	32	$47,811	$2.06	$0.12	H.11
	Connect to UTRWD	2030	1,151	$0	$3.00	$3.00	None
Black Rock WSC	Conservation	2020	46	$17,593	$1.90	$0.78	H.11
	New Well(s) in Trinity Aquifer	2050	154	$2,259,000	$5.20	$2.03	H.14
Bolivar WSC[a]	Conservation	2020	51	$51,327	$1.11	$0.00	H.11
	New Well(s) in Trinity Aquifer	2020	250	$2,955,000	$4.03	$1.48	H.14
	Connect to UTRWD	2030	1,700	$0	$3.00	$3.00	None
	Connect to Gainesville	2030	146	$0	$4.52	$4.52	None
Carrollton[a]	Conservation	2020	1,537	$2,096,860	$0.64	$0.21	H.11

WWP or WUG	Strategy	Online by:	Quantity (Ac-Ft/Yr)[b]	Capital Costs[c]	Unit Cost ($/1000 gal) With Debt Service	Unit Cost ($/1000 gal) After Debt Service	Table
	DWU	2030	5,549	$0	$4.05	$4.05	None
Celina[a]	Conservation	See Collin County.					
	Other WMSs						
Coppell[a]	Conservation	See Dallas County.					
	DWU						
Corinth	Conservation	2020	413	$335,099	$1.76	$0.80	H.11
	UTRWD	2030	2,638	$0	$3.00	$3.00	None
Cross Timbers WSC	Conservation	2020	156	$160,638	$2.67	$0.66	H.11
	New Well(s) in Trinity Aquifer	2020	250	$2,955,000	$4.03	$1.48	H.14
	UTRWD	2030	943	$0	$3.00	$3.00	None
	Additional Delivery Infrastructure	*2030*	*943*	*$8,374,000*	*$2.12*	*$0.20*	*H.101*
Dallas[a]	Conservation	See DWU in **Chapter 5D**.					
	Other WMSs						
Denton County FWSD 1-A	Conservation	2020	562	$565,854	$1.18	$0.38	H.11
	UTRWD	2030	2,842	$0	$3.00	$3.00	None
	DWU through Lewisville	2030	789	$0	$3.00	$3.00	None
Denton County FWSD 10	Conservation	2020	315	$967,900	$17.42	$0.77	H.11
	UTRWD through Mustang	2030	1,414	$0	$3.00	$3.00	None
	UTRWD	2030	550	$0	$3.00	$3.00	None
Denton County FWSD 7	Conservation	2020	293	$178,667	$1.21	$0.56	H.11
	UTRWD	2030	1,808	$0	$3.00	$3.00	None
Flower Mound	Conservation	2020	1,318	$3,422,971	$1.19	$0.18	H.11
	DWU	2030	1,509	$0	$4.05	$4.05	None
	UTRWD	2030	9,063	$0	$3.00	$3.00	None
	Direct reuse	2030	556	$1,638,000	$0.72	$0.08	H.61
Fort Worth[a]	Conservation	See Fort Worth in **Chapter 5D**.					
	Other WMSs						
Frisco[a]	Conservation	See Collin County.					
	Direct reuse						
	NTMWD						
Hackberry	Conservation	2020	111	$15,159	$1.21	$0.63	H.11
	NTMWD	2030	442	$0	$2.78	$2.78	None

WWP or WUG	Strategy	Online by:	Quantity (Ac-Ft/Yr)[b]	Capital Costs[c]	Unit Cost ($/1000 gal)		Table
					With Debt Service	After Debt Service	
	Additional Delivery Infrastructure	*2050*	*442*	*$2,182,000*	*$1.30*	*$0.23*	*H.102*
Highland Village	Conservation	2020	508	$637,042	$0.53	$0.33	H.11
	UTRWD	2030	1,380	$0	$3.00	$3.00	None
Justin	Conservation	2020	39	$68,869	$1.49	$0.10	H.11
	UTRWD	2030	875	$0	$3.00	$3.00	None
	New Well(s) in Trinity Aquifer	2020	244	$2,377,000	$3.54	$1.44	H.14
Krum	Conservation	2020	213	$118,516	$1.34	$0.63	H.11
	UTRWD	2030	1,492	$0	$3.00	$3.00	None
	New Well(s) in Trinity Aquifer	2020	202	$1,805,000	$3.38	$1.45	H.14
Lake Cities MUA	Conservation	2020	66	$316,302	$3.25	$0.00	H.11
	UTRWD	2030	1,761	$0	$3.00	$3.00	None
Lewisville[a]	Conservation	2020	1,886	$1,437,939	$0.84	$0.34	H.11
	DWU	2030	11,057	$0	$4.05	$4.05	None
	6 MGD WTP Expansion-1	*2030*	*3,363*	*$36,568,000*	*$4.11*	*$1.76*	*H.13*
	6 MGD WTP Expansion-2	*2040*	*3,363*	*$22,264,000*	*$2.53*	*$1.10*	*H.13*
	6.5 MGD WTP Expansion	*2050*	*3,434*	*$23,626,000*	*$2.46*	*$1.06*	*H.13*
Little Elm	Conservation	2020	275	$361,083	$0.39	$0.00	H.11
	NTMWD	2030	1,605	$0	$2.78	$2.78	None
Mountain Springs WSC[a]	Conservation	See Cooke County.					
	Connect to Gainesville						
Northlake	Conservation	2020	632	$147,109	$1.99	$0.28	H.11
	TRWD through Fort Worth	2030	1,249	$0	$1.63	$1.63	None
	UTRWD	2030	4,068	$0	$3.00	$3.00	None
Paloma Creek North CRU	Conservation	2020	196	$78,917	$1.14	$0.73	H.11
	UTRWD through Mustang SUD	2030	1,225	$0	$3.00	$3.00	None
Paloma Creek South CRU	Conservation	2020	98	$37,878	$1.17	$0.72	H.11
	UTRWD through Mustang SUD	2030	622	$0	$3.00	$3.00	None
Pilot Point	Conservation	2020	80	$104,529	$3.22	$0.11	H.11

WWP or WUG	Strategy	Online by:	Quantity (Ac-Ft/Yr)[b]	Capital Costs[c]	Unit Cost ($/1000 gal) With Debt Service	Unit Cost ($/1000 gal) After Debt Service	Table
	New Well(s) in Trinity Aquifer	2020	313	$4,127,000	$4.41	$1.56	H.14
	GTUA Regional Water System	2030	1,256	$0	$5.72	$3.06	H.72
	Connect to UTRWD	2030	2,943	$0	$3.00	$3.00	None
Plano[a]	Conservation	See Collin County.					
	NTMWD						
Ponder	Conservation	2020	29	$11,730	$0.84	$0.07	H.11
	UTRWD	2030	1,092	$0	$3.00	$3.00	None
Prosper[a]	Conservation	See Collin County.					
	NTMWD						
Providence Village WCID	Conservation	2020	19	$133,467	$3.60	$0.00	H.11
	UTRWD	2030	553	$0	$3.00	$3.00	None
Roanoke	Conservation	2020	226	$108,611	$1.23	$0.35	H.11
	TRWD through Fort Worth	2030	1,106	$0	$1.63	$1.63	None
Sanger	Conservation	2020	151	$64,721	$0.32	$0.05	H.11
	UTRWD	2030	1,438	$0	$3.00	$3.00	None
Southlake[a]	Conservation	See Tarrant County.					
	TRWD through Fort Worth						
The Colony	Conservation	2020	280	$616,616	$1.07	$0.00	H.11
	DWU	2020	1,791	$0	$4.05	$4.05	None
	NTMWD through Plano	2030	844	$0	$2.78	$2.78	None
Trophy Club MUD 1	Conservation	2020	325	$1,042,999	$0.93	$0.08	H.11
	Fort Worth	2030	1,368	$0	$1.63	$1.63	None
Westlake[a]	Conservation	See Tarrant County.					
	TRWD through Fort Worth						
County Other and Non-Municipal							
County Other, Denton	Conservation	2020	273	$47,949	$1.04	$0.00	H.11
	UTRWD	2030	7,251	$0	$3.00	$3.00	None
	New Well(s) in Woodbine Aquifer	2020	817	$8,554,000	$3.69	$1.43	H.14
	New Well(s) in Trinity Aquifer	2020	504	$5,387,000	$3.80	$1.49	H.14

WWP or WUG	Strategy	Online by:	Quantity (Ac-Ft/Yr)[b]	Capital Costs[c]	Unit Cost ($/1000 gal) With Debt Service	Unit Cost ($/1000 gal) After Debt Service	Table
Irrigation, Denton	DWU	2020	476	$0	$4.05	$4.05	None
	Direct Reuse from UTRWD	2030	2,240	See UTRWD in **Chapter 5D**.			
Livestock, Denton	None	None.					
Manufacturing, Denton	Denton	2020	228	$0	$3.00	$3.00	None
	DWU	2020	8	$0	$4.05	$4.05	None
	NTMWD	2030	11	$0	$2.78	$2.78	None
	UTRWD	2030	31	$0	$3.00	$3.00	None
	Northlake	2030	11	$0	$3.00	$3.00	None
Mining, Denton	UTRWD	2030	2,982	$0	$3.00	$3.00	None
Steam Electric Power, Denton	None	None					

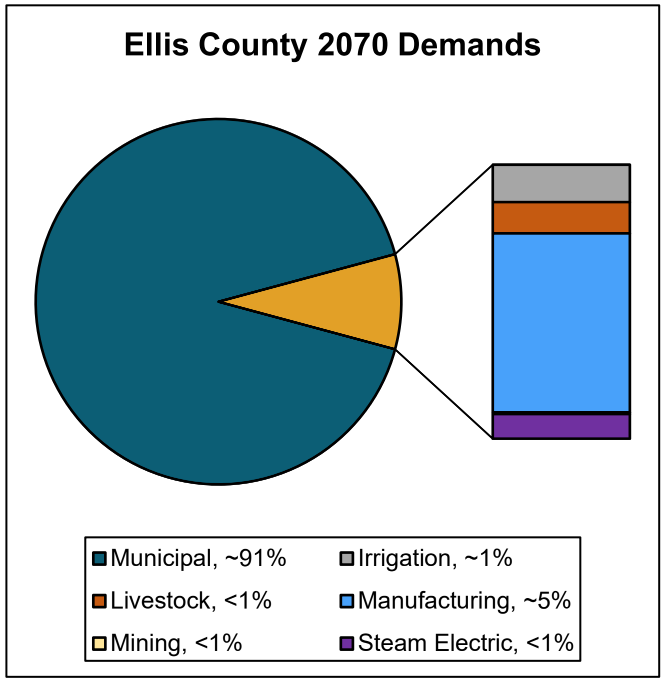
[a]*Water User Groups extend into more than one county*
[b]*Quantities listed are for the WUG only. They do not include the WUG's customers.*
[c]*Purchases from wholesale water providers that require no new infrastructure have no capital costs. The unit costs shown in the table represent the cost to purchase water from the WWP.*

5E.5 Ellis County

Ellis County is located in the south central portion of Region C. **Figure 5E.10** shows water service areas in Ellis County**.**

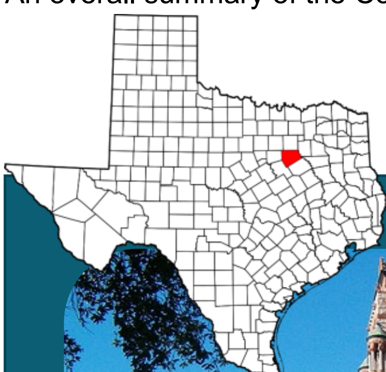
Ellis County's population is projected to more than triple between 2020 and 2070.

Demands for the County are predominately municipal. The second and third largest demands are manufacturing and irrigation. Livestock, mining, and steam electric each account for less than 1 percent of the overall demand for the County each.



Historical groundwater use for Ellis County is higher than can be shown as available in the *Region C Regional Water Plan* due to the MAG limitations. The limited availability of groundwater within the county as quantified by the modeled available groundwater causes unmet needs for Ellis County Irrigation and requires other water users to show less groundwater usage than planned for. Tarrant Regional Water District (TRWD) and Dallas Water Utility (DWU) are among the major water providers that provide surface water supplies to Ellis County.

An overall summary of the County's projections is shown in **Table 5E.129**, and water management strategies for individual WWPs and WUGs are discussed on the following pages.



Ellis County Quick Facts

2010 Population: 149,610

Projected 2070 Population: 670,845

Projected 2070 Demand: 107 MGD

County Seat: Waxahachie

Economy: Cement, steel production; warehousing and distribution; government/services

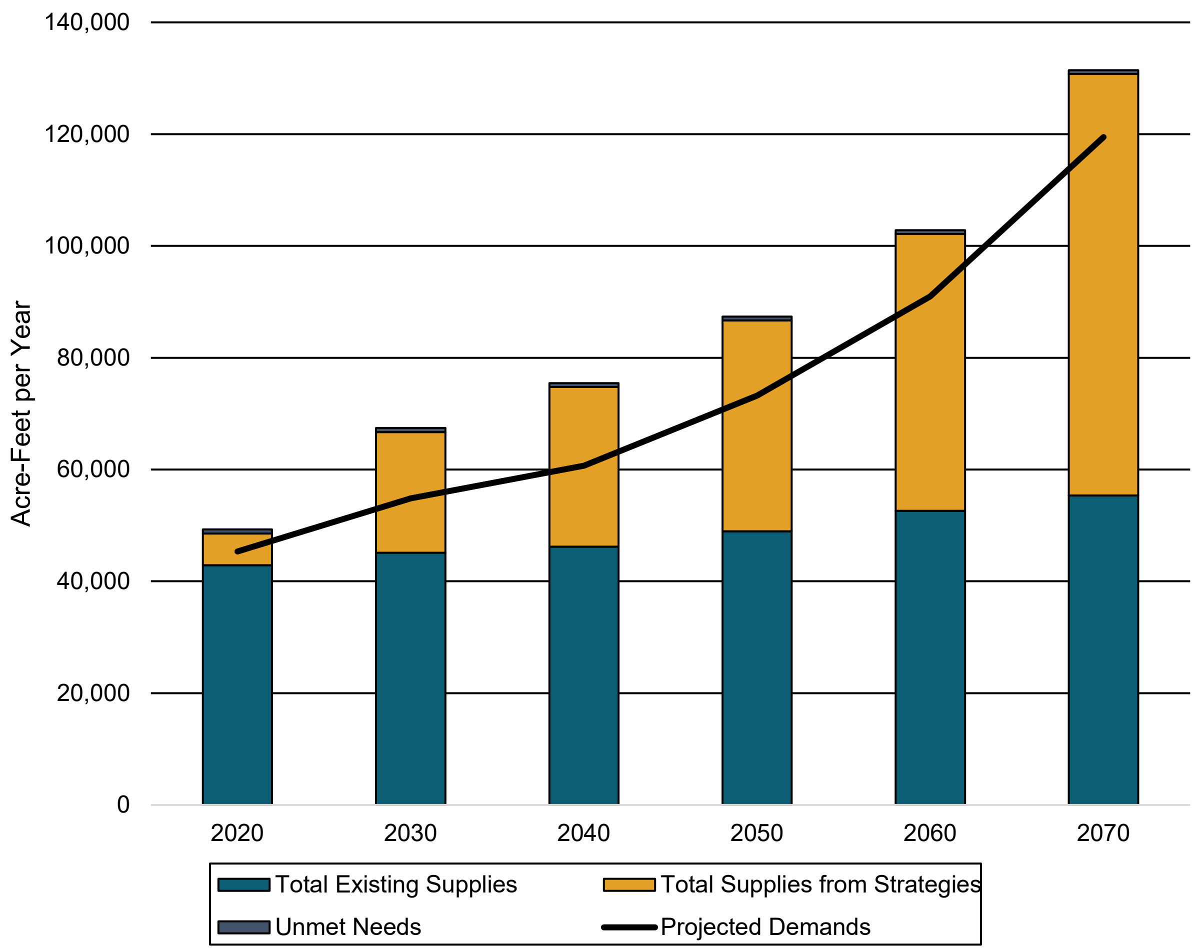
River Basins: Trinity (100%)

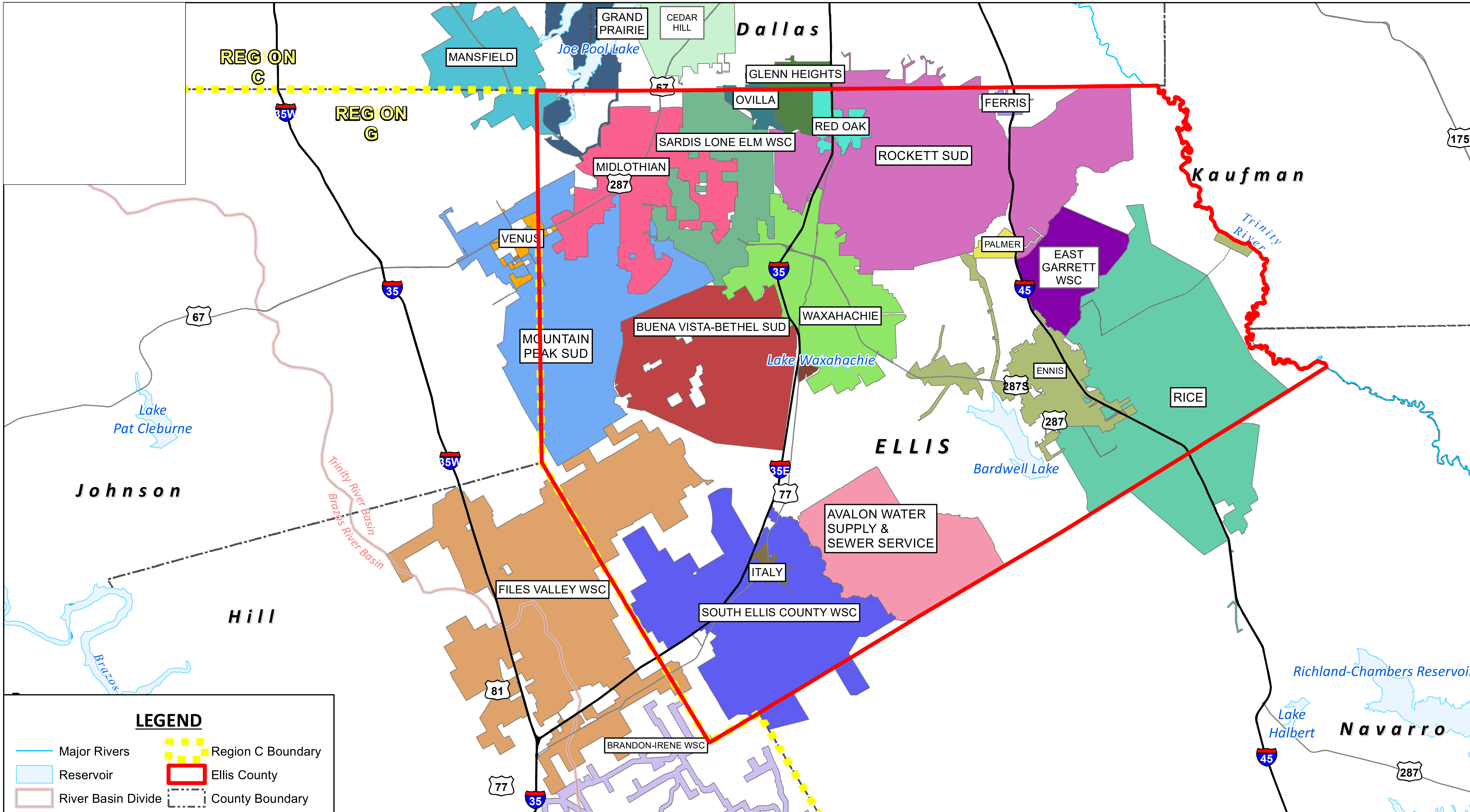
Table 5E.129 Summary of Ellis County

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**191,638**	**241,778**	**280,745**	**360,584**	**479,939**	**670,845**
Projected Demands	**45,341**	**54,859**	**60,713**	**73,196**	**90,964**	**119,473**
Municipal	35,588	44,355	50,592	63,116	80,925	109,461
Irrigation	1,367	1,367	1,367	1,367	1,367	1,367
Livestock	1,140	1,140	1,140	1,140	1,140	1,140
Manufacturing	5,414	6,549	6,549	6,549	6,549	6,549
Mining	931	547	164	123	82	55
Steam Electric	901	901	901	901	901	901
Total Existing Supplies	**42,877**	**45,139**	**46,178**	**48,972**	**52,619**	**55,377**
Need (Demand - Supply)	**2,464**	**9,720**	**14,535**	**24,224**	**38,345**	**64,096**
Total Supplies from Strategies	**5,676**	**21,568**	**28,588**	**37,692**	**49,505**	**75,362**
Reserve (Shortage)	**3,212**	**11,848**	**14,053**	**13,468**	**11,160**	**11,266**
Unmet Needs[a]	**747**	**729**	**711**	**701**	**692**	**684**

[a]Unmet needs are for Ellis County Irrigation

Figure 5E.9 Summary of Ellis County





REGION C
Water Planning for North Texas

2021 Region C Water Plan
ELLIS COUNTY, TEXAS
FIGURE 5E.10

1 in = 5 miles
0 1 2 4 6
Miles

Data Source(s): ESRI, USGS, TNRIS

TR116409: H:\WR_PLANNING\1 - Working\5E_County WMS\Ellis.mxd

5E.5.1 Wholesale Water Provider and Water User Groups

Water management strategies for Ellis County wholesale water providers (WWPs) and water user groups (WUGs) are discussed below (in alphabetical order). The costs for recommended and alternative water management strategies are presented in **Section 5E.5.2. Appendix H** has more detailed cost estimates.

Avalon Water Supply and Sewer Service

Avalon Water Supply and Sewer Service is located in Ellis County. The Water Supply and Sewer Service gets its water supply from the Trinity aquifer. The water management strategies include conservation and TRWD supplies through TRA through Waxahachie. **Table 5E.130** shows the projected population and demand, the current supplies, and the water management strategies for Avalon Water Supply and Sewer Service.

Table 5E.130 Summary of Water User Group – Avalon Water Supply and Sewer Service

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**1,182**	**1,435**	**1,764**	**2,405**	**3,242**	**4,537**
Projected Demands						
Municipal Demand	149	175	211	286	384	538
Total Projected Demand	***149***	***175***	***211***	***286***	***384***	***538***
Currently Available Supplies						
Trinity Aquifer	149	149	149	149	149	149
Total Currently Available Supplies	***149***	***149***	***149***	***149***	***149***	***149***
Need (Demand – Supply)	***0***	***26***	***62***	***137***	***235***	***389***
Water Management Strategies						
Water Conservation	1	2	2	4	6	11
Waxahachie (from TRA from TRWD)	0	24	60	133	229	378
Total Supplies from Strategies	***1***	***26***	***62***	***137***	***235***	***389***
Reserve (Shortage)	**1**	**0**	**0**	**0**	**0**	**0**

Brandon-Irene Water Supply Corporation

Brandon-Irene Water Supply Corporation is located in Ellis, Hill and Navarro Counties. The majority of the WSC's service area is in Hill County in the Brazos G region, so the water supply plans would be covered in more detail in the Brazos G Regional Water Plan. Plans for Region C are covered under Navarro County in **Section 5E.12.**

Buena Vista-Bethel Special Utility District

Buena Vista-Bethel SUD is located in central and western Ellis County. The SUD gets its water supply from groundwater (Trinity aquifer), water purchased from TRWD through Waxahachie, and treated water purchased directly from Waxahachie. Water management strategies for Buena Vista-Bethel SUD include conservation and additional water from Waxahachie. **Table 5E.131** shows the projected population and demand, the current supplies, and the water management strategies for Buena Vista-Bethel SUD.

Table 5E.131 Summary of Water User Group – Buena Vista-Bethel SUD

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**4,619**	**5,617**	**6,605**	**8,465**	**12,169**	**16,217**
Projected Demands						
Municipal Demand	1,282	1,541	1,800	2,299	3,300	4,395
Total Projected Demands	***1,282***	***1,541***	***1,800***	***2,299***	***3,300***	***4,395***
Currently Available Supplies						
Trinity Aquifer	50	50	100	100	100	100
TRWD through Waxahachie	32	178	242	413	795	838
Lake Bardwell through Waxahachie	489	510	462	460	498	511
Lake Waxahachie through Waxahachie	317	329	300	301	330	341
Lake Waxahachie Reuse through Waxahachie	394	474	535	622	710	769
Total Currently Available Supplies	***1,282***	***1,541***	***1,639***	***1,896***	***2,433***	***2,559***
Need (Demand - Supply)	***0***	***0***	***161***	***403***	***867***	***1,836***
Water Management Strategies						
Water Conservation	10	18	94	146	224	319
Waxahachie	0	0	67	257	643	1,517
Total Supplies from Strategies	***10***	***18***	***161***	***403***	***867***	***1,836***
Reserve (Shortage)	**10**	**18**	**0**	**0**	**0**	**0**

Cedar Hill

The City of Cedar Hill is located in southwest Dallas County, with a small part in Ellis County. The city's water supply plans are discussed under Dallas County in **Section 5E.3**.

East Garrett Water Supply Corporation

East Garrett Water Supply Corporation is located in Ellis County. The WSC gets its water supply from Bardwell Lake and TRWD through Ennis. The water management strategies include conservation and additional supplies from Ennis. **Table 5E.132** shows the projected population and demand, the current supplies, and the water management strategies for East Garrett WSC.

Table 5E.132 Summary of Water User Group – East Garrett WSC

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**1,490**	**1,896**	**2,368**	**3,051**	**3,743**	**8,933**
Projected Demands						
Municipal Demand	246	306	377	483	592	1,411
Total Projected Demand	***246***	***306***	***377***	***483***	***592***	***1,411***
Currently Available Supplies						
Bardwell Lake through Ennis	0	29	72	119	103	160
TRWD through Ennis	246	273	284	251	186	250
Total Currently Available Supplies	***246***	***302***	***356***	***370***	***289***	***410***
Need (Demand – Supply)	***0***	***4***	***21***	***113***	***303***	***1,001***
Water Management Strategies						
Water Conservation	2	17	23	30	41	99
Ennis (TRWD)	0	0	0	83	262	902
Total Supplies from Strategies	***2***	***17***	***23***	***113***	***303***	***1,001***
Reserve (Shortage)	**2**	**13**	**2**	**0**	**0**	**0**

Ellis County Irrigation

Irrigation demand projections include the water necessary for irrigation activities, including field crops, orchards, pasture, turf grass, vineyards, golf courses irrigated by raw water, and limited aquaculture operations. The water supplies for Ellis County Irrigation are local supplies and groundwater (Trinity and Woodbine aquifers).

It is expected that the projected needs will continue to be met through groundwater supplies. Historical groundwater use for Ellis County Irrigation is higher than can be shown as available in the *Region C Regional Water Plan* due to the MAG limitations. The limited availability of groundwater within the county as quantified by the modeled available groundwater causes unmet needs for this WUG. **Table 5E.133** shows the projected demand, the current supplies, and the water management strategies for Ellis County Irrigation.

Table 5E.133 Summary of Water User Group – Ellis County Irrigation

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Demands						
Total Projected Demands	**1,367**	**1,367**	**1,367**	**1,367**	**1,367**	**1,367**
Currently Available Supplies						
Local Supplies	3	3	3	3	3	3
Trinity Aquifer	469	469	469	469	469	469
Woodbine Aquifer	147	147	147	147	147	147
Total Currently Available Supplies	***619***	***619***	***619***	***619***	***619***	***619***
Need (Demand - Supply)	***748***	***748***	***748***	***748***	***748***	***748***
Water Management Strategies						
Conservation	1	19	37	47	56	64
Total Supplies from Strategies	***1***	***19***	***37***	***47***	***56***	***64***
Reserve (Shortage)	**(747)**	**(729)**	**(711)**	**(701)**	**(692)**	**(684)**

Ellis County Livestock

Livestock water use is defined as water used in the production of livestock, both for consumption and for cleaning and environmental purposes. The water supplies for Ellis County Livestock are local surface water supplies and groundwater (Woodbine aquifer). This supply is sufficient to meet demand, and there are no water management strategies. **Table 5E.134** shows the projected demand, current supplies, and water management strategies for Ellis County Livestock.

Table 5E.134 Summary of Water User Group – Ellis County Livestock

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Demands						
Total Projected Demands	**1,140**	**1,140**	**1,140**	**1,140**	**1,140**	**1,140**
Currently Available Supplies						
Local Supplies	1,112	1,112	1,112	1,112	1,112	1,112
Woodbine Aquifer	28	28	28	28	28	28
Total Currently Available Supplies	***1,140***	***1,140***	***1,140***	***1,140***	***1,140***	***1,140***
Need (Demand - Supply)	***0***	***0***	***0***	***0***	***0***	***0***
Water Management Strategies						
None	0	0	0	0	0	0
Total Supplies from Strategies	***0***	***0***	***0***	***0***	***0***	***0***
Reserve (Shortage)	**0**	**0**	**0**	**0**	**0**	**0**

Ellis County Manufacturing

Manufacturing water use is defined as water used to produce manufactured goods. The water supplies for Ellis County Manufacturing includes groundwater (Trinity and Woodbine aquifers) and water purchased from Ennis, Midlothian and Waxahachie. Water management strategies for Ellis County Manufacturing include additional water from Midlothian, Ennis, and Waxahachie. **Table 5E.135** shows the projected demand, the current supplies, and the water management strategies for Ellis County Manufacturing. Conservation was considered for this water user group, but it is not recommended because of the uncertainty in the ability to implement conservation measures given the multiple entities, facilities, and various manufacturing processes that make up this WUG.

Table 5E.135 Summary of Water User Group – Ellis County Manufacturing

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Demands						
Total Projected Demands	**5,414**	**6,549**	**6,549**	**6,549**	**6,549**	**6,549**
Currently Available Supplies						
Trinity Aquifer	546	763	763	763	763	763
Woodbine Aquifer	270	270	270	270	270	270
TRWD through Midlothian	1,793	1,323	1,126	1,160	1,105	1,032
TRWD through TRA through Ennis	0	63	125	161	114	74
Lake Bardwell through Ennis	541	583	494	340	206	116
TRWD through Waxahachie	61	269	319	421	557	437
Lake Waxahachie through Waxahachie	576	494	396	307	231	178
Lake Bardwell through Waxahachie	889	767	610	469	349	267
Reuse through Waxahachie	716	712	705	634	498	402
Total Currently Available Supplies	***5,392***	***5,244***	***4,808***	***4,525***	***4,093***	***3,539***
Need (Demand - Supply)	***22***	***1,305***	***1,741***	***2,024***	***2,456***	***3,010***
Water Management Strategies						
Midlothian	373	1,297	1,494	1,460	1,515	1,588
Ennis	0	8	35	153	334	464
Waxahachie	0	0	212	411	607	958
Total Supplies from Strategies	***373***	***1,305***	***1,741***	***2,024***	***2,456***	***3,010***
Reserve (Shortage)	**351**	**0**	**0**	**0**	**0**	**0**

Ellis County Mining

Mining water demand includes water used for oil and gas development, as well as extraction of coal and lignite, sand aggregate, and other resources. The water supply for Ellis County Mining is groundwater (Trinity aquifer). This supply is sufficient to meet demand, and there are no water management strategies. **Table 5E.136** shows the projected demand, the current supplies to meet such demand for Ellis County Mining.

Table 5E.136 Summary of Water User Group – Ellis County Mining

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Demands						
Total Projected Demands	**931**	**547**	**164**	**123**	**82**	**55**
Currently Available Supplies						
Trinity Aquifer	931	547	164	123	82	55
Total Currently Available Supplies	***931***	***547***	***164***	***123***	***82***	***55***
Need (Demand - Supply)	***0***	***0***	***0***	***0***	***0***	***0***
Water Management Strategies						
None	0	0	0	0	0	0
Total Supplies from Strategies	***0***	***0***	***0***	***0***	***0***	***0***
Reserve (Shortage)	**0**	**0**	**0**	**0**	**0**	**0**

Ellis County Other

Ellis County Other includes individual domestic supplies and water suppliers too small to be classified as water user groups. The water supplies for Ellis County Other are groundwater (Trinity aquifer) and water purchased from Ennis, Waxahachie, Rockett SUD, Mountain Peak SUD, Files Valley WSC, and Grand Prairie. Water management strategies for Ellis County Other include conservation and purchasing additional water from Rockett SUD, Waxahachie, Ennis, and Grand Prairie. **Table 5E.137** shows the projected population and demand, the current supplies, and the water management strategies for Ellis County Other.

Table 5E.137 Summary of Water User Group – Ellis County Other

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**3,392**	**2,819**	**4,119**	**13,317**	**42,127**	**86,838**
Projected Demands						
Municipal Demand	414	330	467	1,473	4,649	9,576
Total Projected Demands	***414***	***330***	***467***	***1,473***	***4,649***	***9,576***
Currently Available Supplies						
Lake Bardwell through Ennis	8	15	35	99	190	221
TRWD through Ennis	0	2	9	47	105	141
TRWD through Waxahachie	0	2	7	56	446	678
Lake Waxahachie through Waxahachie	5	6	9	41	185	276
Lake Bardwell through Waxahachie	8	9	14	63	279	413
Reuse through Waxahachie	7	8	16	85	398	622
TRWD through Rockett SUD	76	55	71	152	439	967
Midlothian through Rockett SUD	39	24	30	61	176	387
Lake Aquilla through Files Valley WSC	84	84	84	84	84	84
TRWD through Grand Prairie	385	394	261	210	181	158
Trinity Aquifer	89	89	89	89	809	811
Total Currently Available Supplies	***701***	***688***	***625***	***987***	***3,292***	***4,758***
Need (Demand - Supply)	***0***	***0***	***0***	***486***	***1,357***	***4,818***
Water Management Strategies						
Water Conservation	3	4	5	20	77	192
Rockett SUD	0	7	18	98	581	2,379
Waxahachie	0	0	4	51	455	1,415
Ennis	0	0	3	43	299	858
Grand Prairie	61	499	632	676	701	721
Total Supplies from Strategies	***64***	***510***	***662***	***888***	***2,113***	***5,565***
Reserve (Shortage)	**351**	**868**	**820**	**402**	**756**	**747**

Ellis County Steam Electric Power

Steam electric power demands generally represent the cooling water needs during power generation. These demands do not include water that is used in cogeneration facilities (which is included in manufacturing projections), facilities which do not require water for production, or hydro-electric generation facilities. The water supplies for Ellis County Steam Electric Power are purchased from Ennis and Midlothian. Water management strategies for Ellis County Steam Electric Power includes purchasing additional water from Midlothian. Conservation was a considered strategy for this water user group, but not recommended because the steam electric demand projections themselves considered items such as future efficiency programs. **Table 5E.138** shows the projected demand, the current supplies, and the water management strategies for Ellis County Steam Electric Power.

Table 5E.138 Summary of Water User Group – Ellis County SEP

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Demands						
Total Projected Demands	**901**	**901**	**901**	**901**	**901**	**901**
Currently Available Supplies						
Direct Reuse through Ennis	621	621	621	621	621	621
TRWD through Midlothian	232	141	120	124	118	110
Total Currently Available Supplies	***853***	***762***	***741***	***745***	***739***	***731***
Need (Demand - Supply)	***48***	***139***	***160***	***156***	***162***	***170***
Water Management Strategies						
Midlothian	48	139	160	156	162	170
Total Supplies from Strategies	***48***	***139***	***160***	***156***	***162***	***170***
Reserve (Shortage)	**0**	**0**	**0**	**0**	**0**	**0**

Ennis

Ennis is located in southeastern Ellis County. Ennis is a wholesale water provider (WWP). Current water supplies for the City of Ennis are Bardwell Lake (Trinity River Authority) and water purchased from Tarrant Regional Water District. Ennis' contract amount from Bardwell Lake is 5,200 acre-feet per year. A few customers within the City of Ennis are provided retail water service by Rockett Special Utility District.

Ennis provides treated water to all or portions of East Garrett WSC, Ellis County Other, Rice Water Supply and Sewer Service, and Ellis County Manufacturing. Ennis also sells reclaimed water in Ellis County for steam electric power purposes. Ennis is expected to continue providing water supplies to these customers through the planning period. The recommended water management strategies for Ennis include implementing water conservation measures, developing indirect reuse from Bardwell Lake, purchasing additional TRWD raw water through TRA, and expanding treatment capacity.

Table 5E.139 shows the projected demand, the current supplies, and the water management strategies for Ennis.

Table 5E.139 Summary of Wholesale Water Provider and Customers – City of Ennis

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Demands						
Ennis	4,026	4,625	5,234	7,401	11,887	19,761
East Garrett WSC	246	306	377	483	592	1,411
County Other, Ellis	8	17	47	191	604	1,245
Rice Water Supply and Sewer Service	50	50	50	50	50	50
Manufacturing, Ellis	541	654	654	654	654	654
Steam Electric Power, Ellis	621	621	621	621	621	621
Total Projected Demands	***5,492***	***6,273***	***6,983***	***9,400***	***14,408***	***23,742***
Currently Available Supplies						
Bardwell Lake[a]	5,200	5,035	4,801	4,567	4,333	4,100
Direct Reuse for Steam Electric	621	621	621	621	621	621
Availability from TRWD (TRA)[b]	0	544	1,220	2,813	3,738	3,988
Total Currently Available Supplies with Expected Use from TRWD Limited by Water Treatment Plant Capacity	***5,821***	***6,200***	***6,642***	***7,347***	***7,347***	***7,347***
Need (Demand - Supply)	***0***	***73***	***341***	***2,053***	***7,061***	***16,395***
Water Management Strategies						
Conservation (retail)	38	348	636	928	1,536	2,623
Conservation (wholesale)	2	25	23	32	51	124
Currently Available TRWD Supply Previously Unused Due to WTP Capacity Limit	0	0	0	654	1,345	1,362
Indirect Reuse	0	0	2,025	3,109	3,696	3,696
Additional TRWD	0	0	0	215	433	8,590
Plant Expansions:						
6 MGD WTP Expansion	*0*	*0*	*0*	*3,363*	*3,363*	*3,363*
8 MGD WTP Expansion	*0*	*0*	*0*	*0*	*1,820*	*4,484*
16 MGD WTP Expansion	*0*	*0*	*0*	*0*	*0*	*5,510*
Total Supplies from Strategies	***40***	***373***	***2,684***	***4,938***	***7,061***	***16,395***
Reserve (Shortage)	**369**	**300**	**2,343**	**2,885**	**0**	**0**

[a]Ennis has a contract with the Trinity River Authority for 5,200 acre-feet per year. The yield of Bardwell Lake is decreasing.

[b]Ennis has a contract for up to 3,988 acre-feet per year from TRWD (TRA). Availability from TRWD is limited based off of Ennis's remaining needs and TRWD's current supplies.

Ferris

Ferris is located in northern Ellis and southern Dallas Counties. Ferris gets treated water supplies from Rockett SUD. Water management strategies for Ferris include conservation, purchasing additional water from Rockett SUD, and additional delivery infrastructure from Rockett SUD. **Table 5E.140** shows the projected population and demand, the current supplies, and the water management strategies for Ferris.

Table 5E.140 Summary of Water User Group – City of Ferris

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**2,950**	**5,200**	**7,200**	**8,200**	**9,200**	**10,200**
Projected Demands						
Municipal Demand	461	789	1,071	1,209	1,351	1,496
Total Projected Demands	***461***	***789***	***1,071***	***1,209***	***1,351***	***1,496***
Currently Available Supplies						
TRWD through Rockett SUD	304	504	630	585	488	379
Midlothian through Rockett SUD	157	217	265	234	195	152
Total Currently Available Supplies	***461***	***721***	***895***	***819***	***683***	***531***
Need (Demand - Supply)	***0***	***68***	***176***	***390***	***668***	***965***
Water Management Strategies						
Water Conservation	4	9	11	16	23	32
Rockett SUD	0	59	165	374	645	933
Additional Delivery Infrastructure from Rockett SUD	*0*	*0*	*0*	*77*	*309*	*554*
Total Supplies from Strategies	***4***	***68***	***176***	***390***	***668***	***965***
Reserve (Shortage)	**4**	**0**	**0**	**0**	**0**	**0**

Files Valley Water Supply Corporation

Files Valley WSC is located in western Ellis County in Region C and eastern Hill County in Region G. Files Valley provides water to residents in its service area as well as Ellis County Other. The WSC purchases treated water from the Aquilla Water Supply District, which is located in Hill County in the Brazos G region. Water management strategies for the WSC in Region C includes conservation and connecting to and purchasing water from Waxahachie. **Table 5E.141** shows the projected population and demand, the current supplies, and the water management strategies for Files Valley WSC.

Table 5E.141 Summary of Water User Group – Files Valley Water Supply Corporation

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**3,293**	**3,663**	**4,011**	**4,473**	**4,910**	**5,367**
Projected Demands						
Municipal Demand	505	545	585	646	707	773
County Other, Ellis	*84*	*84*	*84*	*84*	*84*	*84*
Total Projected Demands	***589***	***629***	***669***	***730***	***791***	***857***
Currently Available Supplies						
Lake Aquilla through Aquilla WSC	1,226	1,373	1,373	1,373	1,373	1,298
Total Currently Available Supplies	***1,226***	***1,373***	***1,373***	***1,373***	***1,373***	***1,298***
Need (Demand - Supply)	***0***	***0***	***0***	***0***	***0***	***0***
Water Management Strategies						
Water Conservation	1	2	2	3	5	7
Connect to Waxahachie	0	53	57	62	66	70
Total Supplies from Strategies	***1***	***55***	***59***	***65***	***71***	***77***
Reserve (Shortage)	**638**	**799**	**763**	**708**	**653**	**518**

Glenn Heights

Glenn Heights is located in southern Dallas and northern Ellis Counties. The city's water supply plans are discussed under Dallas County in **Section 5E.3**.

Grand Prairie

Grand Prairie is located in western Dallas County, eastern Tarrant County, and northwestern Ellis County. The city is a wholesale water provider, and there is a discussion of Grand Prairie's water supply plans in **Section 5E.3.**

Hilco United Services

Hilco United Services is located in Ellis County and gets its water supply from the Woodbine aquifer. This source is sufficient to meet future demands, and there are no water management strategies for this water user group. **Table 5E.142** shows the projected population and demand, the current supplies, and the water management strategies for Hilco United Services. The demands and supplies shown are only for the portion of the WUG located within Region C. Information on the Region D portion can be found in the Northeast Texas Regional Water Plan.

Table 5E.142 Summary of Water User Group – Hilco United Services (Region C Only)

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**149**	**160**	**167**	**183**	**192**	**202**
Projected Demands						
Municipal Demand	21	22	22	24	25	26
Total Projected Demand	***21***	***22***	***22***	***24***	***25***	***26***
Currently Available Supplies						
Woodbine Aquifer	21	22	22	24	25	26
Total Currently Available Supplies	***21***	***22***	***22***	***24***	***25***	***26***
Need (Demand – Supply)	***0***	***0***	***0***	***0***	***0***	***0***
Water Management Strategies						
None	0	0	0	0	0	0
Total Supplies from Strategies	***0***	***0***	***0***	***0***	***0***	***0***
Reserve (Shortage)	**0**	**0**	**0**	**0**	**0**	**0**

Italy

Italy is located in southwest Ellis County. The water supplies for the city is groundwater (Trinity and Woodbine aquifers). Water management strategies include conservation and connecting to and purchasing water from Waxahachie. **Table 5E.143** shows the projected population and demand, the current supplies, and the water management strategies for Italy.

Table 5E.143 Summary of Water User Group – City of Italy

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**2,365**	**3,011**	**3,757**	**4,842**	**6,132**	**8,176**
Projected Demands						
Municipal Demand	311	380	464	592	749	997
Total Projected Demands	***311***	***380***	***464***	***592***	***749***	***997***
Currently Available Supplies						
Trinity Aquifer	113	11	11	11	11	11
Woodbine Aquifer	198	198	198	198	198	198
Total Currently Available Supplies	***311***	***209***	***209***	***209***	***209***	***209***
Need (Demand - Supply)	***0***	***171***	***255***	***383***	***540***	***788***
Water Management Strategies						
Water Conservation	3	5	5	8	12	20
Connect to Waxahachie	0	166	250	375	528	768
Total Supplies from Strategies	***3***	***171***	***255***	***383***	***540***	***788***
Reserve (Shortage)	**3**	**0**	**0**	**0**	**0**	**0**

Mansfield

The City of Mansfield is located in Ellis, Johnson and Tarrant Counties. The water supply for Mansfield is discussed under Tarrant County in **Section 5E.15**.

Midlothian

The City of Midlothian is located in northwestern Ellis County. Midlothian is a wholesale water provider (WWP) that currently obtains water from the Trinity River Authority (TRA) supply in Joe Pool Lake and from the Tarrant Regional Water District (TRWD). Midlothian has contracted for 39.19 percent of the conservation storage in Joe Pool Lake, but the reliable (firm yield) supply from Joe Pool Lake is lower and decreases over time due to sedimentation. The city's current contract for TRWD raw water is for 13,655 acre-feet per year, but the supplies are limited by the current treatment capacity of the Auger WTP.

The City of Midlothian has two water treatment plants, the Tayman WTP and the Auger WTP. The Tayman WTP treats supplies from Joe Pool Lake and the Auger WTP treats supplies from TRWD. The Tayman WTP has a current peak capacity of 11.5 MGD and the Auger WTP has a peak capacity of 12 MGD. A peaking factor of 2 is assumed in the *Region C Regional Water Plan* for determining average-day treatment capacity constraints.

Midlothian currently supplies water to Mountain Peak SUD, Ellis County Manufacturing (retail supply within the city), Ellis County Steam Electric Power, Grand Prairie, Rockett SUD, Venus, and Sardis-Lone Elm WSC.

The recommended water management strategies for Midlothian include implementing water conservation measures, indirect reuse, additional purchases from TRWD, and water treatment plant expansions.

The recommended indirect reuse project utilizes effluent from the TRA Mountain Creek Regional Wastewater System (MCRWS) and will augment Joe Pool Lake supplies. Currently, TRA is authorized to divert up to 4,368 acre-feet per year of this reclaimed water (93.5% of discharges). The rest is assumed to be lost in transit. MCRWS projections were developed as part of a separate study being done for TRA and it is assumed that TRA will seek additional reuse water rights as the plant is expanded (which Midlothian can then contract with TRA to utilize).

Two alternative strategies for Midlothian are purchasing Duncanville's unused portion of the yield of Joe Pool Lake (up to 1 MGD) and direct potable reuse of treated effluent from TRA's Mountain Creek Regional Wastewater System.

Table 5E.144 shows the projected demand, the current supplies, and the water management strategies for Midlothian.

Table 5E.144 Summary of Wholesale Water Provider and Customers – Midlothian

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Demands						
Midlothian	4,811	7,094	7,408	7,839	8,359	9,231
Mountain Peak SUD	1,121	1,121	1,121	0	0	0
Manufacturing, Ellis	2,166	2,620	2,620	2,620	2,620	2,620
Steam Electric Power, Ellis	280	280	280	280	280	280
Grand Prairie	1,682	2,803	3,643	3,643	3,643	3,643
Rockett SUD	2,242	2,242	2,242	2,242	2,242	2,242
Venus	535	625	721	830	949	1,079
Sardis-Lone Elm WSC	1,121	2,242	3,206	3,206	3,206	3,206
Total Projected Demands	***13,958***	***19,027***	***21,241***	***20,660***	***21,299***	***22,301***
Currently Available Supplies						
Joe Pool Lake (limited by yield)[a]	*5,833*	*5,712*	*5,591*	*5,470*	*5,349*	*5,229*
TRWD (Contract Amount)	*13,655*	*13,655*	*13,655*	*13,655*	*13,655*	*13,655*
TRWD (limited by Auger WTP; 6 MGD Average and 12 MGD Peak)[b]	*6,726*	*6,726*	*6,726*	*6,726*	*6,726*	*6,726*
Total Currently Available Supplies	***12,559***	***12,438***	***12,317***	***12,196***	***12,075***	***11,955***
Need (Demand - Supply)	***1,399***	***6,589***	***8,924***	***8,464***	***9,224***	***10,346***
Water Management Strategies						
Conservation (retail)	318	557	584	656	733	844
Conservation (wholesale)	0	1	1	2	3	3
Indirect Reuse	2,107	9,203	10,100	10,224	10,324	10,470
Expand Tayman WTP to 20 MGD	*2,107*	*9,203*	*10,100*	*10,224*	*10,324*	*10,470*
Additional TRWD with WTP Expansions as Below:	1,081	6,031	8,339	7,806	8,488	9,499
Expand Auger WTP to 16 MGD	*1,081*	*2,242*	*2,242*	*2,242*	*2,242*	*2,242*
Expand Auger WTP to 24 MGD	*0*	*3,789*	*4,484*	*4,484*	*4,484*	*4,484*
Expand Auger WTP to 32 MGD	*0*	*0*	*0*	*1,080*	*1,762*	*2,773*
Total Supplies from Strategies	***3,506***	***15,792***	***19,024***	***18,688***	***19,548***	***20,816***
Reserve (Shortage)	**2,107**	**9,203**	**10,100**	**10,224**	**10,324**	**10,470**
Alternative Strategies						
Purchase Joe Pool Water Rights	*613*	*734*	*855*	*976*	*961*	*939*
Direct Potable Reuse	*1,121*	*2,242*	*3,363*	*4,484*	*5,605*	*5,605*

[a]Midlothian's contracted amount with the Trinity River Authority is 6,674 acre-feet per year. The yield of Joe Pool (as calculated by TCEQ WAM) is less than the permitted amount and reduces over time due to sedimentation, and Midlothian's share of the reduced yield is shown here.
[b]The Auger WTP has a peak capacity of 12 MGD. A peaking factor of 2 was assumed to determine the average-day capacity constraint.

Mountain Peak Special Utility District

Mountain Peak SUD serves customers in western Ellis County. Water supplies for this SUD include groundwater (Trinity aquifer) and treated water from Midlothian. The SUD's water purchase contract with Midlothian will expire by 2040, and it may not be renewed. Groundwater supplies from Region G will meet the demands of the Region G portion of this WUG. Water management strategies for the Region C part of the SUD include conservation and purchasing treated water from Mansfield, which gets its water from the Tarrant Regional Water District. **Table 5E.145** shows the projected demand, the current supplies, and the water management strategies for Mountain Peak SUD in Region C.

Table 5E.145 Summary of Water User Group – Mountain Peak SUD (Region C Only)

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**13,046**	**16,409**	**17,970**	**24,433**	**28,281**	**31,896**
Projected Demands						
Municipal Demand	4,094	5,084	5,529	7,493	8,666	9,769
Total Projected Demands	***4,094***	***5,084***	***5,529***	***7,493***	***8,666***	***9,769***
Currently Available Supplies						
Trinity Aquifer	2,268	2,264	2,268	2,264	2,268	2,264
Midlothian (TRWD)	1,121	1,121	1,121	0	0	0
Total Currently Available Supplies	***3,389***	***3,385***	***3,389***	***2,264***	***2,268***	***2,264***
Need (Demand - Supply)	***705***	***1,699***	***2,140***	***5,229***	***6,398***	***7,505***
Water Management Strategies						
Water Conservation	293	682	723	1,042	1,232	1,409
Mansfield (TRWD)	412	1,017	1,417	4,187	5,166	6,096
Total Supplies from Strategies	***705***	***2,205***	***2,646***	***5,735***	***6,904***	***8,011***
Reserve (Shortage)	**0**	**0**	**0**	**0**	**0**	**0**

Ovilla

Ovilla is located in northern Ellis County and southern Dallas County. The City purchases treated water supplies from DWU. Water management strategies include conservation, purchasing additional water from DWU, and additional delivery infrastructure from DWU. **Table 5E.146** shows the projected population and demand, the current supplies, and the water management strategies for Ovilla.

Table 5E.146 Summary of Water User Group – City of Ovilla

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**4,485**	**5,713**	**7,120**	**9,110**	**11,118**	**20,367**
Projected Demands						
Municipal Demand	1,070	1,338	1,651	2,104	2,565	4,693
Total Projected Demands	***1,070***	***1,338***	***1,651***	***2,104***	***2,565***	***4,693***
Currently Available Supplies						
DWU	1,027	1,222	1,367	1,606	1,865	3,279
Total Currently Available Supplies	***1,027***	***1,222***	***1,367***	***1,606***	***1,865***	***3,279***
Need (Demand - Supply)	***43***	***116***	***284***	***498***	***700***	***1,414***
Water Management Strategies						
Water Conservation	82	195	240	314	396	751
DWU	0	0	44	184	304	663
Additional Delivery Infrastructure from DWU	*0*	*0*	*0*	*0*	*0*	*663*
Total Supplies from Strategies	***82***	***195***	***284***	***498***	***700***	***1,414***
Reserve (Shortage)	**39**	**79**	**0**	**0**	**0**	**0**

Palmer

Palmer is located in northeastern Ellis County. The city purchases treated water supplies from Rockett SUD. Water management strategies for Palmer include conservation and purchasing additional water from Rockett SUD, including additional delivery infrastructure from Rockett SUD. **Table 5E.147** shows the projected population and demand, the current supplies, and the water management strategies for Palmer.

Table 5E.147 Summary of Water User Group – City of Palmer

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**2,440**	**3,104**	**3,875**	**4,994**	**6,383**	**11,784**
Projected Demands						
Municipal Demand	274	334	407	519	662	1,219
Total Projected Demands	***274***	***334***	***407***	***519***	***662***	***1,219***
Currently Available Supplies						
Rockett SUD	274	305	340	351	335	433
Total Currently Available Supplies	***274***	***305***	***340***	***351***	***335***	***433***
Need (Demand - Supply)	***0***	***29***	***67***	***168***	***327***	***786***
Water Management Strategies						
Water Conservation	2	4	4	7	11	26
Rockett SUD	0	25	63	161	316	760
Additional Delivery Infrastructure from Rockett SUD	*0*	*0*	*0*	*103*	*246*	*760*
Total Supplies from Strategies	***2***	***29***	***67***	***168***	***327***	***786***
Reserve (Shortage)	**2**	**0**	**0**	**0**	**0**	**0**

Red Oak

Red Oak is located in northern Ellis County. The city's water supplies are groundwater (Woodbine aquifer) and purchasing water from DWU. Water management strategies for Red Oak include conservation and purchasing additional water from DWU. **Table 5E.148** shows the projected population and demand, the current supplies, and the water management strategies for Red Oak.

Table 5E.148 Summary of Water User Group – City of Red Oak

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**7,667**	**8,635**	**11,660**	**16,615**	**20,449**	**31,952**
Projected Demands						
Municipal Demand	1,144	1,265	1,687	2,390	2,936	4,582
Total Projected Demands	***1,144***	***1,265***	***1,687***	***2,390***	***2,936***	***4,582***
Currently Available Supplies						
Woodbine Aquifer	516	0	0	0	0	0
DWU	603	1,155	1,397	1,824	2,134	3,202
Total Currently Available Supplies	***1,119***	***1,155***	***1,397***	***1,824***	***2,134***	***3,202***
Need (Demand - Supply)	***25***	***110***	***290***	***566***	***802***	***1,380***
Water Management Strategies						
Water Conservation	10	14	19	38	56	103
DWU	15	96	271	528	746	1,277
Total Supplies from Strategies	***25***	***110***	***290***	***566***	***802***	***1,380***
Reserve (Shortage)	**0**	**0**	**0**	**0**	**0**	**0**

Rice Water Supply and Sewer Service

Rice Water Supply and Sewer Service provides retail service to northern Navarro County and southeastern Ellis County. Rice Water Supply and Sewer Service gets most of its water supply from Corsicana, with a small supply from Ennis. Water management strategies for Rice Water Supply and Sewer Service include conservation, additional water from Corsicana (including an increase in delivery infrastructure), and additional water from Ennis. **Table 5E.149** shows the projected population and demand, the current supplies, and the water management strategies for Rice Water Supply and Sewer Service.

Table 5E.149 Summary of Water User Group – Rice Water Supply and Sewer Service

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**9,521**	**11,701**	**14,202**	**17,272**	**20,753**	**24,759**
Projected Demands						
Municipal Demand	1,139	1,356	1,617	1,951	2,338	2,786
Total Projected Demands	***1,139***	***1,356***	***1,617***	***1,951***	***2,338***	***2,786***
Currently Available Supplies						
Corsicana System	1,089	1,306	1,560	1,721	1,873	1,958
Lake Bardwell through Ennis	50	45	38	26	16	9
TRWD through Ennis	0	5	10	12	9	6
Total Currently Available Supplies	***1,139***	***1,356***	***1,608***	***1,759***	***1,898***	***1,973***
Need (Demand - Supply)	***0***	***0***	***9***	***192***	***440***	***813***
Water Management Strategies						
Water Conservation	10	18	20	31	45	63
Ennis	0	0	2	12	25	35
Corsicana	0	0	0	149	370	715
Additional Delivery Infrastructure from Corsicana	*0*	*0*	*0*	*149*	*370*	*715*
Total Supplies from Strategies	***10***	***18***	***22***	***192***	***440***	***813***
Reserve (Shortage)	**10**	**18**	**13**	**0**	**0**	**0**

Rockett Special Utility District

Rockett Special Utility District is a wholesale water provider (WWP) that provides retail service in northern Ellis County and southern Dallas County and supplies water to a number of water user groups. Wholesale customers of the District include Palmer, Ellis County Other, Sardis-Lone Elm WSC, and Ferris. Rockett SUD's retail service area includes customers in many area cities. The current supplies for Rockett SUD include treated water purchased from Midlothian and water from TRWD.

Rockett SUD jointly owns the Robert W. Sokoll WTP with the City of Waxahachie. The plant was commissioned in December 2009 with a peak treatment capacity of 20 MGD (shared equally between the City of Waxahachie and Rockett SUD). The current supply from TRWD shown on **Table 5E.150** is limited by the Rockett SUD's capacity at Sokoll WTP. The recommended water management strategies for Rockett SUD include implementing water conservation measures, purchasing additional TRWD water, and expanding the Sokoll WTP.

Table 5E.150 shows the projected demand, the current supplies, and the water management strategies for Rockett SUD. An alternative strategy for Rockett SUD is to purchase treated water from Dallas, delivered through an existing 36-inch line that is located near the town of Red Oak. Rockett SUD would construct a 20-inch line to deliver this water into their system.

Table 5E.150 Summary of Water Wholesale Water Provider and Customers – Rockett SUD

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Demands						
Rockett SUD	4,619	5,826	6,351	8,427	11,170	14,454
Palmer	274	334	407	519	662	1,219
County Other, Ellis	115	86	120	315	1,217	3,811
Sardis-Lone Elm WSC	1,121	1,121	1,121	1,121	1,121	1,121
Ferris	461	789	1,071	1,209	1,351	1,496
Total Projected Demands	***6,590***	***8,156***	***9,070***	***11,591***	***15,521***	***22,101***
Currently Available Supplies						
Midlothian	2,242	2,242	2,242	2,242	2,242	2,242
TRWD Limited by Sokoll WTP Capacity	5,556	5,605	5,605	5,605	5,605	5,605
Total Currently Available Supplies	***7,798***	***7,847***	***7,847***	***7,847***	***7,847***	***7,847***
Need (Demand - Supply)	***0***	***703***	***1,492***	***3,744***	***7,674***	***14,254***
Water Management Strategies						
Conservation (retail)	44	83	80	133	214	325
Conservation (wholesale)	7	13	16	27	55	136
TRWD with Treatment as below:		607	1,396	3,584	7,405	13,793
10 MGD WTP Expansion at Sokoll – 1		*607*	*1,396*	*3,584*	*5,605*	*5,605*
10 MGD WTP Expansion at Sokoll – 2					*1,800*	*5,605*
3 MGD WTP Expansion at Sokoll						*1,682*
Total Supplies from Strategies	***51***	***703***	***1,492***	***3,744***	***7,674***	***14,254***
Reserve (Shortage)	**51**	**0**	**0**	**0**	**0**	**0**
Alternative Strategy						
Purchase Water from DWU	*2,242*	*3,363*	*5,605*	*5,605*	*5,605*	*5,605*

Sardis-Lone Elm Water Supply Corporation

Sardis-Lone Elm WSC is located in northern Ellis County. The WSC currently gets water supplies from groundwater (Trinity and Woodbine aquifers), Rockett SUD and Midlothian. Historical groundwater use for Sardis-Lone Elm WSC is higher than can be shown as available in the *Region C Water Plan* due to the MAG limitations. Sardis-Lone Elm WSC has applied for a historic water use permit for twelve wells located within the Trinity aquifer. Sardis-Lone Elm WSC assumes approximately 6 MGD of maximum day demand in 2020 will be met by groundwater supplies.

Water management strategies include conservation, additional supply from Rockett SUD, additional supply from Midlothian, and supplies from TRWD. The shortages from Sardis-Lone Elm WSC are shown to be met through additional sales from TRWD. However, some of this projected need is covered by groundwater supplies that cannot be shown in this plan due to the rules governing regional planning and the Ellis County MAG limitations.

Table 5E.151 shows the projected population and demand, the current supplies, and the water management strategies for Sardis-Lone Elm WSC.

Table 5E.151 Summary of Water User Group – Sardis-Lone Elm Water Supply Corporation

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**19,699**	**26,433**	**30,524**	**31,524**	**32,524**	**32,524**
Projected Demands						
Municipal Demand	5,304	7,037	8,079	8,324	8,583	8,581
Total Projected Demands	***5,304***	***7,037***	***8,079***	***8,324***	***8,583***	***8,581***
Currently Available Supplies						
Trinity Aquifer	956	450	450	450	450	450
Woodbine Aquifer	898	898	898	898	898	898
Midlothian	928	1,133	1,378	1,420	1,352	1,263
Rockett SUD	1,121	1,024	936	759	567	398
Total Currently Available Supplies	***3,903***	***3,505***	***3,662***	***3,527***	***3,267***	***3,009***
Need (Demand - Supply)	***1,401***	***3,532***	***4,417***	***4,797***	***5,316***	***5,572***
Water Management Strategies						
Water Conservation	441	655	751	815	875	904
Midlothian	193	1,109	1,828	1,786	1,854	1,943
Rockett SUD	0	97	185	362	554	723
Treated TRWD Water	767	1,671	1,653	1,834	2,033	2,002
Additional Delivery Infrastructure	*767*	*1,671*	*1,653*	*1,834*	*2,033*	*2,002*
Total Supplies from Strategies	***1,401***	***3,532***	***4,417***	***4,797***	***5,316***	***5,572***
Reserve (Shortage)	**0**	**0**	**0**	**0**	**0**	**0**

South Ellis County Water Supply Corporation

South Ellis County WSC provides water in Ellis and Navarro Counties. The WSC gets its water supply from the Trinity aquifer. The WSC's water management strategies include conservation and supplies from TRWD through TRA through Waxahachie. **Table 5E.152** shows the projected population and demand, the current supplies, and the water management strategies for South Ellis County WSC. The majority of need in 2050-2070 is met through water conservation measures, most notably an enhanced water loss control program consisting of elements such as water main replacement. More details about water conservation measures can be found in Appendix I.

Table 5E.152 Summary of Water User Group – South Ellis County WSC

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**1,622**	**1,958**	**2,401**	**3,259**	**4,381**	**6,117**
Projected Demands						
Municipal Demand	416	494	601	813	1,091	1,523
Total Projected Demand	***416***	***494***	***601***	***813***	***1,091***	***1,523***
Currently Available Supplies						
Trinity Aquifer	416	494	601	601	601	601
Total Currently Available Supplies	***416***	***494***	***601***	***601***	***601***	***601***
Need (Demand – Supply)	***0***	***0***	***0***	***212***	***490***	***922***
Water Management Strategies						
Water Conservation	3	5	6	152	502	705
Connect to Waxahachie	0	0	0	60	0	217
Total Supplies from Strategies	***3***	***5***	***6***	***212***	***502***	***922***
Reserve (Shortage)	**3**	**5**	**6**	**0**	**12**	**0**

Venus

Venus is located in eastern Johnson County and western Ellis County. Most of the city's population is in Johnson County which is located in Region G. The city's water supplies are groundwater (Woodbine aquifer from Region G) and water purchased from Midlothian. Water management strategies for Venus include conservation and purchasing additional water from Midlothian. **Table 5E.153** shows the projected population and demand, the current supplies, and the water management strategies for the City of Venus.

Table 5E.153 Summary of Water User Group – City of Venus (Regions C and G)

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**3,416**	**3,950**	**4,505**	**5,122**	**5,785**	**6,499**
Projected Demands						
Municipal Demand	638	728	824	933	1,052	1,182
Total Projected Demands	***638***	***728***	***824***	***933***	***1,052***	***1,182***
Currently Available Supplies						
Woodbine Aquifer (Region G)	103	103	103	103	103	103
TRWD through Midlothian	443	316	310	368	400	425
Total Currently Available Supplies	***546***	***419***	***413***	***471***	***503***	***528***
Need (Demand - Supply)	***92***	***309***	***411***	***462***	***549***	***654***
Water Management Strategies						
Water Conservation	0	62	119	132	148	166
Midlothian	92	247	292	330	401	488
Total Supplies from Strategies	***92***	***309***	***411***	***462***	***549***	***654***
Reserve (Shortage)	**0**	**0**	**0**	**0**	**0**	**0**

Waxahachie

Waxahachie is a wholesale water provider (WWP) that provides water to Buena Vista-Bethel SUD, Ellis County Other, and Ellis County Manufacturing. Potential future customers include Avalon Water Supply and Sewer Service, Files Valley WSC, Italy, and South Ellis County WSC. Waxahachie obtains its current water supply from Lake Waxahachie, Bardwell Lake (by contract with TRA), indirect reuse from Bardwell Lake (by contract with TRA), and water from TRWD through TRA. Supplies are treated at the Sokoll Water Treatment Plant (a joint project of Rockett SUD and Waxahachie) and the Howard Water Treatment Plant (Waxahachie only).

The following is a brief description of the additional treatment and delivery improvements planned for Waxahachie:

- New raw water lines from TRWDs' new Integrated Pipeline (IPL) to Lake Waxahachie (36" line) and to Howard Road Water Treatment Plant (30" line). These raw water lines enable Waxahachie to take TRWD water and store it in Lake Waxahachie or treat immediately at the WTP as needed. There will be an additional 36" raw water line connecting Lake Waxahachie to Howard Road Water Treatment Plant that will enable Waxahachie to take TRWD water that has been stored in Lake Waxahachie to the Howard Road Water Treatment Plant as needed.
- Waxahachie anticipates serving multiple wholesale customers in southern Ellis County through a joint delivery system. These entities include Italy, Files Valley WSC, Avalon WSC, South Ellis WSC, Ellis County Other (namely Nash-Forreston WSC), and additional portions of Buena Vista-Bethel SUD. An initial system is anticipated to be constructed by 2030, with an expansion in 2050 as demands grow.
- A 48" parallel raw water supply line from TRWD's existing East Texas pipeline to Sokoll Water Treatment Plant will increase delivery capacity from TRWD.
- A new 30" raw water line from Lake Waxahachie (or from Howard Road Water Treatment Plant) to the Sokoll Water Treatment Plant will increase Waxahachie's capacity to delivery TRWD raw water to the Sokoll Water Treatment Plant where more treatment capacity already exists.
- Waxahachie's raw water intake at Lake Bardwell requires improvements in order to use the city's full supply from the lake.
- The city will need water treatment plant expansions to meet growing demands.

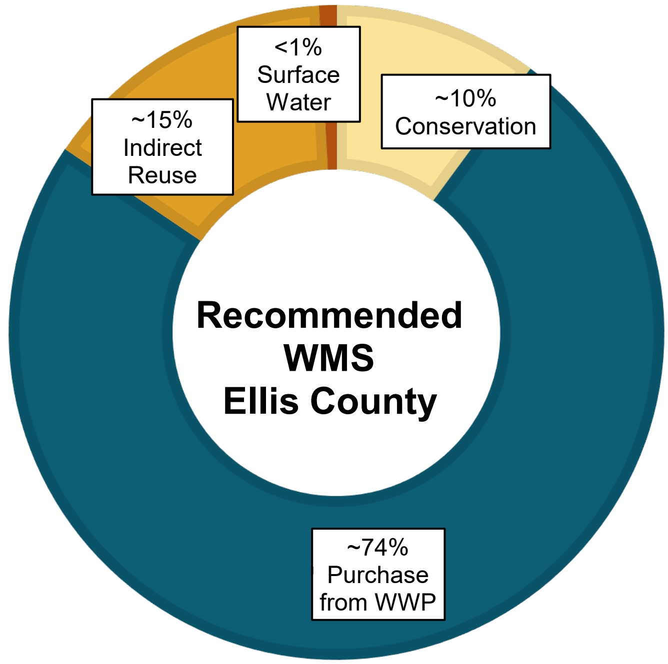
Table 5E.154 shows the projected demand, the current supplies, and the water management strategies for the City of Waxahachie.

Table 5E.154 Summary of Wholesale Water Provider and Customers - Waxahachie

(Values in Ac-Ft/Yr)	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Projected Demands						
Waxahachie	6,872	7,702	9,226	11,299	13,749	16,715
Buena Vista-Bethel SUD	*1,232*	*1,491*	*1,700*	*2,199*	*3,200*	*4,295*
County Other, Ellis	*20*	*25*	*50*	*300*	*1,794*	*3,475*
Manufacturing, Ellis	*2,242*	*2,242*	*2,242*	*2,242*	*2,242*	*2,242*
Avalon WSC (future)	*0*	*26*	*62*	*137*	*235*	*389*
Files Valley WSC (future)	*0*	*55*	*59*	*65*	*71*	*77*
Italy (future)	*0*	*171*	*255*	*383*	*540*	*788*
South Ellis County WSC (future)	*0*	*0*	*0*	*212*	*490*	*922*
Total Projected Demands	***10,366***	***11,712***	***13,594***	***16,837***	***22,321***	***28,903***
Currently Available Supplies						
Lake Bardwell	*4,320*	*4,183*	*3,989*	*3,794*	*3,600*	*3,406*
Lake Waxahachie	*2,800*	*2,695*	*2,590*	*2,485*	*2,380*	*2,275*
Reuse	*3,479*	*3,882*	*4,614*	*5,129*	*5,129*	*5,129*
TRWD through TRA for Sokoll	*2,500*	*2,202*	*1,883*	*3,010*	*5,212*	*5,212*
Current Supply	***13,099***	***12,962***	***13,076***	***14,418***	***16,321***	***16,022***
Current TRWD Supply Limited by Sokoll Plant Capacity (10 MGD peak; 5 MGD average)	***2,500***	***2,202***	***1,883***	***3,010***	***5,212***	***5,212***
Current Non-TRWD Supply Limited by Howard Plant Capacity (18 MGD peak; 9 MGD average)	**10,089**	**10,089**	**10,089**	**10,089**	**10,089**	**10,089**
Total Currently Available Supplies (Limited by Plant Capacity)	***12,589***	***12,291***	***11,972***	***13,099***	***15,301***	***15,301***
Need (Demand - Supply)	***0***	***0***	***1,622***	***3,738***	***7,020***	***13,602***
Water Management Strategies						
Conservation (retail)	66	109	509	755	964	1,229
Conservation (wholesale customers)	18	32	109	317	780	1,133
Dredge Lake Waxahachie	0	0	810	810	810	810
Additional Supplies with Treatment and Delivery Infrastructure Improvements	0	828	1,103	1,856	4,466	10,430
Total Supplies from Strategies	***84***	***969***	***2,531***	***3,738***	***7,020***	***13,602***
Reserve (Shortage)	**2,307**	**1,548**	**909**	**0**	**0**	**0**

5E.5.2 Summary of Costs for Ellis County

Table 5E.155 summarizes the costs of the water management strategies recommended for the WUGs and WWPs who have the majority of their demand located in Ellis County. Total quantities from **Table 5E.155** will not necessarily match total county demands. This is due mainly to water users whose sum of strategies results in a reserve as well as due to water users located in multiple counties (or wholesale water providers who develop strategies and then sell water to users in other counties). Quantities from infrastructure projects needed to deliver and/or treat water (shown in *gray italics*) are not included since the supplies are associated with other strategies. To avoid double-counting quantities of supplies, the quantities in gray italics are **not** included in the total.



The majority of the future supplies needed to meet demands within Ellis County are projected to come through purchases from wholesale water providers. Other strategies include indirect reuse, conservation, and surface water.

Table 5E.156 summarizes the recommended water management strategies within Ellis County individually. Alternative strategies are also included. More detailed cost estimates are located in **Appendix H.**

Table 5E.155 Summary of Recommended Water Management Strategies for Ellis County

Type of Strategy	Quantity (Ac-Ft/Yr)	Capital Costs
Conservation[a]	9,729	$4,339,157
Purchase from WWP	71,745	$0
Additional Infrastructure	*128,431*	*$621,335,000*
Indirect Reuse	14,166	$55,899,000
Surface Water	810	$37,120,000
Total	**96,450**	**$718,693,157**

[a]The conservation quantities represent the sum of the individual water user groups who have the majority of their service areas located in the county, not the total conservation in the county.

Table 5E.156 Costs for Recommended Water Management Strategies for Ellis County

WWP or WUG	Strategy	Online by:	Quantity (Ac-Ft/Yr)[b]	Capital Costs[c]	Unit Cost ($/1000 gal) With Debt Service	Unit Cost ($/1000 gal) After Debt Service	Table
WWPs							
Ennis	Conservation (retail)	2020	2,623	$612,128	$3.48	$1.07	H.11
	Conservation (wholesale)	2020	Included with WUGs.				
	Indirect Reuse	2040	3,696	$55,899,000	$4.45	$1.19	H.103
	TRWD through TRA	2030	9,952	$0	$1.26	$1.26	None
	6 MGD WTP Expansion	*2050*	*3,363*	*$22,264,000*	*$2.53*	*$1.10*	*H.13*
	8 MGD WTP Expansion	*2060*	*4,484*	*$47,735,000*	*$3.97*	*$1.68*	*H.13*
	16 MGD WTP Expansion	*2070*	*5,510*	*$86,402,000*	*$3.57*	*$1.49*	*H.13*
Midlothian	Conservation (retail)	2020	844	$719,507	$1.18	$0.53	H.11
	Conservation (wholesale)	2020	Included with WUGs.				
	Indirect Reuse	2020	10,470	$0	$0.29	$0.29	None
	Expand Tayman WTP to 20 MGD	*2020*	*10,470*	*$46,259,000*	*$2.91*	*$0.68*	*H.13*
	TRWD	2020	9,499	$0	$1.26	$1.26	None
	Expand Auger WTP to 16 MGD	*2020*	*2,242*	*$7,498,000*	*$0.93*	*$0.20*	*H.13*
	Expand Auger WTP to 24 MGD	*2030*	*4,484*	*$24,798,000*	*$1.38*	*$0.19*	*H.13*
	Expand Auger WTP to 32 MGD	*2050*	*2,773*	*$24,798,000*	*$1.38*	*$0.19*	*H.13*
	ALTERNATIVE Direct Potable Reuse (Mountain Creek WWTP effluent)	*2020*	*5,605*	*$43,395,000*	*$5.44*	*$3.76*	*H.105*
	ALTERNATIVE Purchase Duncanville's Joe Pool yield (up to 1 MGD)	*2020*	*976*	*$2,947,000*	*$2.00*	*$1.43*	*H.106*
Rockett SUD	Conservation (retail)	2020	325	$584,694	$2.87	$0.00	H.11
	Conservation (wholesale)	2020	Included with WUGs.				
	TRWD	2030	13,793	$0	$1.26	$1.26	None
	10 MGD WTP Expansion at Sokoll-1	*2030*	*5,605*	*$58,903,000*	*$3.89*	*$1.63*	*H.13*

WWP or WUG	Strategy	Online by:	Quantity (Ac-Ft/Yr)[b]	Capital Costs[c]	Unit Cost ($/1000 gal) With Debt Service	Unit Cost ($/1000 gal) After Debt Service	Table
	10 MGD WTP Expansion at Sokoll-2	*2060*	*5,605*	*$58,903,000*	*$3.89*	*$1.63*	*H.13*
	3 MGD WTP Expansion at Sokoll	*2070*	*1,682*	*$14,095,000*	*$3.37*	*$1.56*	*H.13*
	ALTERNATIVE Purchase treated water from Dallas with 20" transmission line	*2020*	*5,605*	*$45,457,000*	*$1.98*	*$0.23*	*H.110*
Waxahachie	Conservation (retail)	2020	1,229	$1,754,083	$5.74	$0.76	H.11
	Conservation (wholesale)	2020	Included with WUGs.				
	Dredge Lake Waxahachie	2040	810	$37,120,000	$11.37	$0.00	H.116
	TRA/TRWD	2040	10,430	$0	$1.27	$1.27	None
	8 MGD Expansion WTP	*2030*	*4,484*	*$47,735,000*	*$3.97*	*$1.68*	*H.13*
	12 MGD Expansion WTP	*2070*	*5,946*	*$68,069,000*	*$3.75*	*$1.57*	*H.13*
	36" Raw water line from IPL to Lake Waxahachie	*2040*	*10,430*	*$1,302,000*	*$0.03*	*$0.00*	*H.113*
	30" Raw water line from IPL to Howard Road Water Treatment Plant	*2040*	*10,430*	*$4,343,000*	*$0.20*	*$0.02*	*H.112*
	36" Raw water line from Lake Waxahachie to Howard Rd WTP	*2040*	*10,430*	*$6,461,000*	*$0.16*	*$0.03*	*H.114*
	Phase I Delivery Infrastructure to Customers in South Ellis County	*2040*	*1,121*	*$16,338,000*	*$1.63*	*$0.37*	*H.118*
	Phase II Delivery Infrastructure to Customers in South Ellis County	*2050*	*2,520*	*$26,982,000*	*$1.68*	*$0.20*	*H.119*
	48" TRWD Parallel Supply Line to Sokoll WTP	*2040*	*10,430*	*$3,954,000*	*$0.04*	*$0.00*	*H.115*
	Increase delivery infrastructure to	*2040*	*10,430*	*$14,096,000*	*$0.50*	*$0.05*	*H.117*

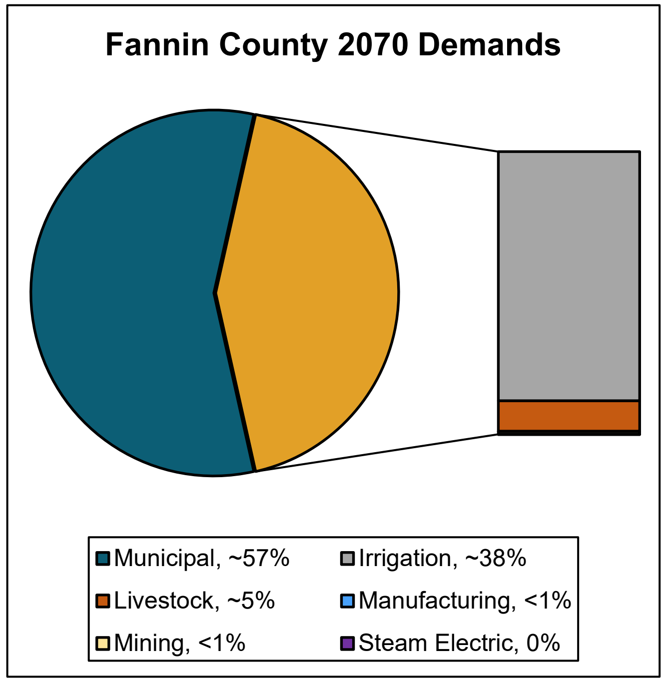
WWP or WUG	Strategy	Online by:	Quantity (Ac-Ft/Yr)[b]	Capital Costs[c]	Unit Cost ($/1000 gal) With Debt Service	Unit Cost ($/1000 gal) After Debt Service	Table
	Rockett SUD (30" Raw water Line)						
	Raw Water Intake Improvements at Lake Bardwell	*2040*	*10,430*	*$4,400,000*	*$0.15*	*$0.08*	*H.120*
WUGs							
Avalon Water Supply and Sewer Service	Conservation	2020	11	$8,624	$1.86	$0.00	H.11
	Waxahachie	2030	378	$0	$4.27	$4.27	None
Brandon-Irene WSC[a] (Region C only)	Conservation	See Navarro County.					
	Other WMSs						
Buena Vista-Bethel SUD	Conservation	2020	319	$29,027	$0.63	$0.51	H.11
	Waxahachie	2040	1,517	$0	$4.27	$4.27	None
Cedar Hill[a]	Conservation	See Dallas County.					
	DWU						
East Garrett WSC	Conservation	2020	99	$6,179	$0.67	$1.00	H.11
	Ennis	2050	902	$0	$3.00	$3.00	None
Ferris	Conservation	2020	32	$31,341	$1.69	$0.06	H.11
	Rockett SUD	2030	933	$0	$4.85	$4.85	None
	Additional Delivery Infrastructure from Rockett SUD	*2050*	*554*	*$1,370,000*	*$3.21*	*$0.54*	*H.104*
Files Valley WSC	Conservation	2020	7	$2,291	$0.49	$0.00	H.11
	Connect to Waxahachie	2030	70	$0	$4.27	$4.27	None
Glenn Heights[a]	Conservation	See Dallas County.					
	DWU						
Grand Prairie[a]	Conservation	See Dallas County.					
	Other WMSs						
Hilco United Services	None	None					
Italy	Conservation	2020	20	$7,419	$0.53	$0.00	H.11
	Waxahachie	2030	768	$0	$4.27	$4.27	None
Mansfield[a]	Conservation	See Tarrant County.					
	Other WMSs						
Mountain Peak SUD[a]	Conservation	2020	1,409	$110,785	$0.98	$0.41	H.11
	Midlothian	2020	6,096	$0	$3.00	$3.00	None

WWP or WUG	Strategy	Online by:	Quantity (Ac-Ft/Yr)[b]	Capital Costs[c]	Unit Cost ($/1000 gal) With Debt Service	Unit Cost ($/1000 gal) After Debt Service	Table
Ovilla[a]	Conservation	2020	751	$30,476	$2.20	$0.57	H.11
	DWU	2040	663	$0	$4.05	$4.05	None
	Additional Delivery Infrastructure from DWU	*2070*	*663*	*$1,810,000*	*$0.76*	*$0.17*	*H.107*
Palmer	Conservation	2020	26	$33,764	$3.65	$0.08	H.11
	Rockett SUD	2030	760	$0	$4.85	$4.85	None
	Additional Delivery Infrastructure from Rockett SUD	*2050*	*760*	*$8,910,000*	*$3.63*	*$0.50*	*H.108*
Red Oak	Conservation	2020	103	$88,296	$1.91	$0.11	H.11
	DWU	2020	1,277	$0	$4.05	$4.05	None
Rice WSC[a]	Conservation	2020	63	$60,243	$1.30	$0.11	H.11
	Ennis	2040	35	$0	$3.00	$3.00	None
	Corsicana	2050	715	$0	$4.15	$4.15	None
	Additional Delivery Infrastructure from Corsicana	*2030*	*1,552*	*$12,214,000*	*$2.00*	*$0.30*	*H.109*
Sardis-Lone Elm WSC	Conservation	2020	904	$238,415	$0.53	$0.30	H.11
	Midlothian	2020	1,943	$0	$2.81	$2.81	None
	Rockett SUD	2020	723	$0	$4.85	$4.85	None
	Treated TRWD	2020	2,033	$0	$1.26	$1.26	None
	Connect to TRWD and Treat Supplies	*2020*	*2,033*	*$11,696,000*	*$4.34*	*$3.22*	*H.111*
South Ellis County WSC	Conservation	2020	705	$14,796	$1.06	$0.30	H.11
	Connect to Waxahachie	2050	217	$0	$4.27	$4.27	None
Venus[a]	Conservation	2030	3	$0	$0.00	$0.86	H.11
	Midlothian	2020	488	$0	$3.95	$3.95	None
County Other and Non-Municipal							
County Other, Ellis	Conservation	2020	192	$7,089	$0.51	$0.00	H.11
	Ennis	2040	858	$0	$3.00	$3.00	None
	Waxahachie	2040	1,415	$0	$4.27	$4.27	None
	Rockett SUD	2030	2,379	$0	$4.85	$4.85	None
	Grand Prairie	2020	721	$0	$3.00	$3.00	None
Irrigation, Ellis	Conservation	2020	64	$0.00	$0.94	$0.94	H-11F

WWP or WUG	Strategy	Online by:	Quantity (Ac-Ft/Yr)[b]	Capital Costs[c]	Unit Cost ($/1000 gal)		Table
					With Debt Service	After Debt Service	
Livestock, Ellis	None	None					
Manufacturing, Ellis	Ennis	2030	464	$0	$3.00	$3.00	None
	Waxahachie	2040	958	$0	$4.27	$4.27	None
	Midlothian	2020	1,588	$0	$3.00	$3.00	None
Mining, Ellis	None	None					
Steam Electric Power, Ellis	Midlothian	2020	170	$0	$3.00	$3.00	None

[a]*Water user groups extend into more than one county.*
[b]*Quantities listed are for the WUG only. They do not include the WUG's customers.*
[c]*Purchases from wholesale water providers that require no new infrastructure have no capital costs. The unit costs shown in the table represent the cost to purchase water from the WWP.*

5E.6 Fannin County



Fannin County is located in the northeast corner of Region C. **Figure 5E.12** shows water service areas in Fannin County.

Fannin County is expected to grow in the later decades of the planning period as development occurs around two new lakes in the county and population from the D/FW Metroplex expands west.

Projected 2070 demands for the county are predominately municipal at over 50 percent of the total demand. A significant portion of the remaining demand comes from irrigation and livestock needs. Mining, and manufacturing are each less that 1 percent of the total demand, and there is no steam electric demand.

Most of the county currently uses groundwater or water from Lake Bonham. Over time more surface water is expected to supply municipal use. NTMWD will cooperate with Fannin County entities to develop a treated water supply system for Fannin County water users after Bois d'Arc Lake is developed by 2030. This is referred to throughout this section as the Fannin County Water Supply Project.

An overall summary of the County's projections are shown in **Table 5E.157** and water management strategies for individual WWPs and WUGs are discussed on the following pages.

Fannin County Quick Facts

2010 Population: 33,915

Projected 2070 Population: 137,732

Projected 2070 Demand: 27 MGD

County Seat: Bonham

Economy: Communications; agriculture; government/services; petroleum distribution; tourism; varied manufacturing

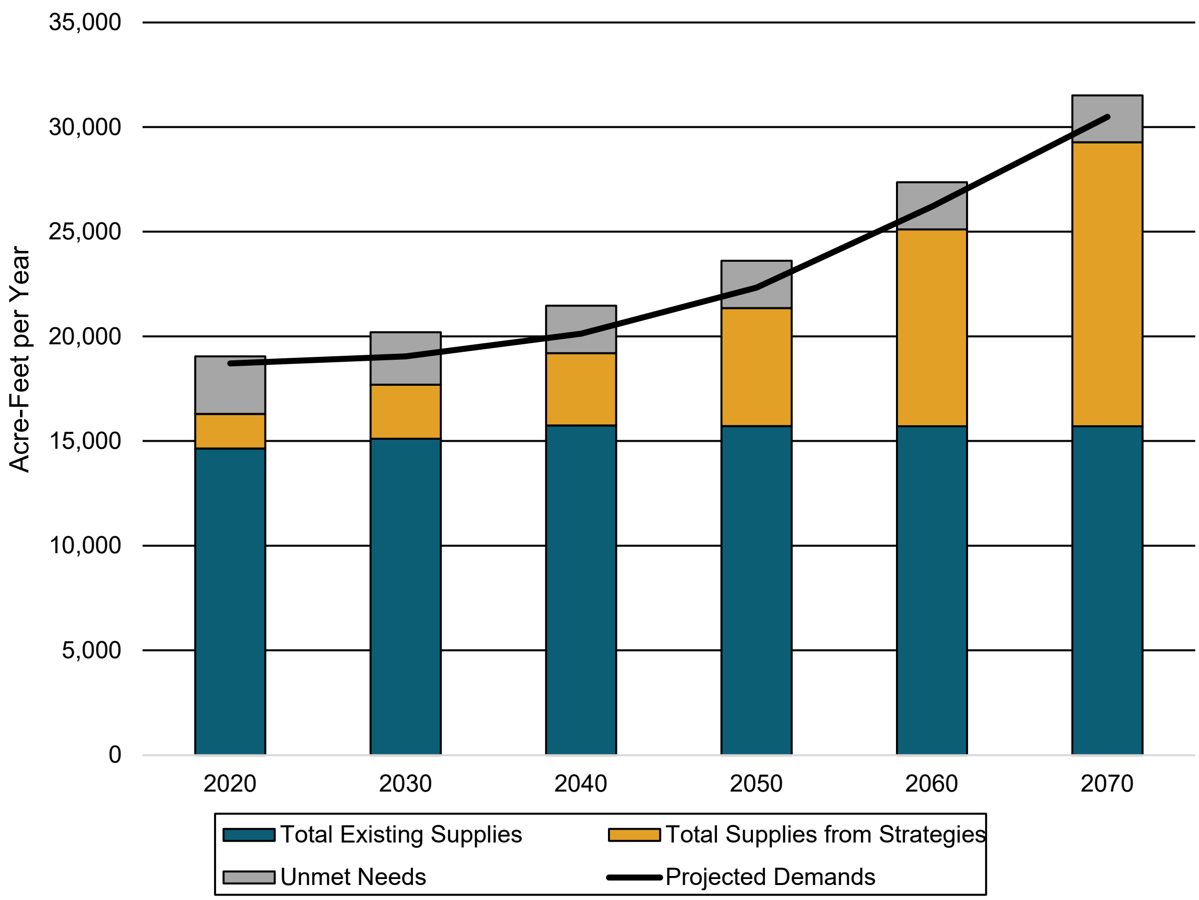
River Basins: Trinity (5%), Red

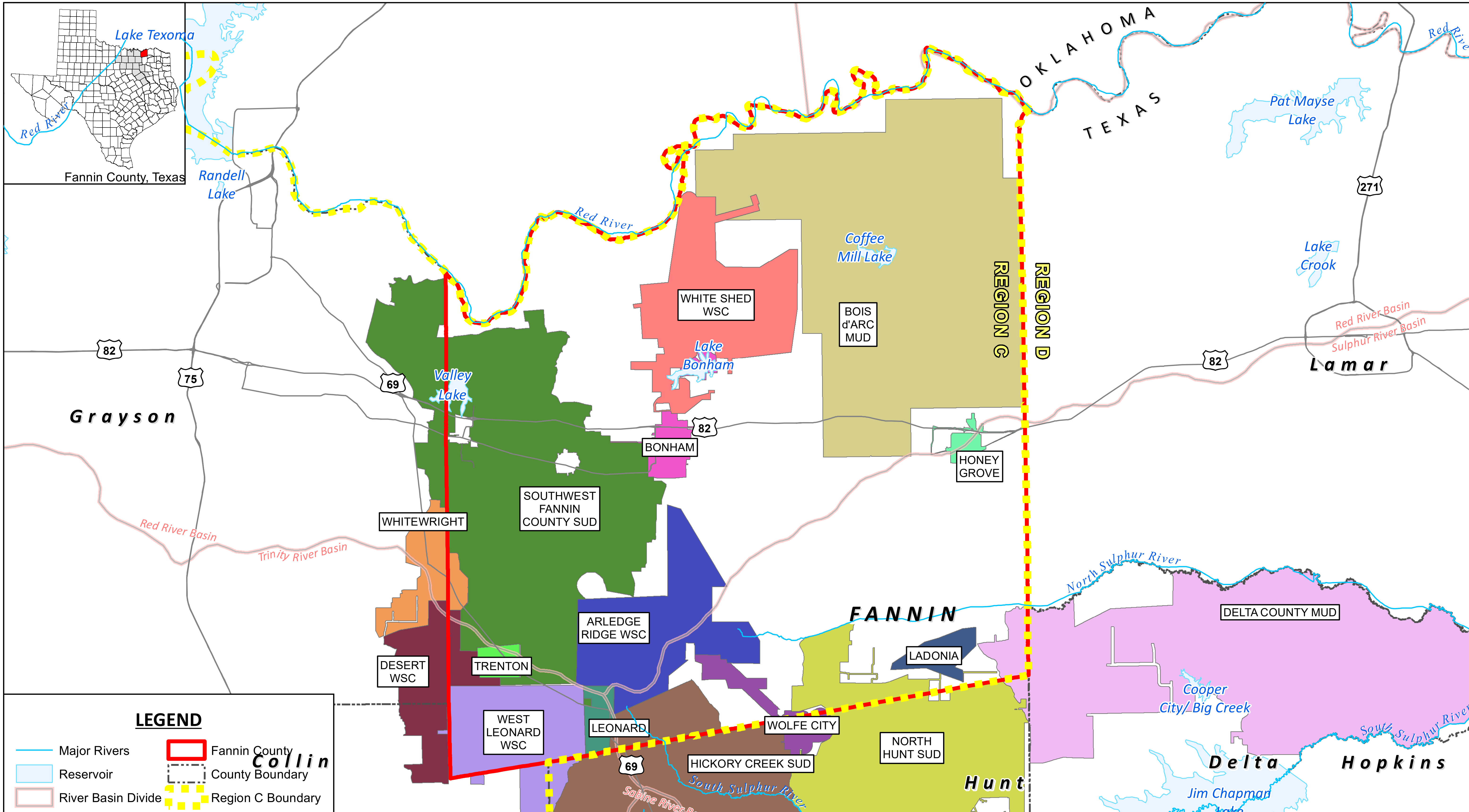
Table 5E.157 Summary of Fannin County

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**38,330**	**43,084**	**52,891**	**69,328**	**101,706**	**137,732**
Projected Demands	**18,708**	**19,045**	**20,125**	**22,330**	**26,203**	**30,487**
Municipal	5,158	5,718	7,021	9,226	13,099	17,383
Irrigation	11,553	11,553	11,553	11,553	11,553	11,553
Livestock	1,411	1,411	1,411	1,411	1,411	1,411
Manufacturing	12	12	12	12	12	12
Mining	574	351	128	128	128	128
Steam Electric	0	0	0	0	0	0
Total Existing Supplies	**14,643**	**15,108**	**15,746**	**15,714**	**15,702**	**15,708**
Need (Demand - Supply)	**4,065**	**3,937**	**4,379**	**6,616**	**10,501**	**14,779**
Total Supplies from Strategies	**1,653**	**2,587**	**3,451**	**5,636**	**9,409**	**13,562**
Reserve (Shortage)	**(2,412)**	**(1,350)**	**(928)**	**(980)**	**(1,092)**	**(1,217)**
Unmet Needs[a]	**2,756**	**2,528**	**2,300**	**2,304**	**2,313**	**2,327**

[a]Unmet needs are for Fannin County Irrigation, Mining, and Hickory Creek SUD

Figure 5E.11 Summary of Fannin County





REGION C Water Planning for North Texas

2021 Region C Water Plan

FANNIN COUNTY, TEXAS

FIGURE 5E.12

1 in = 5 miles

0 3 6 9

Miles

N W E S

Data Source(s): ESRI, USGS, TNRIS

TR116409: H:\WR_PLANNING\1 - Working\5E_County WMS\Fannin1.mxd

5E.6.1 Wholesale Water Providers and Water User Groups

There are no wholesale water providers in Fannin County. Water management strategies for Fannin County water user groups are discussed below (in alphabetical order). The costs for Fannin County water user groups and a summary for Fannin County are presented in **Section 5E.6.2.**

Arledge Ridge Water Supply Corporation

Arledge Ridge WSC supplies water in south-central Fannin County. The WSC gets its water supply from the Woodbine aquifer. The water management strategies include conservation and additional groundwater wells. **Table 5E.158** shows the projected population and demand, the current supplies, and the water management strategies for Arledge Ridge WSC.

Table 5E.158 Summary of Water User Group – Arledge Ridge WSC

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**1,332**	**1,508**	**1,833**	**2,406**	**3,542**	**4,813**
Projected Demands						
Municipal Demand	157	171	202	263	385	523
Total Projected Demand	***157***	***171***	***202***	***263***	***385***	***523***
Currently Available Supplies						
Woodbine Aquifer	187	187	187	187	187	187
Total Currently Available Supplies	***187***	***187***	***187***	***187***	***187***	***187***
Need (Demand – Supply)	***0***	***0***	***15***	***76***	***198***	***336***
Water Management Strategies						
Water Conservation	2	2	2	4	6	10
New Well(s) in Woodbine Aquifer	0	0	350	350	350	350
Total Supplies from Strategies	***2***	***2***	***352***	***354***	***356***	***360***
Reserve (Shortage)	**32**	**18**	**337**	**278**	**158**	**24**

Bois d’Arc Municipal Utility District

Bois d’Arc MUD supplies water in northeastern Fannin County. The MUD gets its water supply from the Woodbine aquifer. The water management strategies include conservation and connecting to NTMWD to purchase treated water. **Table 5E.159** shows the projected population and demand, the current supplies, and the water management strategies for Bois d’Arc MUD.

Table 5E.159 Summary of Water User Group – Bois d’Arc MUD

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**2,319**	**2,625**	**3,190**	**4,187**	**6,164**	**8,376**
Projected Demands						
Municipal Demand	273	297	352	458	672	912
Total Projected Demand	***273***	***297***	***352***	***458***	***672***	***912***
Currently Available Supplies						
Woodbine Aquifer	271	271	271	271	271	271
Total Currently Available Supplies	***271***	***271***	***271***	***271***	***271***	***271***
Need (Demand – Supply)	***2***	***26***	***81***	***187***	***401***	***641***
Water Management Strategies						
Water Conservation	2	3	4	6	11	18
Connect to NTMWD	0	23	77	181	390	623
Total Supplies from Strategies	***2***	***26***	***81***	***187***	***401***	***641***
Reserve (Shortage)	**0**	**0**	**0**	**0**	**0**	**0**

Bonham

Bonham is located in central Fannin County. The city uses raw water from Lake Bonham, which is treated by NTMWD at the Bonham Water Treatment Plant. The WTP is owned and operated by NTMWD. Although the capacity of the WTP is less than the permitted diversion from Lake Bonham, the intake is located in a shallow portion of the lake. Accessing the remaining supplies from Bonham Lake would require a new intake and a water treatment plant expansion.

Water management strategies for Bonham include conservation and participation in the Fannin County Water Supply Project. The Fannin County Water Supply Project would be developed by Fannin County WUGs and NTMWD to provide a treated water supply system for Fannin County after Bois d'Arc Lake is completed. Supplies would be treated at the Leonard WTP and then conveyed through a pipeline to participating entities. This strategy is described in more detail in **Appendix G.**

Table 5E.160 shows the projected population and demand, the current supplies, and the water management strategies for Bonham.

Table 5E.160 Summary of Water User Group – City of Bonham

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**12,603**	**16,000**	**22,000**	**30,000**	**37,000**	**45,000**
Projected Demands						
Municipal Demand	2,024	2,505	3,393	4,598	5,662	6,882
Manufacturing, Fannin	12	12	12	12	12	12
Total Projected Demand	***2,036***	***2,517***	***3,405***	***4,610***	***5,674***	***6,894***
Currently Available Supplies						
Lake Bonham through NTMWD	2,036	2,517	3,195	3,195	3,195	3,195
Total Currently Available Supplies	***2,036***	***2,517***	***3,195***	***3,195***	***3,195***	***3,195***
Need (Demand – Supply)	***0***	***0***	***210***	***1,415***	***2,479***	***3,699***
Water Management Strategies						
Water Conservation	20	36	42	72	108	155
Fannin County Water Supply Project	0	0	168	1,343	2,371	3,544
Total Supplies from Strategies	***20***	***36***	***210***	***1,415***	***2,479***	***3,699***
Reserve (Shortage)	**20**	**36**	**0**	**0**	**0**	**0**

Delta County Municipal Utility District

Delta County MUD supplies water in Fannin County in Region C and Delta County in Region D. The majority of the population resides in Region D. For Region C, the MUD currently gets all necessary supplies from the City of Cooper (Region D) sources. **Table 5E.161** shows the projected population and demand, the current supplies, and the water management strategies for Delta County MUD.

Table 5E.161 Summary of Water User Group – Delta County MUD (Region C Only)

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**45**	**45**	**46**	**46**	**47**	**49**
Projected Demands						
Municipal Demand	3	3	3	3	3	3
Total Projected Demand	***3***	***3***	***3***	***3***	***3***	***3***
Currently Available Supplies						
City of Cooper (Chapman)	3	3	3	3	3	3
Total Currently Available Supplies	***3***	***3***	***3***	***3***	***3***	***3***
Need (Demand – Supply)	***0***	***0***	***0***	***0***	***0***	***0***
Water Management Strategies						
None	0	0	0	0	0	0
Total Supplies from Strategies	***0***	***0***	***0***	***0***	***0***	***0***
Reserve (Shortage)	**0**	**0**	**0**	**0**	**0**	**0**

Desert WSC

Desert WSC serves parts of Fannin, Collin, and Grayson Counties, with the majority of the population located in Fannin County. The WSC gets its water supply from the Woodbine aquifer. Water management strategies for Desert WSC include conservation and new groundwater wells. **Table 5E.162** shows the projected population and demand, the current supplies, and the water management strategies for Desert WSC.

Table 5E.162 Summary of Water User Group – Desert WSC

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**1,700**	**1,897**	**2,080**	**2,464**	**3,234**	**4,280**
Projected Demands						
Municipal Demand	215	234	252	296	388	514
Total Projected Demand	***215***	***234***	***252***	***296***	***388***	***514***
Currently Available Supplies						
Woodbine Aquifer	392	392	392	392	392	392
Total Currently Available Supplies	***392***	***392***	***392***	***392***	***392***	***392***
Need (Demand – Supply)	***0***	***0***	***0***	***0***	***0***	***122***
Water Management Strategies						
Water Conservation	2	3	3	4	6	10
New Well(s) in Woodbine Aquifer	0	0	0	0	0	112
Total Supplies from Strategies	***2***	***3***	***3***	***4***	***6***	***122***
Reserve (Shortage)	**179**	**161**	**143**	**100**	**10**	**0**

Fannin County Irrigation

Irrigation demand projections include the water necessary for irrigation activities, including field crops, orchards, pasture, turf grass, vineyards, golf courses irrigated by raw water, and limited aquaculture operations.

The current supplies for Fannin County Irrigation are diversions from the Red River and groundwater from the Woodbine aquifer and Other aquifer (the alluvium of the Red River). It should be noted that run-of-river supplies are available only along the Red River. Historical groundwater use for Fannin County Irrigation is higher than can be shown as available in the *Region C Regional Water Plan* due to the MAG limitations. The limited availability of groundwater within the county as quantified by the modeled available groundwater causes unmet needs for this WUG.

Water management strategies for Fannin County Irrigation include conservation and new groundwater wells in the Trinity aquifer. **Table 5E.163** shows the projected demand, the current supplies, and the water management strategies for Fannin County Irrigation.

Table 5E.163 Summary of Water User Group – Fannin County Irrigation

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Demands						
Total Projected Demand	**11,553**	**11,553**	**11,553**	**11,553**	**11,553**	**11,553**
Currently Available Supplies						
Run-of-River (Red River)	4,613	4,613	4,613	4,613	4,613	4,613
Other Aquifer	2,909	2,909	2,909	2,909	2,909	2,909
Woodbine Aquifer	195	195	195	195	195	195
Total Currently Available Supplies	***7,717***	***7,717***	***7,717***	***7,717***	***7,717***	***7,717***
Need (Demand – Supply)	***3,836***	***3,836***	***3,836***	***3,836***	***3,836***	***3,836***
Water Management Strategies						
Water Conservation	1	18	34	42	50	58
New Wells in Trinity Aquifer	1,592	1,592	1,592	1,592	1,592	1,592
Total Supplies from Strategies	***1,593***	***1,610***	***1,626***	***1,634***	***1,642***	***1,650***
Reserve (Shortage)	**(2,243)**	**(2,226)**	**(2,210)**	**(2,202)**	**(2,194)**	**(2,186)**

Fannin County Livestock

Livestock water use is defined as water used in the production of livestock, both for consumption and for cleaning and environmental purposes. **Table 5E.164** shows the projected demand, current supplies, and water management strategies for Fannin County Livestock. The current supplies for Fannin County Livestock are local surface water supplies and groundwater (Trinity, Woodbine, and Other aquifers). These sources are sufficient to meet future demands, and there are no water management strategies for this water user group.

Table 5E.164 Summary of Water User Group – Fannin County Livestock

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Demands						
Total Projected Demand	**1,411**	**1,411**	**1,411**	**1,411**	**1,411**	**1,411**
Currently Available Supplies						
Local Supplies	1,306	1,306	1,306	1,306	1,306	1,306
Other Aquifer	10	10	10	10	10	10
Trinity Aquifer	63	63	63	63	63	63
Woodbine Aquifer	32	32	32	32	32	32
Total Currently Available Supplies	***1,411***	***1,411***	***1,411***	***1,411***	***1,411***	***1,411***
Need (Demand – Supply)	***0***	***0***	***0***	***0***	***0***	***0***
Water Management Strategies						
None	0	0	0	0	0	0
Total Supplies from Strategies	***0***	***0***	***0***	***0***	***0***	***0***
Reserve (Shortage)	**0**	**0**	**0**	**0**	**0**	**0**

Fannin County Manufacturing

Manufacturing water use is defined as water used to produce manufactured goods. The current supply is water from Lake Bonham through the City of Bonham. As the City of Bonham develops its strategies, the remaining need for manufacturing will be met. **Table 5E.165** shows the projected demand, the current supplies, and the water management strategies for Fannin County Manufacturing. Conservation was considered for this water user group, but it is not recommended because of the uncertainty in the ability to implement conservation measures given the multiple entities, facilities, and various manufacturing processes that make up this WUG.

Table 5E.165 Summary of Water User Group – Fannin County Manufacturing

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Demands						
Total Projected Demand	**12**	**12**	**12**	**12**	**12**	**12**
Currently Available Supplies						
NTMWD through Bonham	12	12	11	8	7	6
Total Currently Available Supplies	***12***	***12***	***11***	***8***	***7***	***6***
Need (Demand – Supply)	***0***	***0***	***1***	***4***	***5***	***6***
Water Management Strategies						
Bonham	0	0	1	4	5	6
Total Supplies from Strategies	***0***	***0***	***1***	***4***	***5***	***6***
Reserve (Shortage)	**0**	**0**	**0**	**0**	**0**	**0**

Fannin County Mining

Mining water demand includes water used for oil and gas development, as well as extraction of coal and lignite, sand aggregate, and other resources. Fannin County Mining is supplied from run-of-the river diversions. Other surface water supplies located in the county are not permitted for mining use. Remaining need could potentially be met through groundwater or reuse however there is not enough availability of groundwater within the county as quantified by the modeled available groundwater to meet the projected shortage. **Table 5E.166** shows the projected demand, the current supplies, and the water management strategies for Fannin County Mining.

Conservation was considered for this water user group, but it is not recommended because of the uncertainty in the ability to implement conservation measures given the multiple companies, industries, facilities, and types of processes that make up this WUG.

Table 5E.166 Summary of Water User Group – Fannin County Mining

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Demands						
Total Projected Demand	**574**	**351**	**128**	**128**	**128**	**128**
Currently Available Supplies						
Run-Of-River	72	72	72	72	72	72
Total Currently Available Supplies	***72***	***72***	***72***	***72***	***72***	***72***
Need (Demand – Supply)	***502***	***279***	***56***	***56***	***56***	***56***
Water Management Strategies						
None	0	0	0	0	0	0
Total Supplies from Strategies	***0***	***0***	***0***	***0***	***0***	***0***
Reserve (Shortage)	**(502)**	**(279)**	**(56)**	**(56)**	**(56)**	**(56)**

Fannin County Other

Fannin County Other includes individual domestic supplies and water suppliers too small to be classified as water user groups. The entities included under Fannin County Other receive their water supply from run-of-the-river diversions from the Red and Sulphur Rivers, and groundwater (Trinity and Woodbine aquifers). Water management strategies for these entities include conservation and participation in the Fannin County Water Supply Project.

The Fannin County Water Supply Project would be developed by Fannin County WUGs and NTMWD to provide a treated water supply system for Fannin County after Bois d'Arc Lake is completed. Supplies would be treated at the Leonard WTP and then conveyed through a pipeline to participating entities. This strategy is described in more detail in **Appendix G.**

Table 5E.167 shows the projected population and demand, the current supplies, and the water management strategies for Fannin County Other. The reserve is equivalent to the projected decrease in run-of-river and groundwater use.

Table 5E.167 Summary of Water User Group – Fannin County Other

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**5,959**	**4,936**	**5,331**	**7,867**	**22,271**	**38,645**
Projected Demands						
Municipal Demand	663	529	552	795	2,232	3,866
Total Projected Demand	***663***	***529***	***552***	***795***	***2,232***	***3,866***
Currently Available Supplies						
Run-of-River	49	49	49	49	49	49
Trinity Aquifer	184	184	184	184	184	184
Woodbine Aquifer	430	430	430	430	430	430
Total Currently Available Supplies	***663***	***663***	***663***	***663***	***663***	***663***
Need (Demand – Supply)	***0***	***0***	***0***	***132***	***1,569***	***3,203***
Water Management Strategies						
Water Conservation	5	7	6	11	37	77
Fannin County Water Supply Project	0	43	44	305	1,778	3,433
Total Supplies from Strategies	***5***	***50***	***50***	***316***	***1,815***	***3,510***
Reserve (Shortage)	**5**	**184**	**161**	**184**	**246**	**307**

Fannin County Steam Electric Power

Steam electric power demands generally represent the cooling water needs during power generation. These demands do not include water that is used in cogeneration facilities (which is included in manufacturing projections), facilities which do not require water for production, or hydro-electric generation facilities. Luminant has a water right out of Lake Texoma, but the existing power plant in Fannin County is not operational at this time. There is no projected demand for steam electric power in Fannin County.

Hickory Creek Special Utility District

Hickory Creek SUD serves eastern Collin County, southern Fannin County, and northwestern Hunt County. The SUD is primarily located in Hunt County in the North East Texas Region (Region D), and the supply for Region C is groundwater from the Woodbine aquifer in Hunt County in the North East Texas Region. The SUD intends to develop additional groundwater to meet its projected water needs. However, there is insufficient available groundwater under the MAG to show this strategy as recommended. As a result, Hickory Creek SUD is shown to have an unmet need through the planning period. Since Hunt County does not have a groundwater district to enforce MAG limits, the SUD intends to further develop groundwater under State law. **Table 5E.168** shows the projected population and demand, the current supplies, and the water management strategies for Hickory Creek SUD in Region C.

Table 5E.168 Summary of Water User Group – Hickory Creek SUD (Region C Only)

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**401**	**476**	**557**	**674**	**835**	**1,052**
Projected Demands						
Municipal Demand	40	45	53	62	77	98
Total Projected Demand	***40***	***45***	***53***	***62***	***77***	***98***
Currently Available Supplies						
Woodbine Aquifer (Region D)	29	22	19	16	14	13
Total Currently Available Supplies	***29***	***22***	***19***	***16***	***14***	***13***
Need (Demand – Supply)	***11***	***23***	***34***	***46***	***63***	***85***
Water Management Strategies						
None	***0***	***0***	***0***	***0***	***0***	***0***
Reserve (Shortage)	**(11)**	**(23)**	**(34)**	**(46)**	**(63)**	**(85)**

Honey Grove

Honey Grove is located in eastern Fannin County. The city currently gets its water supplies from the Woodbine aquifer. Water management strategies for Honey Grove include water conservation and participation in the Fannin County Water Supply Project.

The Fannin County Water Supply Project would be developed by Fannin County WUGs and NTMWD in order to provide a treated water supply system for Fannin County after Bois d'Arc Lake is completed. . Supplies would be treated at the Leonard WTP and then conveyed through a pipeline to participating entities. This strategy is described in more detail in **Appendix G.**

Table 5E.169 shows the projected population and demand, the current supplies, and the water management strategies for Honey Grove. The reserve is equal to the projected decrease in groundwater use.

Table 5E.169 Summary of Water User Group – City of Honey Grove

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**1,817**	**1,828**	**1,828**	**1,828**	**1,828**	**1,828**
Projected Demands						
Municipal Demand	292	284	277	275	274	274
Total Projected Demand	***292***	***284***	***277***	***275***	***274***	***274***
Currently Available Supplies						
Woodbine Aquifer	292	292	292	292	292	292
Total Currently Available Supplies	***292***	***292***	***292***	***292***	***292***	***292***
Need (Demand – Supply)	***0***	***0***	***0***	***0***	***0***	***0***
Water Management Strategies						
Water Conservation	3	4	3	4	5	5
Fannin County Water Supply Project	0	280	274	271	269	269
Total Supplies from Strategies	***3***	***284***	***277***	***275***	***274***	***274***
Reserve (Shortage)	**3**	**292**	**292**	**292**	**292**	**292**

Ladonia

Ladonia is located in southeastern Fannin County. The city gets its water from the Trinity aquifer, and water management strategies include conservation and purchasing raw water from Upper Trinity Regional Water District and treating it. **Table 5E.170** shows the projected population and demand, the current supplies, and the water management strategies for Ladonia.

Table 5E.170 Summary of Water User Group – City of Ladonia

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**1,600**	**2,000**	**2,200**	**2,500**	**3,000**	**3,000**
Projected Demands						
Municipal Demand	248	304	332	376	451	451
Total Projected Demand	***248***	***304***	***332***	***376***	***451***	***451***
Currently Available Supplies						
Trinity Aquifer	248	248	248	248	248	248
Total Currently Available Supplies	***248***	***248***	***248***	***248***	***248***	***248***
Need (Demand – Supply)	***0***	***56***	***84***	***128***	***203***	***203***
Water Management Strategies						
Water Conservation	3	6	3	5	8	9
UTRWD (Ralph Hall Lake)	0	75	131	199	295	294
Total Supplies from Strategies	***3***	***81***	***134***	***204***	***303***	***303***
Reserve (Shortage)	**3**	**25**	**50**	**76**	**100**	**100**

Leonard

Leonard is located in southwestern Fannin County. The city gets its water from the Woodbine aquifer. Water management strategies for Leonard include conservation, participating in the Fannin County Water Supply Project, and water system improvements needed in order to receive supplies from the Fannin County Water Supply Project (such as an elevated storage tank).

The Fannin County Water Supply Project would be developed by Fannin County WUGs and NTMWD in order to provide a treated water supply system for Fannin County after Bois d'Arc Lake is completed. . Supplies would be treated at the Leonard WTP and then conveyed through a pipeline to participating entities. This strategy is described in more detail in **Appendix G.**

Table 5E.171 shows the projected population and demand, the current supplies, and the water management strategies for Leonard. The reserve is equal to the projected decrease in groundwater use.

Table 5E.171 Summary of Water User Group – City of Leonard

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**2,200**	**2,400**	**2,500**	**2,600**	**2,700**	**2,800**
Projected Demands						
Municipal Demand	328	347	353	363	376	390
Total Projected Demand	***328***	***347***	***353***	***363***	***376***	***390***
Currently Available Supplies						
Woodbine Aquifer	328	328	328	328	328	328
Total Currently Available Supplies	***328***	***328***	***328***	***328***	***328***	***328***
Need (Demand – Supply)	***0***	***19***	***25***	***35***	***48***	***62***
Water Management Strategies						
Water Conservation	3	4	4	5	6	8
Fannin County Water Supply Project	0	343	349	358	370	382
Water System Improvements	*0*	*343*	*349*	*358*	*370*	*382*
Total Supplies from Strategies	***3***	***347***	***353***	***363***	***376***	***390***
Reserve (Shortage)	**3**	**328**	**328**	**328**	**328**	**328**

North Hunt Special Utility District

North Hunt SUD serves southern Fannin County in Region C and Delta and Hunt Counties in the North East Texas Region (Region D). The WSC is primarily located in the North East Texas Region (Region D). North Hunt SUD supply in Region C is groundwater from the Woodbine aquifer, and the only Region C water management strategy is conservation. **Table 5E.172** shows the projected population and demand, the current supplies, and the water management strategy for the Region C portion of North Hunt SUD. Plans for the North East Texas Region portion of the WSC are covered in that regional water plan.

Table 5E.172 Summary of Water User Group – North Hunt Special Utility District (Region C Only)

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**525**	**577**	**617**	**653**	**709**	**769**
Projected Demands						
Municipal Demand	35	39	41	44	48	52
Total Projected Demand	***35***	***39***	***41***	***44***	***48***	***52***
Currently Available Supplies						
Woodbine Aquifer	55	55	55	55	55	55
Total Currently Available Supplies	***55***	***55***	***55***	***55***	***55***	***55***
Need (Demand – Supply)	***0***	***0***	***0***	***0***	***0***	***0***
Water Management Strategies						
Water Conservation	0	0	0	1	1	1
Total Supplies from Strategies	***0***	***0***	***0***	***1***	***1***	***1***
Reserve (Shortage)	**20**	**16**	**14**	**12**	**8**	**4**

Southwest Fannin County Special Utility District

Southwest Fannin County SUD serves western Fannin County and eastern Grayson County. The SUD's existing water supply comes from the Woodbine aquifer. Water management strategies for Southwest Fannin County SUD include water conservation, a new well in the Woodbine aquifer (with associated transmission facilities), and participation in the Fannin County Water Supply Project.

The Fannin County Water Supply Project would be developed by Fannin County WUGs and NTMWD in order to provide a treated water supply system for Fannin County after Bois d'Arc Lake is completed. Supplies would be treated at the Leonard WTP and then conveyed through a pipeline to participating entities. This strategy is described in more detail in **Appendix G.**

Table 5E.173 shows the projected population and demand, the current supplies, and the water management strategies for Southwest Fannin County SUD.

Table 5E.173 Summary of Water User Group – Southwest Fannin County SUD

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**5,835**	**6,824**	**7,878**	**9,037**	**11,496**	**14,330**
Projected Demands						
Municipal Demand	578	654	742	844	1,070	1,331
Total Projected Demand	***578***	***654***	***742***	***844***	***1,070***	***1,331***
Currently Available Supplies						
Woodbine Aquifer	627	627	627	627	627	627
Total Currently Available Supplies	***627***	***627***	***627***	***627***	***627***	***627***
Need (Demand – Supply)	***0***	***27***	***115***	***217***	***443***	***704***
Water Management Strategies						
Water Conservation	5	7	7	11	19	30
New Well(s) in Woodbine Aquifer	0	100	100	100	100	100
Fannin County Water Supply Project	0	0	8	106	324	574
Total Supplies from Strategies	***5***	***107***	***115***	***217***	***443***	***704***
Reserve (Shortage)	**54**	**80**	**0**	**0**	**0**	**0**

Trenton

Trenton is located in southwestern Fannin County. The city gets its water from the Woodbine aquifer. Water management strategies for Trenton include conservation, a new well in the Woodbine Aquifer, and participation in the Fannin County Water Supply Project.

The Fannin County Water Supply Project would be developed by Fannin County WUGs and NTMWD in order to provide a treated water supply system for Fannin County after Bois d'Arc Lake is completed. Supplies would be treated at the Leonard WTP and then conveyed through a pipeline to participating entities. This strategy is described in more detail in **Appendix G.**

Table 5E.174 shows the projected population and demand, the current supplies, and the water management strategies for Trenton.

Table 5E.174 Summary of Water User Group – City of Trenton

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**736**	**934**	**2,102**	**4,203**	**7,248**	**10,271**
Projected Demands						
Municipal Demand	136	166	365	729	1,256	1,780
Total Projected Demand	***136***	***166***	***365***	***729***	***1,256***	***1,780***
Currently Available Supplies						
Woodbine Aquifer	136	136	136	136	136	136
Total Currently Available Supplies	***136***	***136***	***136***	***136***	***136***	***136***
Need (Demand – Supply)	***0***	***30***	***229***	***593***	***1,120***	***1,644***
Water Management Strategies						
Water Conservation	1	8	22	47	84	127
New Well(s) in Woodbine Aquifer	0	25	25	25	25	25
Fannin County Water Supply Project	0	0	182	521	1,011	1,492
Total Supplies from Strategies	***1***	***33***	***229***	***593***	***1,120***	***1,644***
Reserve (Shortage)	**1**	**3**	**0**	**0**	**0**	**0**

West Leonard Water Supply Corporation

West Leonard Water Supply Corporation is located in Collin and Fannin Counties in Region C and Hunt County in Region D. The WSC receives its water supply from the Woodbine aquifer, and the only water management strategy is conservation. **Table 5E.175** shows the projected population and demand, the current supplies, and the water management strategies for Trenton.

Table 5E.175 Summary of Water User Group – West Leonard WSC(Region C and D)

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**1,606**	**1,781**	**1,821**	**2,074**	**2,609**	**3,309**
Projected Demands						
Municipal Demand	214	230	230	260	325	412
Total Projected Demand	***214***	***230***	***230***	***260***	***325***	***412***
Currently Available Supplies						
Woodbine Aquifer	412	412	412	412	412	412
Total Currently Available Supplies	***412***	***412***	***412***	***412***	***412***	***412***
Need (Demand – Supply)	***0***	***0***	***0***	***0***	***0***	***0***
Water Management Strategies						
Water Conservation	2	2	2	3	5	8
Total Supplies from Strategies	***2***	***2***	***2***	***3***	***5***	***8***
Reserve (Shortage)	**200**	**184**	**184**	**155**	**92**	**8**

White Shed Water Supply Corporation

White Shed WSC supplies water to north-central Fannin County. The WSC gets its water supply from the Woodbine aquifer. The water management strategies are conservation and new groundwater wells. **Table 5E.176** shows the projected population and demand, the current supplies, and the water management strategies for White Shed WSC.

Table 5E.176 Summary of Water User Group – White Shed WSC

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**2,769**	**3,133**	**3,809**	**4,998**	**7,360**	**10,001**
Projected Demands						
Municipal Demand	301	327	386	501	735	998
Total Projected Demand	***301***	***327***	***386***	***501***	***735***	***998***
Currently Available Supplies						
Woodbine Aquifer	301	301	301	301	301	301
Total Currently Available Supplies	***301***	***301***	***301***	***301***	***301***	***301***
Need (Demand – Supply)	***0***	***26***	***85***	***200***	***434***	***697***
Water Management Strategies						
Water Conservation	3	4	4	7	12	21
New Well(s) in Woodbine Aquifer	0	22	81	193	422	676
Total Supplies from Strategies	***3***	***26***	***85***	***200***	***434***	***697***
Reserve (Shortage)	**3**	**0**	**0**	**0**	**0**	**0**

Whitewright

Whitewright is located in eastern Grayson County with a small area in Fannin County. The city's water supply plans are discussed under Grayson County in **Section 5E.8**.

Wolfe City

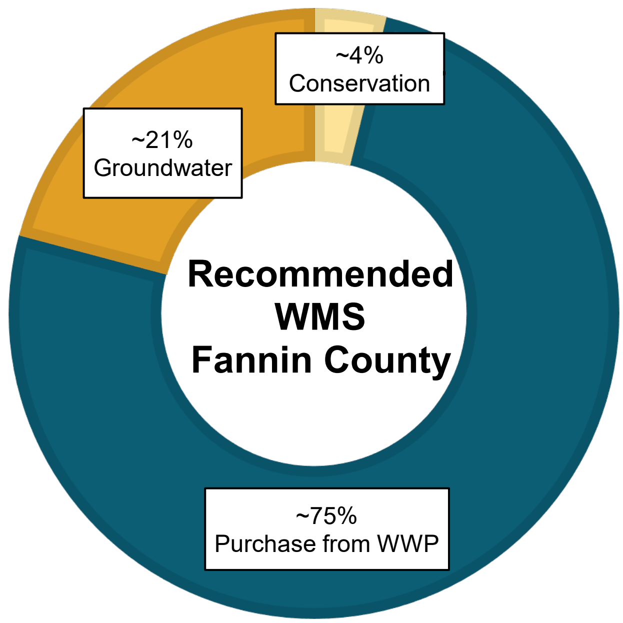
Wolfe City is located in Fannin County. The city gets its water supply from Turkey Creek Lake and the Woodbine aquifer. The recommended water management strategies include conservation and additional groundwater. **Table 5E.177** shows the projected population and demand, the current supplies, and the water management strategies for Wolfe City.

Table 5E.177 Summary of Water User Group – Wolfe City (Region C Only)

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**90**	**112**	**142**	**183**	**242**	**327**
Projected Demands						
Municipal Demand	9	10	13	16	22	29
Total Projected Demand	***9***	***10***	***13***	***16***	***22***	***29***
Currently Available Supplies						
Turkey Creek Lake	10	10	10	10	10	10
Woodbine Aquifer	4	3	4	4	4	4
Total Currently Available Supplies	***14***	***13***	***14***	***14***	***14***	***14***
Need (Demand – Supply)	***0***	***0***	***0***	***2***	***8***	***15***
Water Management Strategies						
Water Conservation	0	0	0	0	0	1
Additional Groundwater	0	0	0	2	8	14
Total Supplies from Strategies	***0***	***0***	***0***	***2***	***8***	***15***
Reserve (Shortage)	**5**	**3**	**1**	**0**	**0**	**0**

5E.6.2 Summary of Costs for Fannin County

Table 5E.178 summarizes the costs of the water management strategies recommended for the WUGs and WWPs who have the majority of their demand located in Fannin County. Total quantities from **Table 5E.178** will not necessarily match total county demands. This is due mainly to water users whose sum of strategies results in a reserve as well as due to water users located in multiple counties (or wholesale water providers who develop strategies and then sell water to users in other counties). Quantities from infrastructure projects needed to deliver and/or treat water (shown in *gray italics*) are not included since the supplies are associated with other strategies. To avoid double-counting quantities of supplies, the quantities in gray italics are **not** included in the total.



The majority of the future supplies needed to meet demands within Fannin County are projected to come through additional groundwater. Other strategies include purchases from WWPs, conservation and additional surface water from Lake Ralph Hall and the Fannin County Water Supply Project (Bois d'Arc Lake).

Table 5E.179 summarizes the recommended water management strategies within Fannin County individually. Alternative strategies are also included. More detailed cost estimates are located in **Appendix H.**

Table 5E.178 Summary of Recommended Water Management Strategies for Fannin County

Type of Strategy	Quantity (Ac-Ft/Yr)	Capital Costs
Conservation[a]	540	$199,586
Purchase from WWP	10,623	$0
Additional Infrastructure	*1,306*	*$22,163,000*
Groundwater	2,943	$15,028,000
Total	**14,106**	**$37,390,586**

[a]The conservation quantities represent the sum of the individual water user groups who have the majority of their service areas located in the county, not the total conservation in the county.

Table 5E.179 Costs for Water Management Strategies for Fannin County

WWP or WUG	Strategy	Online by:	Quantity (Ac-Ft/Yr)[b]	Capital Costs[c]	Unit Cost ($/1000 gal) With Debt Service	Unit Cost ($/1000 gal) After Debt Service	Table
WWPs							
There are no wholesale water providers in Fannin County.							
WUGs							
Arledge Ridge WSC	Conservation	2020	10	$2,763	$0.30	$0.00	H.11
Arledge Ridge WSC	New Well(s) in Woodbine Aquifer	2040	350	$4,537,000	$4.75	$1.95	H.14
Bois D Arc MUD	Conservation	2020	18	$8,698	$0.94	$0.00	H.11
Bois D Arc MUD	NTMWD	2030	623	$0	$2.78	$2.78	None
Bois D Arc MUD	*Connect to NTMWD*	*2030*	*623*	*$4,108,000*	*$1.64*	*$1.64*	*H.121*
Bonham	Conservation	2040	155	$72,634	$0.78	$0.00	H.11
Bonham	Fannin County Water Supply Project	2040	3,544	See NTMWD in **Chapter 5D**.			
Delta County MUD	None	None					
Desert WSC	Conservation	2020	10	$11,979	$1.29	$0.00	H.11
Desert WSC	New Well(s) in Woodbine Aquifer	2070	112	$1,469,000	$4.98	$2.14	H.14
Hickory Creek SUD[a] (Region C portion only)	None	2020	0	See Region D Plan.			
Honey Grove	Conservation	2020	5	$25,668	$1.85	$0.00	H.11
Honey Grove	Fannin County Water Supply Project	2030	280	See NTMWD in **Chapter 5D**.			
Ladonia	Conservation	2020	9	$1,864	$0.13	$0.00	H.11
Ladonia	UTRWD (Lake Ralph Hall) and Treatment	2030	295	$0	$1.48	$1.48	None
Ladonia	*Infrastructure and treatment for water from Ralph Hall*	*2030*	*295*	*$14,774,000*	*$19.22*	*$8.40*	*H.122*
Leonard	Conservation	2020	8	$19,291	$1.39	$0.00	H.11

WWP or WUG	Strategy	Online by:	Quantity (Ac-Ft/Yr)[b]	Capital Costs[c]	Unit Cost ($/1000 gal) With Debt Service	Unit Cost ($/1000 gal) After Debt Service	Table
	Fannin County Water Supply Project	2030	382	See NTMWD in **Chapter 5D**.			
	Water System Improvements	*2030*	*382*	*$3,281,000*	*$4.14*	*$0.80*	*H.123*
North Hunt WSC[a]	Conservation	2020	1	See Region D Plan.			
Southwest Fannin Co SUD[a]	Conservation	2020	30	$14,710	$0.64	$0.10	H.11
	New Well(s) in Woodbine Aquifer	2030	100	$1,148,000	$4.19	$1.71	H.14
	Fannin County Water Supply Project	2040	574	See NTMWD in **Chapter 5D**.			
Trenton	Conservation	2020	127	$1,908	$0.41	$0.80	H.11
	New Well(s) in Woodbine Aquifer	2030	25	$1,341,000	$14.55	$2.97	H.14
	Fannin County Water Supply Project	2040	1,492	See NTMWD in **Chapter 5D**.			
West Leonard WSC	Conservation	2020	8	$11,752	$1.27	$0.00	H.11
White Shed WSC	Conservation	2020	21	$14,466	$1.04	$0.05	H.11
	New Well(s) in Woodbine Aquifer	2030	676	$6,299,000	$3.64	$1.63	H.14
Whitewright[a]	Conservation	See Grayson County.					
	Connect to Sherman						
Wolfe City	Conservation	2020	1	$0	$0.00	$0.00	H.11
County Other and Non-Municipal							
County Other, Fannin	Conservation	2020	77	$13,853	$0.60	$0.00	H.11
	Fannin County Water Supply Project	2030	3,433	See NTMWD in **Chapter 5D**.			
Irrigation, Fannin	Conservation	2020	58	$0	$0.94	$0.94	H.11F
	New Well(s) in Trinity Aquifer	2020	1,592	$234,000	$0.09	$0.06	H.14
Livestock, Fannin	None	None					

WWP or WUG	Strategy	Online by:	Quantity (Ac-Ft/Yr)[b]	Capital Costs[c]	Unit Cost ($/1000 gal)		Table
					With Debt Service	After Debt Service	
Manufacturing, Fannin	Bonham	2040	6	$0	$3.00	$3.00	None
Mining, Fannin	None	None					
Steam Electric Power, Fannin	None	None					

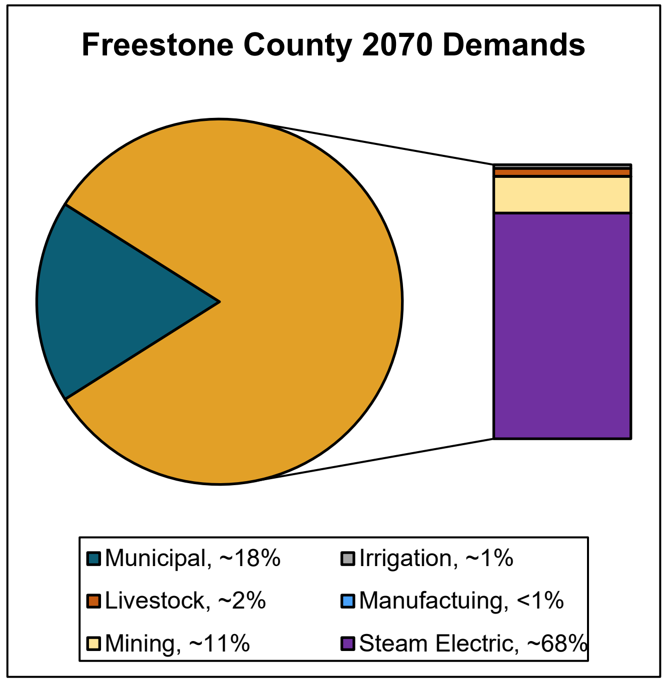
[a]Water user groups extend into more than one county.
[b]Quantities listed are for the WUG only. They do not include the WUG's customers.
[c]Purchases from wholesale water providers that require no new infrastructure have no capital costs. The unit costs shown in the table represent the cost to purchase water from the WWP.

5E.7 Freestone County

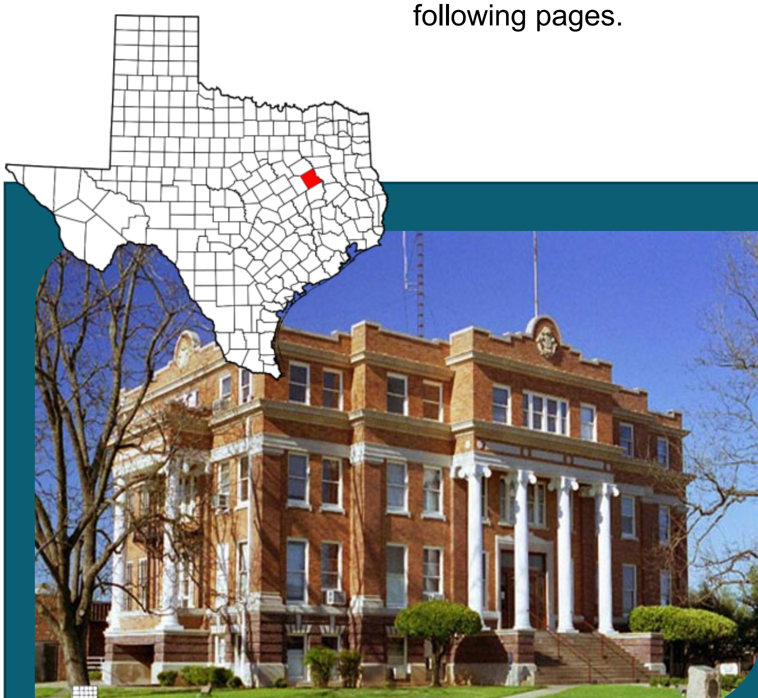
Freestone County is located in the southeast portion of Region C. **Figure 5E.14** shows water service areas in Freestone County.

Freestone County's population is projected to more than triple between 2020 and 2070.

The largest demand in the county is steam electric power. However, the largest power plant in the county, Luminant's Big Brown Plant, has been shut down and is not currently operating. The demands are still included in the projections in case the plant becomes operational again over the planning horizon. The second and third largest demand categories are municipal and mining. Livestock, irrigation and manufacturing demands account for less than 5% of the county's total demands each.



Tarrant Regional Water District (TRWD) is a major water provider that provides supplies to Freestone County. An overall summary of the County's projections are shown in **Table 5E.180**, and water management strategies for individual WWPs and WUGs are discussed on the following pages.



Freestone County Quick Facts

2010 Population: 19,816

Projected 2070 Population: 73,287

Projected 2070 Demand: 45 MGD

County Seat: Fairfield

Economy: Natural gas, mining, electricity generating plants, agriculture

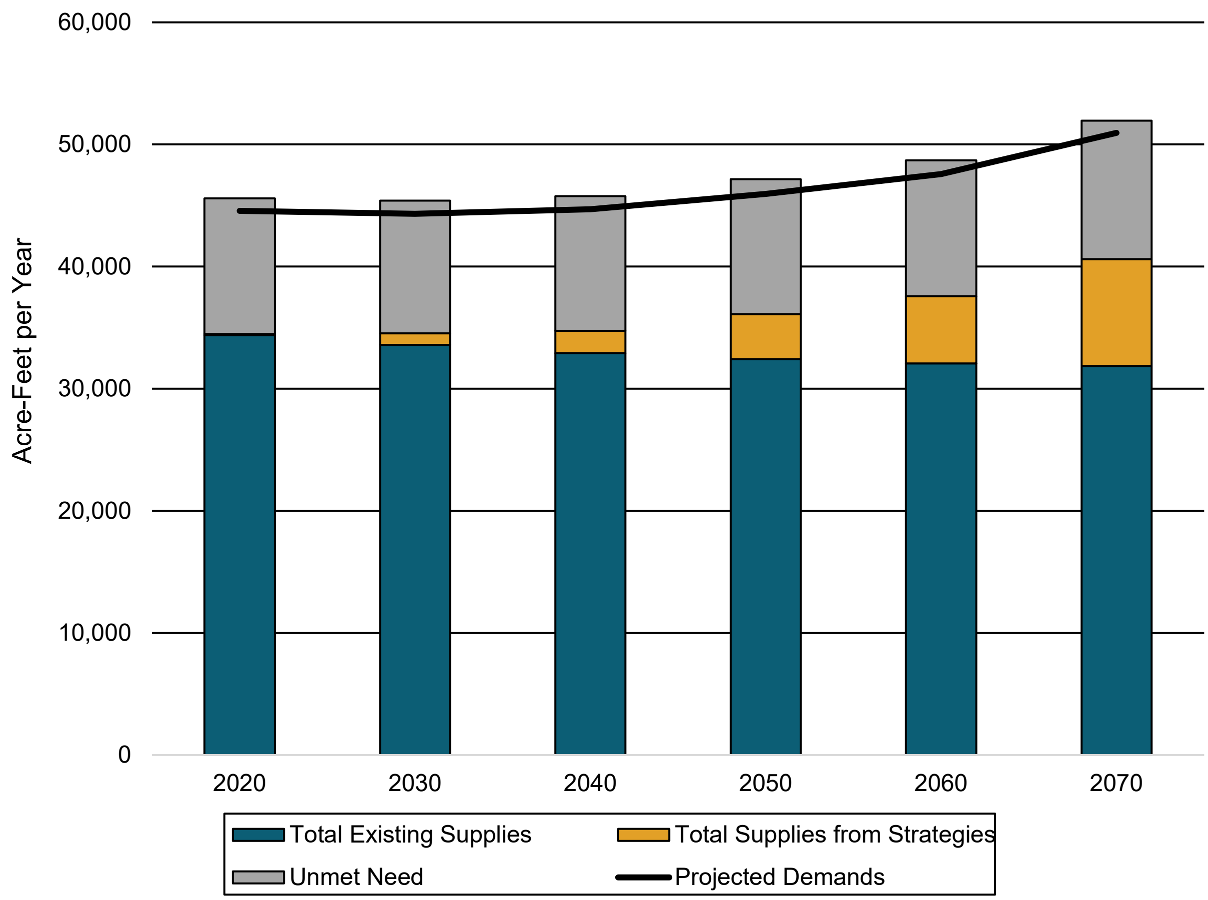
River Basins: Trinity (89%), Brazos (11%)

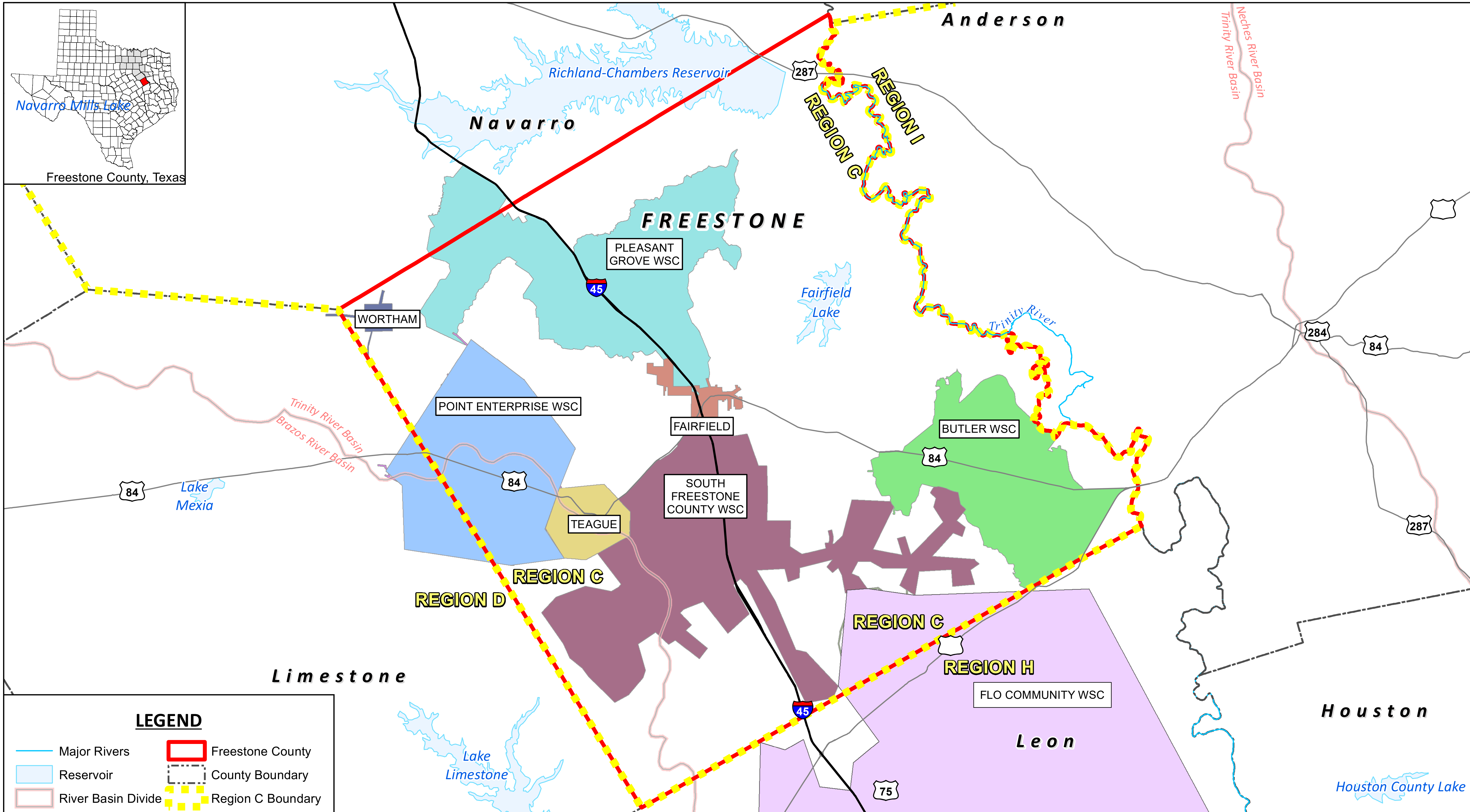
Table 5E.180 Summary of Freestone County

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**20,437**	**21,077**	**22,947**	**31,142**	**44,475**	**73,287**
Projected Demands	**44,552**	**44,322**	**44,683**	**45,961**	**47,574**	**50,948**
Municipal	2,978	2,980	3,205	4,448	5,991	9,139
Irrigation	569	569	569	569	569	569
Livestock	1,207	1,207	1,207	1,207	1,207	1,207
Manufacturing	19	19	19	19	19	19
Mining	5,347	5,115	5,251	5,286	5,356	5,582
Steam Electric	34,432	34,432	34,432	34,432	34,432	34,432
Total Existing Supplies	**34,380**	**33,585**	**32,914**	**32,404**	**32,076**	**31,860**
Need (Demand - Supply)	**10,172**	**10,737**	**11,769**	**13,557**	**15,498**	**19,088**
Total Supplies from Strategies	**112**	**954**	**1,835**	**3,702**	**5,503**	**8,744**
Reserve (Shortage)	**(10,060)**	**(9,783)**	**(9,934)**	**(9,855)**	**(9,995)**	**(10,344)**
Unmet Needs[a]	**11,101**	**10,869**	**11,005**	**11,040**	**11,110**	**11,336**

[a]Unmet needs are for Freestone County Mining and Steam Electric Power

Figure 5E.13 Summary of Freestone County





REGION C
Water Planning for North Texas

2021 Region C Water Plan
FREESTONE COUNTY, TEXAS
FIGURE 5E.14

Data Source(s): ESRI, USGS, TNRIS

5E.7.1 Wholesale Water Providers and Water User Groups

There are no wholesale water providers in Freestone County. Water management strategies for Freestone County water user groups are discussed below (in alphabetical order). The costs for Freestone County water user groups and a summary for Freestone County are presented in **Section 5E.7.2**

Butler Water Supply Corporation

Butler WSC provides water to Freestone County. The WSC gets its water supply from the Carrizo-Wilcox aquifer, and the only water management strategy is conservation. **Table 5E.181** shows the projected population and demand, the current supplies, and the water management strategies for Butler WSC.

Table 5E.181 Summary of Water User Group – Butler WSC

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**1,450**	**1,465**	**1,475**	**1,490**	**1,497**	**1,506**
Projected Demands						
Municipal Demand	223	218	214	214	215	216
Total Projected Demand	***223***	***218***	***214***	***214***	***215***	***216***
Currently Available Supplies						
Carrizo-Wilcox Aquifer	223	223	223	223	223	223
Total Currently Available Supplies	***223***	***223***	***223***	***223***	***223***	***223***
Need (Demand – Supply)	***0***	***0***	***0***	***0***	***0***	***0***
Water Management Strategies						
Water Conservation	2	2	2	3	4	4
Total Supplies from Strategies	***2***	***2***	***2***	***3***	***4***	***4***
Reserve (Shortage)	**2**	**7**	**11**	**12**	**12**	**11**

Fairfield

Fairfield is located in central Freestone County. The city's water supply is groundwater from the Carrizo-Wilcox aquifer. Water management strategies for Fairfield include conservation and purchasing raw water from TRWD and building a new treatment plant. **Table 5E.182** shows the projected population and demand, the current supplies, and the water management strategies for Fairfield.

Table 5E.182 Summary of Water User Group – City of Fairfield

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**4,593**	**4,670**	**4,951**	**8,749**	**10,498**	**14,116**
Projected Demands						
Municipal Demand	955	948	987	1,730	2,073	2,786
Total Projected Demand	***955***	***948***	***987***	***1,730***	***2,073***	***2,786***
Currently Available Supplies						
Carrizo-Wilcox Aquifer	1,100	1,100	1,100	1,100	1,100	1,100
Total Currently Available Supplies	***1,100***	***1,100***	***1,100***	***1,100***	***1,100***	***1,100***
Need (Demand – Supply)	***0***	***0***	***0***	***630***	***973***	***1,686***
Water Management Strategies						
Water Conservation	8	11	10	96	141	203
Connect to TRWD with New 3 MGD WTP	0	0	0	534	832	1,483
Total Supplies from Strategies	***8***	***11***	***10***	***630***	***973***	***1,686***
Reserve (Shortage)	**153**	**163**	**123**	**0**	**0**	**0**

Flo Community Water Supply Corporation

Flo Community WSC serves southern Freestone County and part of Leon County in Region H. The current water supply for this WSC in Region C is the Carrizo-Wilcox aquifer. The only water management strategy for Flo Community WSC in Region C is conservation. Most of the WSC's service area is in Region H, and the strategies for Region H are covered in that regional water plan. **Table 5E.183** shows the projected population and demand, the current supplies, and the water management strategies for Flo Community WSC in Region C.

Table 5E.183 Summary of Water User Group – Flo Community WSC (Region C Only)

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population (Region C)	**3,079**	**3,604**	**4,129**	**4,654**	**5,179**	**5,704**
Projected Demands						
Municipal Demand	392	444	498	553	615	677
Total Projected Demand	***392***	***444***	***498***	***553***	***615***	***677***
Currently Available Supplies						
Carrizo-Wilcox Aquifer	392	444	498	553	615	677
Total Currently Available Supplies	***392***	***444***	***498***	***553***	***615***	***677***
Need (Demand – Supply)	***0***	***0***	***0***	***0***	***0***	***0***
Water Management Strategies						
Water Conservation	0	0	1	1	1	1
Total Supplies from Strategies	***0***	***0***	***1***	***1***	***1***	***1***
Reserve (Shortage)	**0**	**0**	**1**	**1**	**1**	**1**

Freestone County Irrigation

Irrigation demand projections include the water necessary for irrigation activities, including field crops, orchards, pasture, turf grass, vineyards, golf courses irrigated by raw water, and limited aquaculture operations. The water supplies for Freestone County irrigation are local supplies and groundwater from the Carrizo-Wilcox aquifer. These existing supplies are sufficient to meet the projected demand. **Table 5E.184** shows the projected demand, the current supplies, and the water management strategies for Freestone County Irrigation.

Table 5E.184 Summary of Water User Group – Freestone County Irrigation

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Demands						
Total Projected Demand	**569**	**569**	**569**	**569**	**569**	**569**
Currently Available Supplies						
Carrizo-Wilcox Aquifer	613	613	613	613	613	613
Local Supplies	87	87	87	87	87	87
Total Currently Available Supplies	***700***	***700***	***700***	***700***	***700***	***700***
Need (Demand – Supply)	***0***	***0***	***0***	***0***	***0***	***0***
Water Management Strategies						
None	0	0	0	0	0	0
Total Supplies from Strategies	***0***	***0***	***0***	***0***	***0***	***0***
Reserve (Shortage)	**131**	**131**	**131**	**131**	**131**	**131**

Freestone County Livestock

Livestock water use is defined as water used in the production of livestock, both for consumption and for cleaning and environmental purposes. The water supplies for Freestone County Livestock are local surface water supplies and groundwater (Carrizo-Wilcox aquifer). These supplies are sufficient to meet projected demands, and there are no water management strategies. **Table 5E.185** shows the projected demand, current supplies, and water management strategy for Freestone County Livestock.

Table 5E.185 Summary of Water User Group – Freestone County Livestock

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Demands						
Total Projected Demand	**1,207**	**1,207**	**1,207**	**1,207**	**1,207**	**1,207**
Currently Available Supplies						
Carrizo-Wilcox Aquifer	164	164	164	164	164	164
Local Supplies	1,043	1,043	1,043	1,043	1,043	1,043
Total Currently Available Supplies	***1,207***	***1,207***	***1,207***	***1,207***	***1,207***	***1,207***
Need (Demand – Supply)	***0***	***0***	***0***	***0***	***0***	***0***
Water Management Strategies						
None	0	0	0	0	0	0
Total Supplies from Strategies	***0***	***0***	***0***	***0***	***0***	***0***
Reserve (Shortage)	**0**	**0**	**0**	**0**	**0**	**0**

Freestone County Manufacturing

Manufacturing water use is defined as water used to produce manufactured goods. The water supply for Freestone County Manufacturing is groundwater from the Carrizo-Wilcox aquifer through the City of Teague. The existing supplies are sufficient to meet the projected demand, and there are no water management strategies for Freestone County Manufacturing. **Table 5E.186** shows the projected demand, the current supplies, and the water management strategies for Freestone County Manufacturing.

Table 5E.186 Summary of Water User Groups – Freestone County Manufacturing

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Demands						
Total Projected Demand	**19**	**19**	**19**	**19**	**19**	**19**
Currently Available Supplies						
Carrizo-Wilcox Aquifer (Teague)	19	19	19	19	19	19
Total Currently Available Supplies	***19***	***19***	***19***	***19***	***19***	***19***
Need (Demand – Supply)	***0***	***0***	***0***	***0***	***0***	***0***
Water Management Strategies						
None	0	0	0	0	0	0
Total Supplies from Strategies	***0***	***0***	***0***	***0***	***0***	***0***
Reserve (Shortage)	**0**	**0**	**0**	**0**	**0**	**0**

Freestone County Mining

Mining water demand includes water used for oil and gas development, as well as extraction of coal and lignite, sand aggregate, and other resources. The water supplies for Freestone County Mining are local supplies and groundwater from the Carrizo-Wilcox aquifer.

The large demand associated with Freestone County Mining is primarily the de-watering of mines during mining operations rather than water required for the mining process. Since the dewatering of mines is not considered to be a true demand, Region C has chosen to leave this as an unmet need and is not developing water management strategies to meet this demand. Consequently, there are no water management strategies for Freestone County Mining.

Table 5E.187 shows the projected demand, the current supplies, and the water management strategies for Freestone County Mining.

Table 5E.187 Summary of Water User Groups – Freestone County Mining

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Demands						
Total Projected Demand	**5,347**	**5,115**	**5,251**	**5,286**	**5,356**	**5,582**
Currently Available Supplies						
Carrizo-Wilcox Aquifer	892	892	892	892	892	892
Local Supplies	120	120	120	120	120	120
Total Currently Available Supplies	***1,012***	***1,012***	***1,012***	***1,012***	***1,012***	***1,012***
Need (Demand – Supply)	***4,335***	***4,103***	***4,239***	***4,274***	***4,344***	***4,570***
Water Management Strategies						
None	0	0	0	0	0	0
Total Supplies from Strategies	***0***	***0***	***0***	***0***	***0***	***0***
Reserve (Shortage)	**(4,335)**	**(4,103)**	**(4,239)**	**(4,274)**	**(4,344)**	**(4,570)**

Freestone County Other

Freestone County Other includes individual domestic supplies and water suppliers too small to be classified as water user groups. The water supplies for these entities are run-of-the-river local supply, groundwater from the Carrizo-Wilcox aquifer, and water purchased from Corsicana. Water management strategies for these entities include conservation, purchasing additional water from Corsicana (with additional delivery infrastructure), and developing a treated water supply from TRWD including new delivery facilities and water treatment facilities. **Table 5E.188** shows the projected population and demand, the current supplies, and the water management strategies for Freestone County Other.

Table 5E.188 Summary of Water User Group – Freestone County Other

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**4,101**	**4,078**	**3,751**	**4,673**	**11,270**	**29,241**
Projected Demands						
Municipal Demand	422	405	361	439	1,051	2,716
Total Projected Demand	***422***	***405***	***361***	***439***	***1,051***	***2,716***
Currently Available Supplies						
Carrizo-Wilcox Aquifer	848	848	848	848	848	848
Corsicana	42	41	36	40	86	195
Run-of-River	41	41	41	41	41	41
Total Currently Available Supplies	***931***	***930***	***925***	***929***	***975***	***1,084***
Need (Demand – Supply)	***0***	***0***	***0***	***0***	***76***	***1,632***
Water Management Strategies						
Water Conservation	3	5	4	6	18	54
Corsicana with Additional Delivery Infrastructure	0	0	0	3	17	72
Connect to TRWD with Delivery and Treatment Facilities	0	0	0	349	889	2,354
Total Supplies from Strategies	***3***	***5***	***4***	***358***	***924***	***2,480***
Reserve (Shortage)	**512**	**530**	**568**	**848**	**848**	**848**

Freestone County Steam Electric Power

Steam electric power demands generally represent the cooling water needs during power generation. These demands do not include water that is used in cogeneration facilities (which is included in manufacturing projections), facilities which do not require water for production, or hydro-electric generation facilities. The current water supplies for Freestone County Steam Electric Power are groundwater (Carrizo-Wilcox aquifer), supplies from Lake Fairfield, Lake Livingston and TRWD water through TRA. Water management strategies for Freestone County Steam Electric Power are purchasing additional water from TRWD.

Table 5E.189 shows the projected demand, the current supplies, and the water management strategies for Freestone County Steam Electric Power. Conservation was considered for this water user group, but it is not recommended because the steam electric demand projections themselves considered items such as future efficiency programs. It is projected that future needs will be met through groundwater. However, due to MAG limitations, there is no more groundwater supply available within the county. It was determined to leave some steam electric demand as an unmet need in the *2021 Region C Regional Water Plan*.

Table 5E.189 Summary of Water User Group – Freestone County Steam Electric Power

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Demands						
Total Projected Demand	**34,432**	**34,432**	**34,432**	**34,432**	**34,432**	**34,432**
Currently Available Supplies						
Carrizo-Wilcox Aquifer	70	70	70	70	70	70
Lake Fairfield	870	870	870	870	870	870
Lake Livingston through TRA	20,000	20,000	20,000	20,000	20,000	20,000
TRWD through TRA	6,722	5,927	5,257	4,743	4,367	4,040
Total Currently Available Supplies	***27,662***	***26,867***	***26,197***	***25,683***	***25,307***	***24,980***
Need (Demand – Supply)	***6,770***	***7,565***	***8,235***	***8,749***	***9,125***	***9,452***
Water Management Strategies						
TRWD	4	799	1,469	1,983	2,359	2,686
Total Supplies from Strategies	***4***	***799***	***1,469***	***1,983***	***2,359***	***2,686***
Reserve (Shortage)	**(6,766)**	**(6,766)**	**(6,766)**	**(6,766)**	**(6,766)**	**(6,766)**

Pleasant Grove WSC

Pleasant Grove WSC provides water in Freestone and Navarro Counties. The WSC gets its water supply from the Carrizo Wilcox aquifer. The water management strategies include conservation and new groundwater wells. **Table 5E.190** shows the projected population and demand, the current supplies, and the water management strategies for Pleasant Grove WSC.

Table 5E.190 Summary of Water User Group – Pleasant Grove WSC

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**1,354**	**1,403**	**1,527**	**2,044**	**2,885**	**4,675**
Projected Demands						
Municipal Demand	135	134	140	185	260	420
Total Projected Demand	***135***	***134***	***140***	***185***	***260***	***420***
Currently Available Supplies						
Carrizo-Wilcox Aquifer	386	386	386	386	386	386
Total Currently Available Supplies	***386***	***386***	***386***	***386***	***386***	***386***
Need (Demand – Supply)	***0***	***0***	***0***	***0***	***0***	***34***
Water Management Strategies						
Water Conservation	1	2	1	2	4	8
New Well(s) in Carrizo-Wilcox Aquifer	0	0	0	0	0	26
Total Supplies from Strategies	***1***	***2***	***1***	***2***	***4***	***34***
Reserve (Shortage)	**252**	**254**	**247**	**203**	**130**	**0**

Point Enterprise Water Supply Corporation

Point Enterprise WSC supplies water in Freestone County in Region C and Limestone County in Region G. The WSC gets its water supply from the Carrizo-Wilcox Aquifer, and the only water management strategy is conservation. **Table 5E.191** shows the projected population and demand, the current supplies, and the water management strategies for Point Enterprise WSC.

Table 5E.191 Summary of Water User Group – Point Enterprise WSC

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**1,599**	**1,690**	**1,763**	**1,837**	**1,899**	**1,948**
Projected Demands						
Municipal Demand	174	178	179	184	189	194
Total Projected Demand	***174***	***178***	***179***	***184***	***189***	***194***
Currently Available Supplies						
Carrizo-Wilcox Aquifer	194	194	194	194	194	194
Total Currently Available Supplies	***194***	***194***	***194***	***194***	***194***	***194***
Need (Demand – Supply)	***0***	***0***	***0***	***0***	***0***	***0***
Water Management Strategies						
Water Conservation	0	1	1	1	2	2
Total Supplies from Strategies	***0***	***1***	***1***	***1***	***2***	***2***
Reserve (Shortage)	**20**	**17**	**16**	**11**	**7**	**2**

South Freestone County Water Supply Corporation

South Freestone County WSC supplies Freestone County. The WSC gets its water supply from the Carrizo-Wilcox Aquifer. The water management strategies include conservation and new groundwater wells. **Table 5E.192** shows the projected population and demand, the current supplies, and the water management strategies for South Freestone County WSC.

Table 5E.192 Summary of Water User Group – South Freestone County WSC

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**2,565**	**2,646**	**2,880**	**3,908**	**5,582**	**9,198**
Projected Demands						
Municipal Demand	255	251	263	352	500	824
Total Projected Demand	***255***	***251***	***263***	***352***	***500***	***824***
Currently Available Supplies						
Carrizo-Wilcox Aquifer	237	237	237	237	237	237
Total Currently Available Supplies	***237***	***237***	***237***	***237***	***237***	***237***
Need (Demand – Supply)	***18***	***14***	***26***	***115***	***263***	***587***
Water Management Strategies						
Water Conservation	2	3	3	5	8	16
New Well(s) in Carrizo-Wilcox Aquifer	571	571	571	571	571	571
Total Supplies from Strategies	***573***	***574***	***574***	***576***	***579***	***587***
Reserve (Shortage)	**555**	**560**	**548**	**461**	**316**	**0**

Teague

Teague is located in western Freestone County. The city's water supply is groundwater from the Carrizo-Wilcox aquifer. The water management strategies for Teague include conservation and new wells in the Carrizo-Wilcox aquifer. **Table 5E.193** shows the projected population and demand, the current supplies, and the water management strategies for Teague.

Table 5E.193 Summary of Water User Group – City of Teague

(Values in Ac-Ft/Yr)	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Projected Population	**4,029**	**4,298**	**5,728**	**7,575**	**9,132**	**10,744**
Projected Demands						
Municipal Demand	683	708	917	1,201	1,445	1,699
Manufacturing, Freestone	*19*	*19*	*19*	*19*	*19*	*19*
Total Projected Demand	***702***	***727***	***936***	***1,220***	***1,464***	***1,718***
Currently Available Supplies						
Carrizo-Wilcox Aquifer	638	638	638	638	638	638
Total Currently Available Supplies	***638***	***638***	***638***	***638***	***638***	***638***
Need (Demand – Supply)	***64***	***89***	***298***	***582***	***826***	***1,080***
Water Management Strategies						
Water Conservation	51	101	129	173	213	258
New Well(s) in Carrizo-Wilcox Aquifer	822	822	822	822	822	822
Total Supplies from Strategies	***873***	***923***	***951***	***995***	***1,035***	***1,080***
Reserve (Shortage)	**809**	**834**	**653**	**413**	**209**	**0**

Wortham

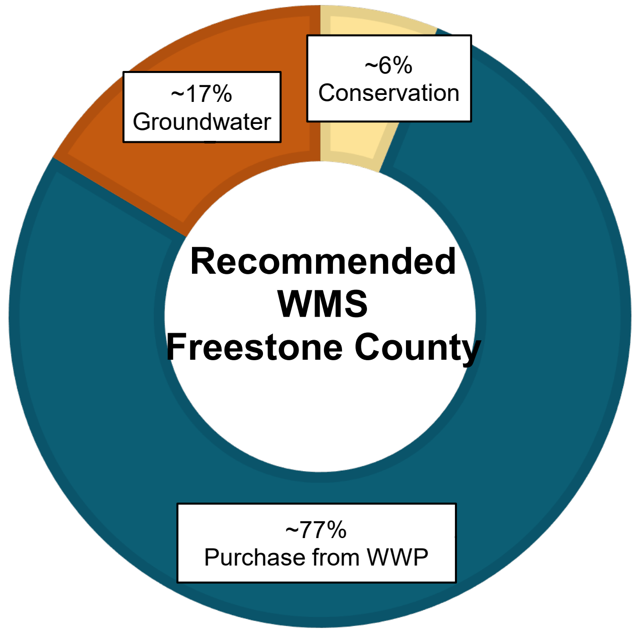
Wortham is a city located in western Freestone County. The city's water supply is purchased water from Mexia (which is located in the Brazos G Region). Water management strategies for Wortham include conservation and purchasing additional water from Mexia. **Table 5E.194** shows the projected population and demand, the current supplies, and the water management strategies for Wortham.

Table 5E.194 Summary of Water User Group – City of Wortham

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**1,185**	**1,278**	**1,342**	**1,390**	**2,319**	**2,622**
Projected Demands						
Municipal Demand	169	176	180	184	305	345
Total Projected Demand	***169***	***176***	***180***	***184***	***305***	***345***
Currently Available Supplies						
Bistone WSC Groundwater Supplies through Mexia	157	157	157	157	157	157
Total Currently Available Supplies	***157***	***157***	***157***	***157***	***157***	***157***
Need (Demand – Supply)	***12***	***19***	***23***	***27***	***148***	***188***
Water Management Strategies						
Water Conservation	2	2	2	2	5	7
Mexia (Region G)	10	17	21	25	143	181
Total Supplies from Strategies	***12***	***19***	***23***	***27***	***148***	***188***
Reserve (Shortage)	**0**	**0**	**0**	**0**	**0**	**0**

5E.7.2 Summary of Costs for Freestone County

Table 5E.195 summarizes the costs of the water management strategies recommended for the WUGs and WWPs who have the majority of their demand located in Freestone County. Total quantities from **Table 5E.195** will not necessarily match total county demands. This is due mainly to water users whose sum of strategies results in a reserve as well as due to water users located in multiple counties (or wholesale water providers who develop strategies and then sell water to users in other counties). Quantities from infrastructure projects needed to deliver and/or treat water (shown in *gray italics*) are not included since the supplies are associated with other strategies. To avoid double-counting quantities of supplies, the quantities in gray italics are **not** included in the total.



The majority of the future supplies needed to meet demands within Freestone County are projected to come through purchases from wholesale water providers. Other strategies include conservation and groundwater.

Table 5E.196 summarizes the recommended water management strategies within Freestone County individually. Alternative strategies are also included. More detailed cost estimates are located in **Appendix H.**

Table 5E.195 Summary of Recommended Water Management Strategies for Freestone County

Type of Strategy	Quantity (Ac-Ft/Yr)	Capital Costs
Conservation[a]	553	$135,478
Purchase from WWP	6,776	$0
Additional Infrastructure	*3,909*	*$84,733,000*
Groundwater	1,419	$11,063,000
Total	**8,748**	**$95,931,478**

[a]The conservation quantities represent the sum of the individual water user groups who have the majority of their service areas located in the county, not the total conservation in the county.

Table 5E.196 Costs for Recommended Water Management Strategies for Freestone County

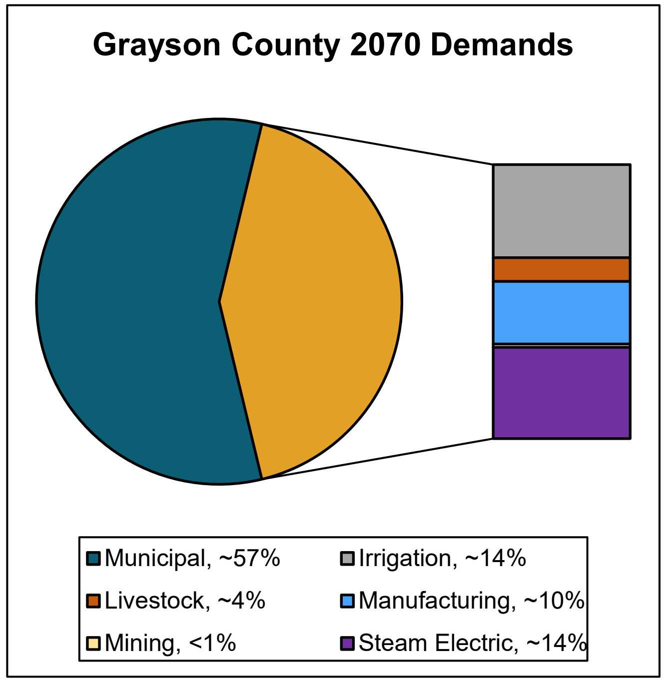
WWP or WUG	Strategy	Online by:	Quantity (Ac-Ft/Yr)[b]	Capital Costs[c]	Unit Cost ($/1000 gal) With Debt Service	Unit Cost ($/1000 gal) After Debt Service	Table
WWPs							
There are no wholesale water providers in Freestone County.							
WUGs							
Butler WSC	Conservation	2020	4	$4,404	$0.48	$0.00	H.11
Fairfield	Conservation	2020	203	$84,573	$2.28	$0.69	H.11
Fairfield	TRWD	2050	1,483	$0	$1.26	$1.26	None
Fairfield	*New WTP and transmission*	*2050*	*1,483*	*$35,205,000*	*$7.92*	*$2.79*	*H.124*
Flo Community WSC[a] (Region C only)	Conservation	2020	1	$0	$0.00	$0.00	H.11
Flo Community WSC[a] (Region C only)	New Wells	See Region H Plan.					
Pleasant Grove WSC	Conservation	2020	8	$3,871	$0.83	$0.00	H.11
Pleasant Grove WSC	New Well(s) in Carrizo-Wilcox Aquifer	2070	26	$600,000	$7.23	$2.25	H.14
Point Enterprise WSC	Conservation	2030	2	$0	$0.00	$0.00	H.11
South Freestone County WSC	Conservation	2020	16	$9,541	$1.03	$0.00	H.11
South Freestone County WSC	New Well(s) in Carrizo-Wilcox Aquifer	2020	571	$6,485,000	$3.98	$1.52	H.14
Teague	Conservation	2020	258	$14,991	$3.59	$1.11	H.11
Teague	New Well(s) in Carrizo-Wilcox Aquifer	2020	822	$3,978,000	$2.26	$1.21	H.14
Wortham	Conservation	2020	7	$8,939	$0.97	$0.00	H.11
Wortham	Mexia	2020	181	$0	$11.00	$11.00	None
County Other and Non-Municipal							
County Other, Freestone	Conservation	2020	54	$9,159	$0.66	$0.00	H.11
County Other, Freestone	Corsicana	2050	72	$0	$4.15	$4.15	None
County Other, Freestone	*Additional Delivery Infrastructure from Corsicana*	*2050*	*72*	*$2,868,000*	*$9.80*	*$1.20*	*H.125*
County Other, Freestone	TRWD	2050	2,354	$0	$1.26	$1.26	None
County Other, Freestone	*New Delivery and Treatment Facilities*	*2050*	*2,354*	*$46,660,000*	*$6.89*	*$2.61*	*H.126*

WWP or WUG	Strategy	Online by:	Quantity (Ac-Ft/Yr)[b]	Capital Costs[c]	Unit Cost ($/1000 gal) With Debt Service	Unit Cost ($/1000 gal) After Debt Service	Table
Irrigation, Freestone	None	None					
Livestock, Freestone	None	None					
Manufacturing, Freestone	None	None					
Mining, Freestone	None	None					
Steam Electric Power, Freestone	TRWD through TRA	2020	2,686	$0	$3.61	$3.61	None

[a]*Water user groups extend into more than one county*
[b]*Quantities listed are for the WUG only. They do not include the WUG's customers.*
[c]*Purchases from wholesale water providers that require no new infrastructure have no capital costs. The unit costs shown in the table represent the cost to purchase water from the WWP.*

5E.8 Grayson County

Grayson County is located in the northern portion of Region C. **Figure 5E.16** shows water service areas in Grayson County.



Grayson County's population is projected to more than double between 2020 and 2070.

The 2070 projected demands for the county are predominately municipal. The second and third largest demands are irrigation and steam electric power. Manufacturing, livestock and mining demands account for less than 15% of the county's total demands.

Greater Texoma Utility Authority (GTUA) is a regional water provider that provides supplies to Grayson County. Several of the entities in this area hold water rights in Lake Texoma but currently do not have access to this resource. The GTUA Regional Water System strategy would make additional supplies available by treating Lake Texoma water and delivering to these entities.

An overall summary of the County's projections are shown in **Table 5E.197** and water management strategies for individual WWPs and WUGs are discussed on the following pages.

Grayson County Quick Facts

2010 Population: 120,877

Projected 2070 Population: 337,120

Projected 2070 Demand: 28 MGD

County Seat: Sherman

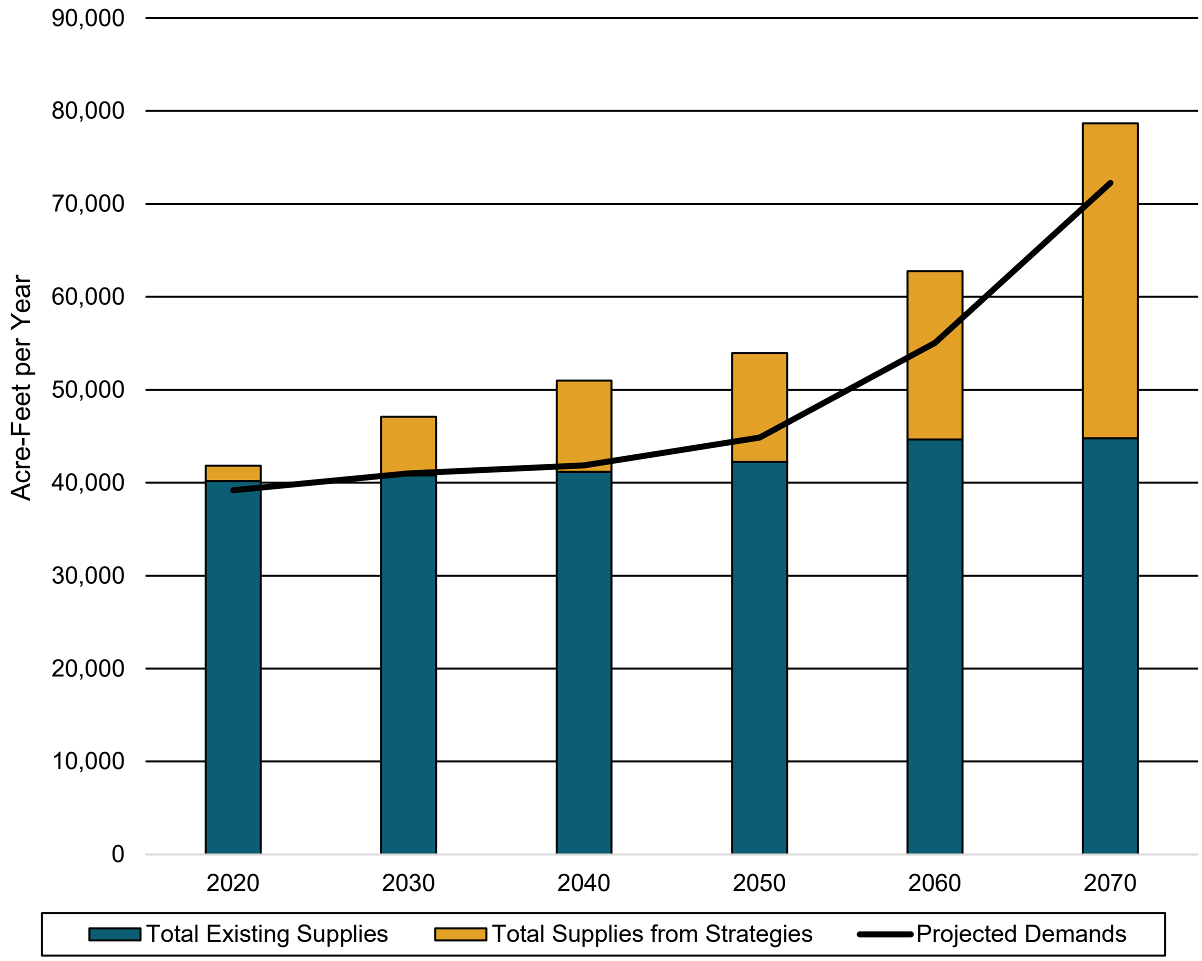
Economy: Manufacturing, distribution and trade; tourism; mineral production

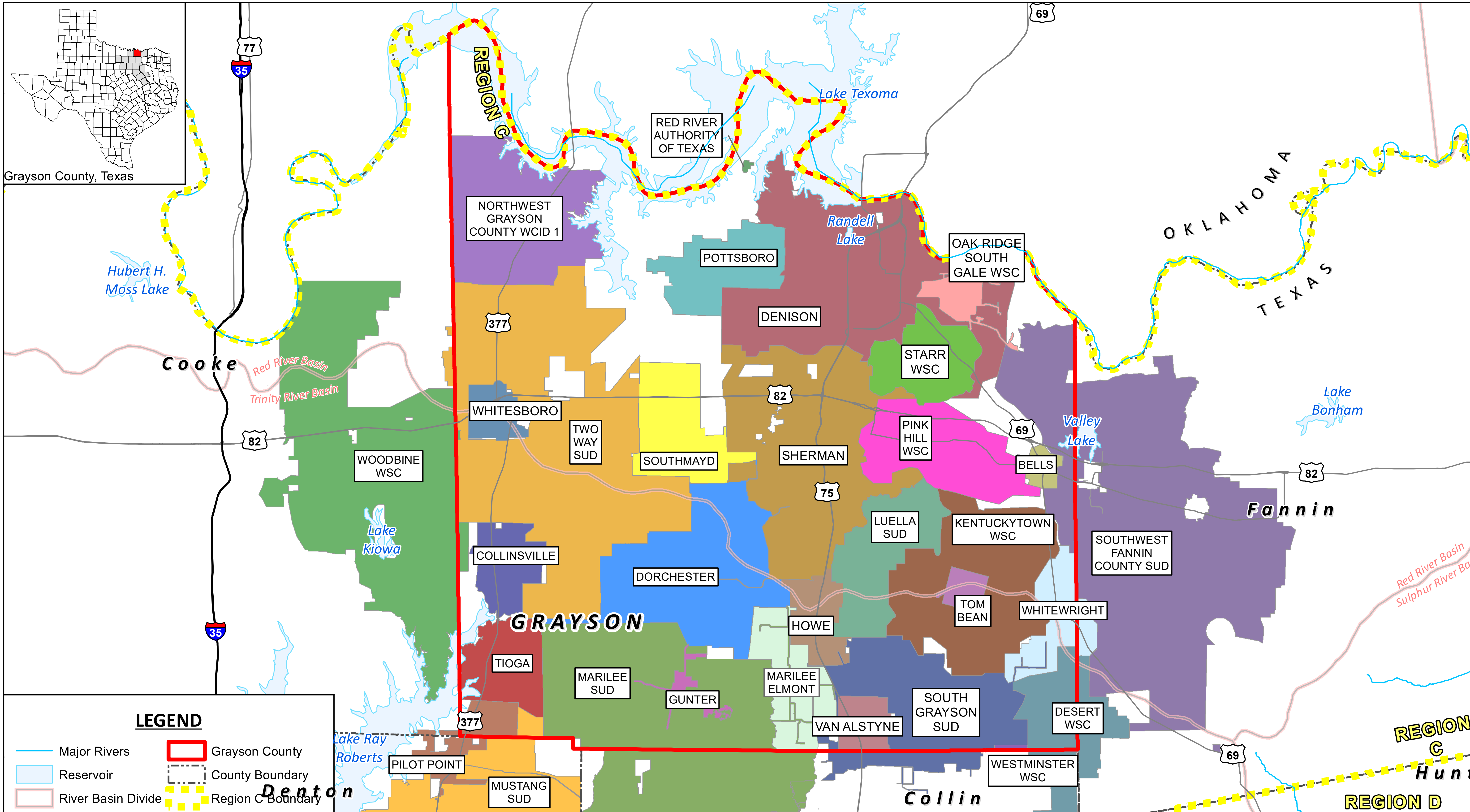
River Basins: Trinity (36%), Red (64%)

Table 5E.197 Summary of Grayson County

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**135,311**	**149,527**	**159,610**	**178,907**	**242,865**	**337,120**
Projected Demands	**39,192**	**41,009**	**41,881**	**44,867**	**55,068**	**72,258**
Municipal	25,922	27,783	28,758	31,728	41,910	59,079
Irrigation	4,477	4,477	4,477	4,477	4,477	4,477
Livestock	1,143	1,143	1,143	1,143	1,143	1,143
Manufacturing	2,951	3,009	3,009	3,009	3,009	3,009
Mining	312	210	107	123	142	163
Steam Electric	4,387	4,387	4,387	4,387	4,387	4,387
Total Existing Supplies	**40,189**	**40,785**	**41,183**	**42,255**	**44,660**	**44,790**
Need (Demand - Supply)	**0**	**224**	**698**	**2,612**	**10,408**	**27,468**
Total Supplies from Strategies	**1,650**	**6,296**	**9,814**	**11,681**	**18,098**	**33,884**
Reserve (Shortage)	**2,647**	**6,072**	**9,116**	**9,069**	**7,690**	**6,416**

Figure 5E.15 Summary of Grayson County





REGION C
Water Planning for North Texas

2021 Region C Water Plan

GRAYSON COUNTY, TEXAS

FIGURE 5E.16

1 in = 5 miles
0 1 2 4 6
Miles

N W E S

Data Source(s): ESRI, USGS, TNRIS

TR116409: H:\WR_PLANNING\1 - Working\5E_County WMS\Grayson.mxd

5E.8.1 Wholesale Water Provider and Water User Groups

Water management strategies for Grayson County wholesale water providers (WWPs) and water user groups (WUGs) are discussed below (in alphabetical order). The costs for recommended and alternative water management strategies are presented in **Section 5E.8.2. Appendix H** has more detailed cost estimates.

Bells

Bells is located in eastern Grayson County. The city gets its water supply from groundwater (Woodbine and Trinity aquifers). Water management strategies for Bells include conservation, participating in the Grayson County Water Supply Project, and new well(s) in the Woodbine Aquifer. **Table 5E.198** shows the projected population and demand, the current supplies, and the water management strategies for Bells.

Table 5E.198 Summary of Water User Group – City of Bells

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**1,713**	**2,020**	**2,322**	**2,536**	**5,925**	**8,000**
Projected Demands						
Municipal Demand	182	206	232	250	580	783
Total Projected Demand	***182***	***206***	***232***	***250***	***580***	***783***
Currently Available Supplies						
Woodbine Aquifer	107	107	107	107	107	107
Trinity Aquifer	175	175	175	175	175	175
Total Currently Available Supplies	***282***	***282***	***282***	***282***	***282***	***282***
Need (Demand – Supply)	***0***	***0***	***0***	***0***	***298***	***501***
Water Management Strategies						
Water Conservation	2	2	2	3	10	16
Connect to Sherman	0	8	34	51	374	571
New Well(s) in Woodbine Aquifer	0	55	55	55	55	55
Total Supplies from Strategies	***2***	***65***	***91***	***109***	***439***	***642***
Reserve (Shortage)	**102**	**141**	**141**	**141**	**141**	**141**

Collinsville

Collinsville is located in western Grayson County. The city gets its water supply from the Trinity aquifer. Water management strategies for Collinsville include conservation and supplies from GTUA Regional Water System through Sherman. **Table 5E.199** shows the projected population and demand, the current supplies, and the water management strategies for Collinsville.

Table 5E.199 Summary of Water User Group – City of Collinsville

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**2,567**	**3,139**	**3,798**	**4,596**	**4,850**	**6,370**
Projected Demands						
Municipal Demand	282	333	395	473	498	653
Total Projected Demand	***282***	***333***	***395***	***473***	***498***	***653***
Currently Available Supplies						
Trinity Aquifer	297	242	242	242	242	242
Total Currently Available Supplies	***297***	***242***	***242***	***242***	***242***	***242***
Need (Demand – Supply)	***0***	***91***	***153***	***231***	***256***	***411***
Water Management Strategies						
Water Conservation	2	4	4	6	8	13
GTUA Regional Water System	0	87	149	225	248	398
Total Supplies from Strategies	***2***	***91***	***153***	***231***	***256***	***411***
Reserve (Shortage)	**17**	**0**	**0**	**0**	**0**	**0**

Denison

Denison is one of the two largest cities in Grayson County and is located in the northern part of the county. Denison is a wholesale water provider (WWP) that currently provides treated water to residents of Denison, Pottsboro, Oak Ridge South Gale WSC, and rural areas of Grayson County. Denison also provides raw water to Grayson County Manufacturing users. Denison's current sources of water supply are groundwater, Lake Randell, and Lake Texoma. Denison's water right in Lake Randell is 5,280 acre-feet per year, but the firm yield for Lake Randell as calculated by the approved TCEQ Water Availability Model (modeled without backup supplies from Lake Texoma) is 1,400 acre-feet per year. Denison holds a water right from Lake Texoma for 24,400 acre-feet per year, and Denison also has an agreement to purchase an additional 12,204 acre-feet per year of Lake Texoma water from GTUA.

Denison has an existing intake structure and pipeline that currently delivers water from Lake Texoma to Lake Randell. A conventional treatment plant located near Lake Randell treats the blended water from Lake Randell and Lake Texoma.

The amount of water currently available to Denison is partially limited by the capacity of its water treatment plant. Denison will need to develop up to 14 MGD of additional treatment capacity to meet its 2070 demands. Due to the high TDS of Lake Texoma, planning level treatment costs are based on advanced desalination treatment. The city currently blends the two sources to resolve quality issues. However, due to the limitations placed on supplies from Lake Randell, any additional Texoma water will need advanced treatment.

Along with the water treatment expansions, Denison will also need to expand its current delivery infrastructure from Lake Texoma. Denison has designed an expanded pump station and pipeline capable of delivering all future supply from Lake Texoma.

The proposed future strategies for Denison are to implement water conservation measures, add water treatment plant capacity, and expand raw water delivery infrastructure from Lake Texoma. **Table 5E.200** shows the projected demand, the current supplies, and the water management strategies for Denison.

Table 5E.200 Summary of Wholesale Water Provider and Customers – Denison

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Demands						
Denison	7,226	7,888	7,877	8,598	9,992	13,298
Manufacturing, Grayson	*443*	*451*	*451*	*451*	*451*	*451*
County Other, Grayson	*400*	*400*	*400*	*400*	*400*	*400*
Oak Ridge South Gale WSC	*221*	*209*	*224*	*249*	*335*	*459*
Pottsboro	*406*	*543*	*679*	*918*	*1,512*	*1,682*
Total Projected Demand	***8,696***	***9,491***	***9,631***	***10,616***	***12,690***	***16,290***
Currently Available Supplies						
Lake Randell	1,400	1,400	1,400	1,400	1,400	1,400
Lake Texoma (Water Right)	24,400	24,400	24,400	24,400	24,400	24,400
Lake Texoma (Contracted with GTUA)	12,204	12,204	12,204	12,204	12,204	12,204
Woodbine Aquifer	84	84	84	84	84	84
Total Currently Available Supplies	***38,088***	***38,088***	***38,088***	***38,088***	***38,088***	***38,088***
Total Currently Available Supplies Limited by WTP Capacity (7,278 acre-feet per year), plus Groundwater and Raw Water Manufacturing Demand	***7,814***	***7,822***	***7,822***	***7,822***	***7,822***	***7,822***
Need (Demand – Supply)	***882***	***1,669***	***1,809***	***2,794***	***4,868***	***8,468***
Water Management Strategies						
Conservation (retail)	512	930	915	1,030	1,235	1,695
Conservation (customers)	27	40	48	66	110	0
Lake Texoma with Infrastructure	343	2,242	2,242	4,484	4,484	6,773
New 4 MGD Desalination WTP	*343*	*699*	*846*	*1,698*	*2,242*	*2,242*
10 MGD Desalination WTP Expansion					*1,281*	*4,531*
Expand Raw Water Delivery from Lake Texoma		*699*	*846*	*1,698*	*3,523*	*6,773*
Total Supplies from Strategies	***882***	***1,669***	***1,809***	***2,794***	***4,868***	***8,468***
Reserve (Shortage)	**0**	**0**	**0**	**0**	**0**	**0**

Desert WSC

Desert WSC is located in Fannin, Collin, and Grayson Counties. Water management strategies for Desert WSC are discussed under Fannin County in **Section 5E.6**.

Dorchester

Dorchester is located in Grayson County. The city gets its water supply from the Woodbine aquifer and the Trinity aquifer through Sherman. The only water management strategy is conservation. **Table 5E.201** shows the projected population and demand, the current supplies, and the water management strategies for Dorchester.

Table 5E.201 Summary of Water User Group – Dorchester

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**1,622**	**1,762**	**1,907**	**2,000**	**2,183**	**2,436**
Projected Demands						
Municipal Demand	123	126	132	136	147	164
Total Projected Demand	***123***	***126***	***132***	***136***	***147***	***164***
Currently Available Supplies						
Trinity Aquifer through Sherman	84	84	84	84	84	84
Woodbine Aquifer	113	113	113	113	113	113
Total Currently Available Supplies	***197***	***197***	***197***	***197***	***197***	***197***
Need (Demand – Supply)	***0***	***0***	***0***	***0***	***0***	***0***
Water Management Strategies						
Water Conservation	1	2	1	2	2	3
New Well(s) in Trinity Aquifer	0	90	90	90	90	90
Total Supplies from Strategies	***1***	***92***	***91***	***92***	***92***	***93***
Reserve (Shortage)	**75**	**163**	**156**	**153**	**142**	**126**

Grayson County Irrigation

Irrigation demand projections include the water necessary for irrigation activities, including field crops, orchards, pasture, turf grass, vineyards, golf courses irrigated by raw water, and limited aquaculture operations. Grayson County Irrigation gets its water supply from local supplies and groundwater (Trinity and Woodbine aquifers). The existing supplies are sufficient to meet the projected needs so consequently there are no recommended water management strategies. **Table 5E.202** shows the projected demand, the current supplies, and the water management strategies for Grayson County Irrigation.

Table 5E.202 Summary of Water User Group – Grayson County Irrigation

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Demands						
Total Projected Demand	**4,477**	**4,477**	**4,477**	**4,477**	**4,477**	**4,477**
Currently Available Supplies						
Local Supplies	1,091	1,091	1,091	1,091	1,091	1,091
Trinity Aquifer	1,179	1,179	1,179	1,179	1,179	1,179
Woodbine Aquifer	2,207	2,207	2,207	2,207	2,207	2,207
Total Currently Available Supplies	***4,477***	***4,477***	***4,477***	***4,477***	***4,477***	***4,477***
Need (Demand – Supply)	***0***	***0***	***0***	***0***	***0***	***0***
Water Management Strategies						
None	0	0	0	0	0	0
Total Supplies from Strategies	***0***	***0***	***0***	***0***	***0***	***0***
Reserve (Shortage)	**0**	**0**	**0**	**0**	**0**	**0**

Grayson County Livestock

Livestock water use is defined as water used in the production of livestock, both for consumption and for cleaning and environmental purposes. The current supplies are local surface water supplies and groundwater from the Woodbine aquifer. These sources are sufficient to meet future demands, and there are no water management strategies for this water user group. **Table 5E.203** shows the projected demand, current supplies, and water management strategies for Grayson County Livestock.

Table 5E.203 Summary of Water User Group – Grayson County Livestock

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Demands						
Total Projected Demand	**1,143**	**1,143**	**1,143**	**1,143**	**1,143**	**1,143**
Currently Available Supplies						
Woodbine Aquifer	215	215	215	215	215	215
Local Supplies	1,075	1,075	1,075	1,075	1,075	1,075
Total Currently Available Supplies	***1,290***	***1,290***	***1,290***	***1,290***	***1,290***	***1,290***
Need (Demand – Supply)	***0***	***0***	***0***	***0***	***0***	***0***
Water Management Strategies						
None	0	0	0	0	0	0
Total Supplies from Strategies	***0***	***0***	***0***	***0***	***0***	***0***
Reserve (Shortage)	**147**	**147**	**147**	**147**	**147**	**147**

Grayson County Manufacturing

Manufacturing water use is defined as water used to produce manufactured goods. Current supplies include Sherman (from Lake Texoma), Denison, Howe (from GTUA and NTMWD), local supplies, and groundwater (Woodbine aquifer). Additional supplies from Sherman and Howe are the water management strategies for this water user group. An alternative strategy would be direct reuse from Sherman. **Table 5E.204** shows the projected demand, the current supplies, and the water management strategies for Grayson County Manufacturing. Conservation was considered for this water user group, but it is not recommended because of the uncertainty in the ability to implement conservation measures given the multiple entities, facilities, and various manufacturing processes that make up this WUG.

Table 5E.204 Summary of Water User Group – Grayson County Manufacturing

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Demands						
Total Projected Demand	**2,951**	**3,009**	**3,009**	**3,009**	**3,009**	**3,009**
Currently Available Supplies						
Lake Texoma through Sherman	2,213	2,257	2,257	2,257	1,840	1,113
Denison	443	451	451	451	451	451
NTMWD through Howe	30	26	23	21	19	17
Woodbine Aquifer	694	694	694	694	694	694
Local Supplies	30	30	30	30	30	30
Total Currently Available Supplies	***3,410***	***3,458***	***3,455***	***3,453***	***3,034***	***2,305***
Need (Demand – Supply)	***0***	***0***	***0***	***0***	***0***	***704***
Water Management Strategies						
Howe	0	13	13	14	15	16
Sherman	0	0	0	0	417	1,144
Total Supplies from Strategies	***0***	***13***	***13***	***14***	***432***	***1,160***
Reserve (Shortage)	**459**	**462**	**459**	**458**	**457**	**456**
Alternative Strategy						
Direct Reuse	*561*	*561*	*561*	*561*	*561*	*561*

Grayson County Mining

Mining water demand includes water used for oil and gas development, as well as extraction of coal and lignite, sand aggregate, and other resources. Grayson County Mining is supplied from groundwater (Trinity aquifer). The only water management strategy for this water user group is new well(s) in the Trinity Aquifer. **Table 5E.205** shows the projected demand, the current supplies, and the water management strategies for Grayson County Mining. Conservation was considered for this water user group, but it is not recommended because of the uncertainty in the ability to implement conservation measures given the multiple companies, industries, facilities, and types of processes that make up this WUG.

Table 5E.205 Summary of Water User Group – Grayson County Mining

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Demands						
Total Projected Demand	**312**	**210**	**107**	**123**	**142**	**163**
Currently Available Supplies						
Trinity Aquifer	212	212	212	212	212	212
Total Currently Available Supplies	***212***	***212***	***212***	***212***	***212***	***212***
Need (Demand – Supply)	***100***	***0***	***0***	***0***	***0***	***0***
Water Management Strategies						
New Well(s) in Trinity Aquifer	100	100	100	100	100	100
Total Supplies from Strategies	***100***	***100***	***100***	***100***	***100***	***100***
Reserve (Shortage)	**0**	**102**	**205**	**189**	**170**	**149**

Grayson County Other

Grayson County Other includes individual domestic supplies and water suppliers too small to be classified as water user groups. The entities receive their water supply from Denison (Lake Texoma and Lake Randell), the Red River Authority (Lake Texoma), Sherman (GTUA), Northwest Grayson County WCID 1 (Trinity Aquifer), and the Woodbine aquifer. Water management strategies for these entities include conservation and additional supplies through Sherman. **Table 5E.206** shows the projected population and demand, the current supplies, and the water management strategies for Grayson County Other.

Table 5E.206 Summary of Water User Group – Grayson County Other

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**5,882**	**4,929**	**3,073**	**3,631**	**12,314**	**20,310**
Projected Demands						
Municipal Demand	747	602	363	426	1,434	2,356
Total Projected Demand	***747***	***602***	***363***	***426***	***1,434***	***2,356***
Currently Available Supplies						
Lake Randell through Denison	307	280	276	249	207	160
Lake Texoma through Denison	68	62	61	55	46	35
Lake Texoma through RRA	358	392	421	454	487	467
Lake Texoma through GTUA through Sherman	747	747	747	747	609	590
Trinity Aquifer through Northwest Grayson County WCID 1	75	75	75	75	75	75
Woodbine Aquifer	75	75	75	75	75	75
Total Currently Available Supplies	***1,630***	***1,631***	***1,655***	***1,655***	***1,499***	***1,402***
Need (Demand – Supply)	***0***	***0***	***0***	***0***	***0***	***954***
Water Management Strategies						
Water Conservation	6	7	4	6	24	47
Denison	25	58	63	96	147	205
Sherman	0	760	860	960	1,174	1,719
Total Supplies from Strategies	***31***	***825***	***927***	***1,062***	***1,345***	***1,971***
Reserve (Shortage)	**914**	**1,854**	**2,219**	**2,291**	**1,410**	**1,017**

Grayson County Steam Electric Power

Steam electric power demands generally represent the cooling water needs during power generation. These demands do not include water that is used in cogeneration facilities (which is included in manufacturing projections), facilities which do not require water for production, or hydro-electric generation facilities. The current supply for this water user group is treated water from Lake Texoma from GTUA through Sherman. This source is sufficient to meet future demands, and there are no water management strategies for this water user group. **Table 5E.207** shows the projected demand, the current supplies, and the water management strategies for Grayson County Steam Electric Power.

Table 5E.207 Summary of Water User Group – Grayson County SEP

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Demands						
Total Projected Demand	**4,387**	**4,387**	**4,387**	**4,387**	**4,387**	**4,387**
Currently Available Supplies						
Lake Texoma from GTUA through Sherman	4,387	4,387	4,387	4,387	4,387	4,387
Total Currently Available Supplies	***4,387***	***4,387***	***4,387***	***4,387***	***4,387***	***4,387***
Need (Demand – Supply)	***0***	***0***	***0***	***0***	***0***	***0***
Water Management Strategies						
None	0	0	0	0	0	0
Total Supplies from Strategies	***0***	***0***	***0***	***0***	***0***	***0***
Reserve (Shortage)	**0**	**0**	**0**	**0**	**0**	**0**

Gunter

Gunter is located in southern Grayson County. The city gets water supplies from the Trinity aquifer. Water management strategies for Gunter include conservation, new groundwater wells, and participation in the GTUA Regional Water System (RWS). The supplies from the GTUA RWS are based on demand projections developed after regional planning demands were finalized. This difference accounts for the larger reserve shown.

Table 5E.208 shows the projected population and demand, the current supplies, and the water management strategies for Gunter.

Table 5E.208 Summary of Water User Group – City of Gunter

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**1,841**	**2,538**	**3,384**	**4,230**	**5,182**	**6,046**
Projected Demands						
Municipal Demand	297	400	527	656	803	936
Total Projected Demand	***297***	***400***	***527***	***656***	***803***	***936***
Currently Available Supplies						
Trinity Aquifer	173	173	173	173	173	173
Total Currently Available Supplies	***173***	***173***	***173***	***173***	***173***	***173***
Need (Demand – Supply)	***124***	***227***	***354***	***483***	***630***	***763***
Water Management Strategies						
Water Conservation	24	65	5	9	13	19
New Well(s) in Trinity Aquifer	50	50	50	50	50	50
GTUA Regional Water System	273	630	2,854	2,850	2,846	2,840
Total Supplies from Strategies	***347***	***745***	***2,909***	***2,909***	***2,909***	***2,909***
Reserve (Shortage)	**223**	**518**	**2,555**	**2,426**	**2,279**	**2,146**

Howe

Howe is located in southern Grayson County, on the border between the Red and Trinity River basins. The city provides water to a portion of Grayson County Manufacturing. The city gets its current supplies from the Woodbine aquifer and the North Texas Municipal Water District (NTMWD) via GTUA and the Collin-Grayson Municipal Alliance Project. Water management strategies for Howe include conservation and additional water from the CGMA through both NTMWD and Sherman. **Table 5E.209** shows the projected population and demand, the current supplies, and the water management strategies for Howe. An alternative strategy would be the Grayson County Water Supply Project.

Table 5E.209 Summary of Water User Group – City of Howe

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**2,868**	**3,372**	**3,854**	**4,275**	**4,823**	**5,379**
Projected Demands						
Municipal Demand	274	306	339	370	416	464
Manufacturing, Grayson	*30*	*30*	*30*	*30*	*30*	*30*
Total Projected Demand	***304***	***336***	***369***	***400***	***446***	***494***
Currently Available Supplies						
Woodbine Aquifer	282	282	282	282	282	282
NTMWD through GTUA	30	46	68	83	104	124
Total Currently Available Supplies	***312***	***328***	***350***	***365***	***386***	***406***
Need (Demand – Supply)	***0***	***8***	***19***	***35***	***60***	***88***
Water Management Strategies						
Water Conservation	2	4	3	5	7	9
Sherman (Expanded CGMA)	0	16	17	19	21	23
NTMWD (Expanded CGMA)	0	4	16	30	53	79
Total Supplies from Strategies	***2***	***8***	***19***	***35***	***60***	***88***
Reserve (Shortage)	**10**	**0**	**0**	**0**	**0**	**0**
Alternative Strategy						
Grayson County Water Supply Project	*0*	*4*	*16*	*30*	*53*	*79*

Kentucky Town Water Supply Corporation

The Kentucky Town WSC is located in southeastern Grayson County. The WSC gets its current water supply from the Woodbine aquifer, and water management strategies include conservation and connection to Sherman. **Table 5E.210** shows the projected population and demand, the current supplies, and the water management strategies for Kentucky Town WSC.

Table 5E.210 Summary of Water User Group – Kentucky Town WSC

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**2,856**	**3,443**	**4,008**	**4,537**	**5,761**	**7,387**
Projected Demands						
Municipal Demand	355	412	469	525	665	852
Total Projected Demand	***355***	***412***	***469***	***525***	***665***	***852***
Currently Available Supplies						
Woodbine Aquifer	365	365	365	365	365	365
Total Currently Available Supplies	***365***	***365***	***365***	***365***	***365***	***365***
Need (Demand – Supply)	***0***	***47***	***104***	***160***	***300***	***487***
Water Management Strategies						
Water Conservation	3	5	5	7	11	17
Connect to Sherman	0	42	99	153	289	470
Total Supplies from Strategies	***3***	***47***	***104***	***160***	***300***	***487***
Reserve (Shortage)	**13**	**0**	**0**	**0**	**0**	**0**

Luella Special Utility District

The Luella SUD is located in central Grayson County. The SUD gets its current water supply from the Woodbine aquifer, and water management strategies include conservation and connection to Sherman. **Table 5E.211** shows the projected population and demand, the current supplies, and the water management strategies for Luella SUD.

Table 5E.211 Summary of Water User Group – Luella Special Utility District

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**3,680**	**4,248**	**4,803**	**5,203**	**5,865**	**6,861**
Projected Demands						
Municipal Demand	387	430	475	508	571	667
Total Projected Demand	***387***	***430***	***475***	***508***	***571***	***667***
Currently Available Supplies						
Woodbine Aquifer	390	390	390	390	390	390
Total Currently Available Supplies	***390***	***390***	***390***	***390***	***390***	***390***
Need (Demand – Supply)	***0***	***40***	***85***	***118***	***181***	***277***
Water Management Strategies						
Water Conservation	3	5	5	7	10	13
Connect to Sherman	0	35	80	111	171	264
Total Supplies from Strategies	***3***	***40***	***85***	***118***	***181***	***277***
Reserve (Shortage)	**6**	**0**	**0**	**0**	**0**	**0**

Marilee Special Utility District

Marilee SUD is located in northeastern Collin County and southwestern Grayson County. The SUD currently gets its water supplies from treated water purchased from Sherman and from the Trinity aquifer. Water management strategies include conservation and additional water from Sherman through the GTUA Regional Water System. **Table 5E.212** shows the projected population and demand, the current supplies, and the water management strategies for Marilee SUD.

Table 5E.212 Summary of Water User Group – Marilee SUD

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**7,686**	**7,955**	**8,233**	**8,233**	**8,233**	**8,233**
Projected Demands						
Municipal Demand	1,133	1,155	1,181	1,176	1,174	1,174
Total Projected Demand	***1,133***	***1,155***	***1,181***	***1,176***	***1,174***	***1,174***
Currently Available Supplies						
Trinity Aquifer	939	939	939	939	939	939
Sherman	194	216	242	237	192	116
Total Currently Available Supplies	***1,133***	***1,155***	***1,181***	***1,176***	***1,131***	***1,055***
Need (Demand – Supply)	***0***	***0***	***0***	***0***	***43***	***119***
Water Management Strategies						
Water Conservation	10	14	12	16	20	23
GTUA Regional Water System	0	1,376	1,546	1,542	1,538	1,535
Total Supplies from Strategies	***10***	***1,390***	***1,558***	***1,558***	***1,558***	***1,558***
Reserve (Shortage)	**10**	**1,390**	**1,558**	**1,558**	**1,515**	**1,439**

Mustang Special Utility District

Mustang SUD is located in northeastern Denton County and Grayson County. The SUD is a wholesale water provider, and the discussion of its water supply plans is under Denton County in **Section 5E.4.**

Northwest Grayson County WCID 1

Northwest Grayson County WCID 1 supplies water to northwest Grayson County and gets its water supply from the Trinity aquifer. The water management strategies include conservation, supplies from the GTUA Regional Water System through Sherman, and new groundwater wells. **Table 5E.213** shows the projected population and demand, the current supplies, and the water management strategies for Northwest Grayson County WCID 1.

Table 5E.213 Summary of Water User Group – Northwest Grayson County WCID 1

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**1,906**	**1,990**	**2,095**	**2,362**	**3,194**	**4,479**
Projected Demands						
Municipal Demand	194	194	199	221	298	418
County Other, Grayson	*75*	*75*	*75*	*75*	*75*	*75*
Total Projected Demand	***269***	***269***	***274***	***296***	***373***	***493***
Currently Available Supplies						
Trinity Aquifer	238	238	238	238	238	238
Total Currently Available Supplies	***238***	***238***	***238***	***238***	***238***	***238***
Need (Demand – Supply)	***31***	***31***	***36***	***58***	***135***	***255***
Water Management Strategies						
Water Conservation	2	2	2	3	5	8
GTUA Regional Water System	0	194	572	572	572	572
New Well(s) in Trinity Aquifer	29	29	34	55	130	247
Total Supplies from Strategies	***31***	***225***	***608***	***630***	***707***	***827***
Reserve (Shortage)	**0**	**194**	**572**	**572**	**572**	**572**

Oak Ridge South Gale Water Supply Corporation

Oak Ridge South Gale WSC supplies water in northeast Grayson County. The WSC gets its water supply from Denison. The water management strategies include conservation and additional supplies from Denison. **Table 5E.214** shows the projected population and demand, the current supplies, and the water management strategies for Oak Ridge South Gale WSC.

Table 5E.214 Summary of Water User Group – Oak Ridge South Gale WSC

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**2,551**	**2,522**	**2,802**	**3,161**	**4,273**	**5,861**
Projected Demands						
Municipal Demand	221	209	224	249	335	459
Total Projected Demand	***221***	***209***	***224***	***249***	***335***	***459***
Currently Available Supplies						
Denison	207	179	189	189	211	225
Total Currently Available Supplies	***207***	***179***	***189***	***189***	***211***	***225***
Need (Demand – Supply)	***14***	***30***	***35***	***60***	***124***	***234***
Water Management Strategies						
Water Conservation	2	2	2	3	6	9
Denison	12	28	33	57	118	225
Total Supplies from Strategies	***14***	***30***	***35***	***60***	***124***	***234***
Reserve (Shortage)	**0**	**0**	**0**	**0**	**0**	**0**

Pink Hill Water Supply Corporation

Pink Hill WSC supplies water in east central Grayson County. The WSC gets its water supply from the Trinity and Woodbine aquifers. The water management strategies include conservation and new groundwater wells in both the Woodbine and Trinity aquifers. **Table 5E.215** shows the projected population and demand, the current supplies, and the water management strategies for Pink Hill WSC.

Table 5E.215 Summary of Water User Group – Pink Hill WSC

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**1,992**	**2,187**	**2,187**	**2,467**	**3,335**	**4,576**
Projected Demands						
Municipal Demand	228	242	236	263	355	486
Total Projected Demand	***228***	***242***	***236***	***263***	***355***	***486***
Currently Available Supplies						
Trinity Aquifer	128	128	128	128	128	128
Woodbine Aquifer	100	100	100	100	100	100
Total Currently Available Supplies	***228***	***228***	***228***	***228***	***228***	***228***
Need (Demand – Supply)	***0***	***14***	***8***	***35***	***127***	***258***
Water Management Strategies						
Water Conservation	2	3	2	4	6	10
New Well(s) in Woodbine Aquifer	0	6	3	16	61	124
New Well(s) in Trinity Aquifer	0	6	3	16	61	124
Total Supplies from Strategies	***2***	***14***	***8***	***35***	***127***	***258***
Reserve (Shortage)	**2**	**0**	**0**	**0**	**0**	**0**

Pottsboro

Pottsboro is located in northern Grayson County, near Lake Texoma. The city gets its current supplies from the Woodbine aquifer and treated water purchased from Denison. Water management strategies for Pottsboro include conservation, additional water from Denison, and supplies through Sherman. **Table 5E.216** shows the projected population and demand, the current supplies, and the water management strategies for Pottsboro.

Table 5E.216 Summary of Water User Group – City of Pottsboro

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**3,056**	**3,951**	**4,834**	**6,331**	**10,000**	**18,000**
Projected Demands						
Municipal Demand	518	655	791	1,030	1,624	2,920
Total Projected Demand	***518***	***655***	***791***	***1,030***	***1,624***	***2,920***
Currently Available Supplies						
Woodbine Aquifer	112	112	112	112	112	112
Lake Texoma through Denison	311	381	469	572	783	673
Total Currently Available Supplies	***423***	***493***	***581***	***684***	***895***	***785***
Need (Demand – Supply)	***95***	***162***	***210***	***346***	***729***	***2,135***
Water Management Strategies						
Water Conservation	27	40	48	66	110	211
Denison	68	122	162	280	619	1,009
Connect to Sherman	0	0	0	0	0	915
Total Supplies from Strategies	***95***	***162***	***210***	***346***	***729***	***2,135***
Reserve (Shortage)	**0**	**0**	**0**	**0**	**0**	**0**

Red River Authority of Texas

The Red River Authority of Texas supplies water in Grayson County in Region C and multiple other Counties in Regions A, B, G, and O. The only water management strategy for the Region C portion of the Authority's service area is conservation. **Table 5E.217** shows the projected population and demand, the current supplies, and the water management strategies for the Red River Authority of Texas in Region C.

Table 5E.217 Summary of Water User Group – Red River Authority of Texas (Region C Only)

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**1,457**	**1,625**	**1,773**	**1,921**	**2,062**	**1,976**
Projected Demands						
Municipal Demand	358	392	421	454	487	467
Total Projected Demand	***358***	***392***	***421***	***454***	***487***	***467***
Currently Available Supplies						
Red River Authority of Texas	358	392	421	454	487	467
Total Currently Available Supplies	***358***	***392***	***421***	***454***	***487***	***467***
Need (Demand – Supply)	***0***	***0***	***0***	***0***	***0***	***0***
Water Management Strategies						
Water Conservation	3	5	4	6	8	9
Total Supplies from Strategies	***3***	***5***	***4***	***6***	***8***	***9***
Reserve (Shortage)	**3**	**5**	**4**	**6**	**8**	**9**

Sherman

Sherman is the largest city in Grayson County and is located in the center of the county. Sherman is a wholesale water provider (WWP) that provides water to Grayson County Steam Electric Power, Grayson County Manufacturing, Grayson County Other, Dorchester and Marilee Special Utility District.

In the future, Sherman is assumed to treat water for other water suppliers in Collin, Grayson, Denton, and Cooke Counties through their own Texoma supplies, the GTUA Regional Water System and the existing Collin-Grayson Municipal Alliance (Anna, Howe, Melissa and Van Alstyne).

Several water users in the county plan to participate in the GTUA Regional Water System. Several entities hold water rights in Lake Texoma but currently do not have access to this resource. The GTUA Regional Water System strategy would make additional supplies available by treating Lake Texoma water and delivering to these WUGs. The strategy assumes that supplies will be transported to and then treated at the existing Sherman WTP. Details on the GTUA Regional Water System are discussed further in **Appendix G**.

Sherman uses groundwater from the Trinity and Woodbine aquifers and water from Lake Texoma purchased from the Greater Texoma Utility Authority. Sherman's existing water treatment plant has a peak capacity of 20 MGD and is capable of treating the high TDS levels from Lake Texoma without needing to blend with other sources. There are sufficient supplies in Lake Texoma to meet needs for Sherman and its customers over the planning period. Recommended water management strategies include expanding the existing treatment plant and the necessary raw water delivery infrastructure. Planned WTP expansions will be located at the existing site.

Table 5E.218 shows the projected demand, the current supplies, and the water management strategies for Sherman.

Table 5E.218 Summary of Wholesale Water Provider and Customers – Sherman

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Demands						
Sherman	10,701	11,043	11,152	12,009	15,825	24,226
County Other, Grayson	*747*	*747*	*747*	*747*	*747*	*1,196*
Dorchester	*84*	*84*	*84*	*84*	*84*	*84*
Manufacturing, Grayson	*2,213*	*2,257*	*2,257*	*2,257*	*2,257*	*2,257*
Marilee SUD	*194*	*216*	*242*	*237*	*235*	*235*
Steam Electric Power, Grayson	*4,387*	*4,387*	*4,387*	*4,387*	*4,387*	*4,387*
Future Direct Customers						
Anna	*0*	*1,235*	*875*	*1,053*	*1,112*	*1,207*
Bells	*0*	*10*	*36*	*54*	*384*	*587*
County Other, Grayson (Additional)	*0*	*760*	*860*	*960*	*1,060*	*1,160*
Howe	*0*	*7*	*11*	*14*	*17*	*20*
Manufacturing, Grayson	*0*	*9*	*6*	*5*	*4*	*3*
Kentucky Town WSC	*0*	*47*	*104*	*160*	*300*	*487*
Luella SUD	*0*	*40*	*85*	*118*	*181*	*277*
Melissa	*0*	*3,172*	*3,497*	*3,296*	*3,112*	*2,974*
Pottsboro	*0*	*0*	*0*	*0*	*0*	*1,126*
South Grayson SUD	*0*	*51*	*156*	*222*	*293*	*354*
Southmayd	*49*	*59*	*70*	*85*	*146*	*229*
Tioga	*0*	*10*	*19*	*31*	*265*	*424*
Tom Bean	*0*	*27*	*52*	*83*	*157*	*353*
Van Alstyne	*0*	*61*	*95*	*116*	*239*	*280*
Whitewright	*0*	*0*	*50*	*50*	*100*	*100*
GTUA Regional Water System Customers						
Celina	*0*	*5,605*	*5,605*	*5,605*	*5,605*	*5,605*
Collinsville	*0*	*91*	*153*	*231*	*256*	*411*
County Other, Collin (Weston)	*0*	*550*	*1,099*	*1,099*	*1,099*	*1,099*
Gainesville and Customers	*0*	*1,632*	*5,605*	*5,605*	*5,605*	*5,605*
Gunter	*297*	*695*	*2,859*	*2,859*	*2,859*	*2,859*
Lake Kiowa SUD	*0*	*886*	*886*	*886*	*886*	*886*
Marilee SUD (Additional)	*0*	*1,390*	*1,558*	*1,558*	*1,515*	*1,439*
Northwest Grayson County WCID 1	*0*	*194*	*572*	*572*	*572*	*572*
Pilot Point	*0*	*975*	*1,256*	*1,256*	*1,256*	*1,256*
Two Way SUD	*0*	*867*	*1,007*	*1,204*	*1,603*	*1,682*
Whitesboro	*0*	*461*	*453*	*441*	*471*	*471*
Woodbine WSC	*0*	*716*	*942*	*942*	*942*	*942*
Total Projected Demand	***18,672***	***38,284***	***46,780***	***48,226***	***53,574***	***64,793***
Treated Water Demand	*14,285*	*33,897*	*42,393*	*43,839*	*49,187*	*60,406*
Raw Water Demand (for SEP)	*4,387*	*4,387*	*4,387*	*4,387*	*4,387*	*4,387*

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Currently Available Supplies						
Trinity Aquifer	*4,822*	*4,822*	*4,822*	*4,822*	*4,822*	*4,822*
Woodbine Aquifer	*996*	*996*	*996*	*996*	*996*	*996*
GTUA (Lake Texoma, Treated, Limited by WTP)	*11,210*	*11,210*	*11,210*	*11,210*	*11,210*	*11,210*
GTUA (Lake Texoma, Raw for SEP)	*4,387*	*4,387*	*4,387*	*4,387*	*4,387*	*4,387*
Total Currently Available Supplies (Treated Supplies)	***17,028***	***17,028***	***17,028***	***17,028***	***17,028***	***17,028***
Total Currently Available Supplies (Raw Supplies)	***4,387***	***4,387***	***4,387***	***4,387***	***4,387***	***4,387***
Treated Need (Demand – Supply)	***0***	***16,869***	***25,365***	***26,811***	***32,159***	***43,378***
Raw Water Need (Demand – Supply)	***0***	***0***	***0***	***0***	***0***	***0***
Water Management Strategies						
Conservation (retail)	152	206	195	251	1,048	1,868
Conservation (wholesale)	93	190	173	216	352	732
Additional Texoma Supply from GTUA:	20,937	41,477	47,082	47,082	52,687	63,897
GTUA Regional Water System	*15,332*	*35,872*	*35,872*	*35,872*	*35,872*	*35,872*
10 MGD WTP Expansion (desal)	*5,605*	*5,605*	*5,605*	*5,605*	*5,605*	*5,605*
10 MGD WTP Expansion (desal)			*5,605*	*5,605*	*5,605*	*5,605*
10 MGD WTP Expansion (desal)					*5,605*	*5,605*
20 MGD WTP Expansion (desal)						*11,210*
Total Supplies from Strategies	***21,182***	***41,873***	***47,450***	***47,549***	***54,087***	***66,497***
Reserve (Shortage)	***42,597***	***63,288***	***68,865***	***68,964***	***75,502***	***87,912***

South Grayson Special Utility District

South Grayson SUD is located in southern Grayson County and northern Collin County. The WSC gets its current supplies from the Trinity and Woodbine aquifers. Water management strategies for South Grayson SUD include conservation and supplies from GTUA through Sherman**. Table 5E.219** shows the projected population and demand, the current supplies, and the water management strategies for South Grayson SUD.

Table 5E.219 Summary of Water User Group – South Grayson Special Utility District

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**4,134**	**4,656**	**5,622**	**6,218**	**6,848**	**7,376**
Projected Demands						
Municipal Demand	506	557	662	728	799	860
Total Projected Demand	***506***	***557***	***662***	***728***	***799***	***860***
Currently Available Supplies						
Trinity Aquifer	400	400	400	400	400	400
Woodbine Aquifer	106	106	106	106	106	106
Total Currently Available Supplies	***506***	***506***	***506***	***506***	***506***	***506***
Need (Demand – Supply)	***0***	***51***	***156***	***222***	***293***	***354***
Water Management Strategies						
Water Conservation	5	7	7	10	13	17
Connect to Sherman	0	44	149	212	280	337
Total Supplies from Strategies	***5***	***51***	***156***	***222***	***293***	***354***
Reserve (Shortage)	**5**	**0**	**0**	**0**	**0**	**0**

Southmayd

Southmayd is located in central Grayson County. The city gets its current supplies from the Woodbine aquifer. Water management strategies for Southmayd include conservation and supplies from GTUA through Sherman. **Table 5E.220** shows the projected population and demand, the current supplies, and the water management strategies for Southmayd.

Table 5E.220 Summary of Water User Group – City of Southmayd

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**1,281**	**1,426**	**1,569**	**1,731**	**2,334**	**3,151**
Projected Demands						
Municipal Demand	143	153	164	179	240	323
Total Projected Demand	***143***	***153***	***164***	***179***	***240***	***323***
Currently Available Supplies						
Woodbine Aquifer	94	94	94	94	94	94
Total Currently Available Supplies	***94***	***94***	***94***	***94***	***94***	***94***
Need (Demand – Supply)	***49***	***59***	***70***	***85***	***146***	***229***
Water Management Strategies						
Water Conservation	1	2	2	2	4	6
Connect to Sherman	48	57	68	83	142	223
Total Supplies from Strategies	***49***	***59***	***70***	***85***	***146***	***229***
Reserve (Shortage)	**0**	**0**	**0**	**0**	**0**	**0**

Southwest Fannin County Special Utility District

Southwest Fannin County SUD serves western Fannin County and eastern Grayson County. The water supply plan for Southwest Fannin County SUD is discussed under Fannin County in **Section 5E.6.**

Starr Water Supply Corporation

Starr WSC supplies water to Grayson County. The WSC gets its water from the Trinity aquifer and the only water management strategy is conservation. **Table 5E.221** shows the projected population and demand, the current supplies, and the water management strategies for Starr WSC.

Table 5E.221 Summary of Water User Group – Starr WSC

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**2,355**	**2,588**	**2,556**	**2,882**	**3,897**	**5,347**
Projected Demands						
Municipal Demand	242	255	245	273	368	504
Total Projected Demand	***242***	***255***	***245***	***273***	***368***	***504***
Currently Available Supplies						
Trinity Aquifer	504	504	504	504	504	504
Total Currently Available Supplies	***504***	***504***	***504***	***504***	***504***	***504***
Need (Demand – Supply)	***0***	***0***	***0***	***0***	***0***	***0***
Water Management Strategies						
Water Conservation	2	3	2	4	6	10
Total Supplies from Strategies	***2***	***3***	***2***	***4***	***6***	***10***
Reserve (Shortage)	**264**	**252**	**261**	**235**	**142**	**10**

Tioga

Tioga is located in southwestern Grayson County. The city gets its water supply from the Trinity aquifer. Water management strategies for Tioga include conservation and connecting to Sherman. **Table 5E.222** shows the projected population and demand, the current supplies, and the water management strategies for Tioga. An alternative water management strategy for Tioga is participating in the Grayson County Water Supply Project.

Table 5E.222 Summary of Water User Group – City of Tioga

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**1,209**	**1,322**	**1,421**	**1,535**	**3,395**	**4,656**
Projected Demands						
Municipal Demand	165	175	184	196	430	589
Total Projected Demand	***165***	***175***	***184***	***196***	***430***	***589***
Currently Available Supplies						
Trinity Aquifer	165	165	165	165	165	165
Total Currently Available Supplies	***165***	***165***	***165***	***165***	***165***	***165***
Need (Demand – Supply)	***0***	***10***	***19***	***31***	***265***	***424***
Water Management Strategies						
Water Conservation	17	17	20	21	68	95
Connect to Sherman	0	0	0	10	197	329
Total Supplies from Strategies	***17***	***17***	***20***	***31***	***265***	***424***
Reserve (Shortage)	**17**	**7**	**1**	**0**	**0**	**0**
Alternative Strategy						
Grayson County Water Supply Project	*0*	*0*	*0*	*10*	*197*	*329*

Tom Bean

Tom Bean is located in southeastern Grayson County. The city gets its water supply from the Woodbine aquifer. Water management strategies for Tom Bean include conservation and connecting to Sherman. **Table 5E.223** shows the projected population and demand, the current supplies, and the water management strategies for Tom Bean.

Table 5E.223 Summary of Water User Group – City of Tom Bean

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**1,256**	**1,432**	**1,593**	**1,779**	**2,196**	**3,294**
Projected Demands						
Municipal Demand	237	264	289	320	394	590
Total Projected Demand	***237***	***264***	***289***	***320***	***394***	***590***
Currently Available Supplies						
Woodbine Aquifer	237	237	237	237	237	237
Total Currently Available Supplies	***237***	***237***	***237***	***237***	***237***	***237***
Need (Demand – Supply)	***0***	***27***	***52***	***83***	***157***	***353***
Water Management Strategies						
Water Conservation	2	33	80	89	111	168
Connect to Sherman	0	0	0	0	46	185
Total Supplies from Strategies	***2***	***33***	***80***	***89***	***157***	***353***
Reserve (Shortage)	**2**	**6**	**28**	**6**	**0**	**0**

Two Way Special Utility District

Two Way SUD serves eastern Cooke County and western Grayson County. The SUD currently gets its water supplies from the Trinity aquifer. Water management strategies for Two Way SUD include conservation and participation in the GTUA Regional Water System. **Table 5E.224** shows the projected population and demand, the current supplies, and the water management strategies for Two Way SUD.

Table 5E.224 Summary of Water User Group – Two Way SUD

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**6,256**	**8,071**	**9,524**	**11,487**	**15,324**	**19,781**
Projected Demands						
Municipal Demand	693	867	1,007	1,204	1,603	2,066
Total Projected Demand	***693***	***867***	***1,007***	***1,204***	***1,603***	***2,066***
Currently Available Supplies						
Trinity Aquifer	688	688	688	688	688	688
Total Currently Available Supplies	***688***	***688***	***688***	***688***	***688***	***688***
Need (Demand – Supply)	***5***	***179***	***319***	***516***	***915***	***1,378***
Water Management Strategies						
Water Conservation	5	10	10	18	31	46
GTUA Regional Water System	0	857	997	1,186	1,572	1,636
Total Supplies from Strategies	***5***	***867***	***1,007***	***1,204***	***1,603***	***1,682***
Reserve (Shortage)	**0**	**688**	**688**	**688**	**688**	**304**

Van Alstyne

Van Alstyne is located in southern Grayson County on the border with Collin County. The city gets its current supplies from the Trinity and Woodbine aquifers and the North Texas Municipal Water District (NTMWD) via GTUA and the Collin-Grayson Municipal Alliance pipeline. Water management strategies for Van Alstyne include conservation, additional water through the CGMA from NTMWD and Sherman, and water system improvements needed to take delivery of additional water from GTUA. **Table 5E.225** shows the projected population and demand, the current supplies, and the water management strategies for Van Alstyne.

Table 5E.225 Summary of Water User Group – City of Van Alstyne

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**3,750**	**5,300**	**7,470**	**9,640**	**18,644**	**23,494**
Projected Demands						
Municipal Demand	518	710	983	1,258	2,420	3,047
Total Projected Demand	***518***	***710***	***983***	***1,258***	***2,420***	***3,047***
Currently Available Supplies						
Trinity Aquifer	300	300	300	300	300	300
Woodbine Aquifer	208	208	208	208	208	208
NTMWD through GTUA (CGMA)	10	171	371	530	1,157	1,291
Total Currently Available Supplies	***518***	***679***	***879***	***1,038***	***1,665***	***1,799***
Need (Demand – Supply)	***0***	***31***	***104***	***220***	***755***	***1,248***
Water Management Strategies						
Water Conservation	24	33	45	61	131	181
Sherman (CGMA)	0	61	95	116	239	280
NTMWD (CGMA)	0	0	59	159	624	1,067
Water System Improvements	*0*	*0*	*59*	*159*	*624*	*1,067*
Total Supplies from Strategies	***24***	***94***	***199***	***336***	***994***	***1,528***
Reserve (Shortage)	**24**	**63**	**95**	**116**	**239**	**280**

Westminster WSC

Westminster WSC serves parts of Collin County and Grayson Counties. Water management strategies for Westminster WSC are discussed under Collin County in **Section 5E.1.**

Whitesboro

Whitesboro is located in western Grayson County. The city gets its water supply from the Trinity aquifer. Water management strategies for Whitesboro include conservation and participation in the GTUA Regional Water System. **Table 5E.226** shows the projected population and demand, the current supplies, and the water management strategies for Whitesboro.

Table 5E.226 Summary of Water User Group – City of Whitesboro

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**3,839**	**3,908**	**3,956**	**3,917**	**4,975**	**6,582**
Projected Demands						
Municipal Demand	469	461	453	441	557	735
Total Projected Demand	***469***	***461***	***453***	***441***	***557***	***735***
Currently Available Supplies						
Trinity Aquifer	547	547	547	547	547	547
Total Currently Available Supplies	***547***	***547***	***547***	***547***	***547***	***547***
Need (Demand – Supply)	***0***	***0***	***0***	***0***	***10***	***188***
Water Management Strategies						
Water Conservation	4	5	5	6	9	15
GTUA Regional Water System	0	456	448	435	462	456
Total Supplies from Strategies	***4***	***461***	***453***	***441***	***471***	***471***
Reserve (Shortage)	**82**	**547**	**547**	**547**	**461**	**283**

Whitewright

Whitewright is located in eastern Grayson County with a small area in Fannin County. The city gets its current water supply from the Woodbine aquifer, and water management strategies include conservation and connecting to Sherman. **Table 5E.227** shows the projected population and demand, the current supplies, and the water management strategies for Whitewright.

Table 5E.227 Summary of Water User Group – City of Whitewright

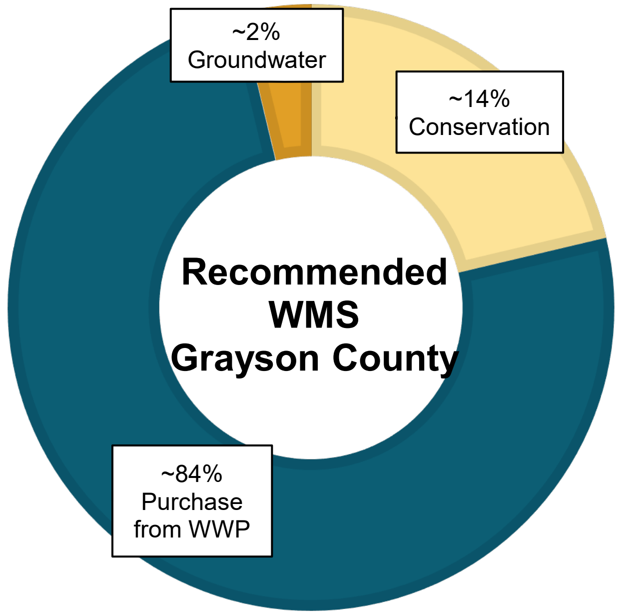
(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**1,906**	**1,930**	**1,953**	**1,880**	**1,992**	**2,214**
Projected Demands						
Municipal Demand	261	255	251	239	252	280
Total Projected Demand	***261***	***255***	***251***	***239***	***252***	***280***
Currently Available Supplies						
Woodbine Aquifer	305	305	305	305	305	305
Total Currently Available Supplies	***305***	***305***	***305***	***305***	***305***	***305***
Need (Demand – Supply)	***0***	***0***	***0***	***0***	***0***	***0***
Water Management Strategies						
Water Conservation	2	3	3	3	4	6
Connect to Sherman	0	0	47	47	96	94
Total Supplies from Strategies	***2***	***3***	***50***	***50***	***100***	***100***
Reserve (Shortage)	**46**	**53**	**104**	**116**	**153**	**125**

Woodbine Water Supply Corporation

Woodbine WSC serves eastern Cooke County and western Grayson County. The water supply plan for Woodbine WSC is discussed under Cooke County in **Section 5E.2**.

5E.8.2 Summary of Costs for Grayson County

Table 5E.228 summarizes the costs of the water management strategies recommended for the WUGs and WWPs who have the majority of their demand located in Grayson County. Total quantities from **Table 5E.228** will not necessarily match total county demands. This is due mainly to water users whose sum of strategies results in a reserve as well as due to water users located in multiple counties (or wholesale water providers who develop strategies and then sell water to users in other counties). Quantities from infrastructure projects needed to deliver and/or treat water (shown in *gray italics*) are not included since the supplies are associated with other strategies. To avoid double-counting quantities of supplies, the quantities in gray italics are **not** included in the total.



The majority of the future supplies needed to meet demands within Collin County are projected to come through purchases from wholesale water providers and the GTUA Regional System Project. Other strategies include conservation and groundwater.

Table 5E.229 summarizes the recommended water management strategies within Grayson County individually. Alternative strategies are also included. More detailed cost estimates are located in **Appendix H.**

Table 5E.228 Summary of Recommended Water Management Strategies for Grayson County

Type of Strategy	Quantity (Ac-Ft/Yr)	Capital Costs
Conservation[a]	4,491	$2,036,218
Purchase from WWP	28,114	$0
Additional Infrastructure	*45,167*	*$543,531,000*
Groundwater	790	$10,214,000
Total	33,395	**$555,781,218**

[a]The conservation quantities represent the sum of the individual water user groups who have the majority of their service areas located in the county, not the total conservation in the county.

Table 5E.229 Costs for Recommended Water Management Strategies for Grayson County

WWP or WUG	Strategy	Online by:	Quantity (Ac-Ft/Yr)[b]	Capital Costs[c]	Unit Cost ($/1000 gal) With Debt Service	Unit Cost ($/1000 gal) After Debt Service	Table
WWPs							
Denison	Conservation (retail)	2020	1,695	$698,755	$1.65	$0.83	H.11
	Conservation (wholesale)	2020	Included with WUGs.				
	New 4 MGD Desalination WTP	*2030*	*2,242*	*$36,137,000*	*$7.33*	*$3.85*	*H.13*
	10 MGD Desalination WTP Expansion	*2060*	*4,531*	*$82,213,000*	*$6.46*	*$3.30*	*H.12*
	Expand Raw Water Delivery from Lake Texoma - Phase I	*2030*	*2,242*	*$17,674,000*	*$1.95*	*$0.25*	*H.127*
	Expand Raw Water Delivery from Lake Texoma - Phase II	*2060*	*5,605*	*$9,022,000*	*$0.41*	*$0.06*	*H.128*
Sherman	Conservation (retail)	2020	1,868	$628,668	$0.89	$0.00	H.11
	Conservation (wholesale)	2020	Included with WUGs.				
	GTUA Regional Water System	2020	13,045	See GTUA in **Chapter 5D**.			
	10 MGD WTP Expansion (desal)	*2020*	*5,605*	*$82,213,000*	*$6.46*	*$3.30*	*H.13*
	10 MGD WTP Expansion (desal)	*2040*	*5,605*	*$82,213,000*	*$6.46*	*$3.30*	*H.13*
	10 MGD WTP Expansion (desal)	*2060*	*5,605*	*$82,213,000*	*$6.46*	*$3.30*	*H.13*
	20 MGD WTP Expansion (desal)	*2070*	*11,210*	*$149,002,000*	*$5.90*	*$3.03*	*H.13*
WUGs							
Bells	Conservation	2020	16	$292,347	$31.56	$0.00	H.11
	Connect to Sherman	2030	571	$0	$3.48	$3.48	None
	New Well(s) in Woodbine Aquifer	2030	55	$822,000	$5.91	$2.68	H.14
Collinsville	Conservation	2020	13	$16,010	$1.73	$0.00	H.11
	GTUA Regional Water System	2030	398	$0	$4.75	$2.93	None
Desert WSC	Conservation	See Fannin County.					
	New Well						
Dorchester	Conservation	2020	3	$5,172	$1.12	$0.00	H.11

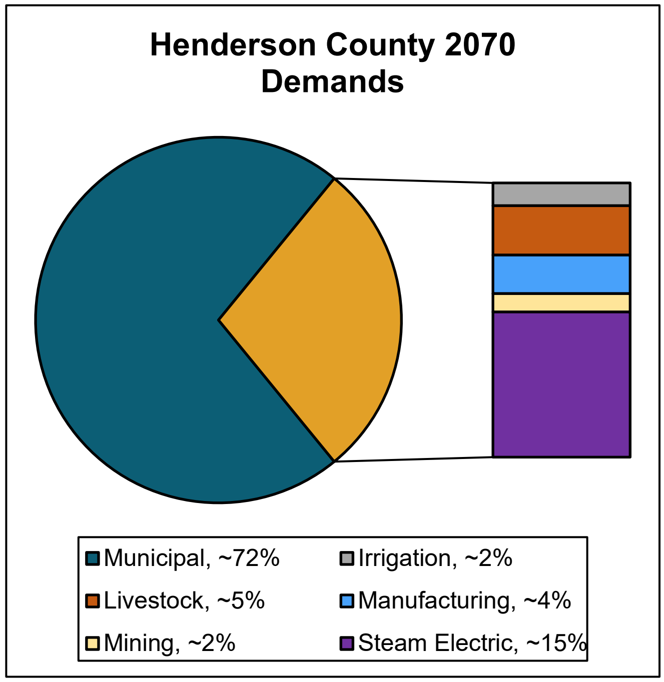
WWP or WUG	Strategy	Online by:	Quantity (Ac-Ft/Yr)[b]	Capital Costs[c]	Unit Cost ($/1000 gal) With Debt Service	Unit Cost ($/1000 gal) After Debt Service	Table
	New Well(s) in Trinity Aquifer	2020	90	$1,845,000	$6.33	$1.90	H.14
Gunter	Conservation	2020	19	$22,898	$6.30	$0.00	H.11
	New Well(s) in Trinity Aquifer	2020	50	$1,835,000	$10.41	$2.48	H.14
	GTUA Regional Water System	2030	2,854	$0	$5.72	$3.06	None
Howe	Conservation	2020	9	$28,900	$3.12	$0.00	H.11
	NTMWD through GTUA (CGMA)	2040	66	$0	$0.50	$0.50	None
	Sherman through GTUA (CGMA)	2030	20	$0	$3.48	$3.48	None
	CGMA Supplies	*2030*	*86*	*See GTUA in **Chapter 5D**.*			
	ALTERNATIVE Grayson County Water Supply Project	*2030*	*79*	*See GTUA in **Chapter 5D**.*			
Kentuckytown WSC	Conservation	2020	17	$18,044	$1.30	$0.00	H.11
	Connect to Sherman	2030	470	$0	$3.48	$3.48	None
Luella SUD	Conservation	2020	13	$23,749	$1.71	$0.00	H.11
	Connect to Sherman	2040	264	$0	$3.48	$3.48	None
Marilee SUD[a]	Conservation	See Collin County.					
	Sherman						
Mustang SUD[a]	Conservation	See Denton County.					
	Other measures						
Northwest Grayson County WCID 1	Conservation	2020	8	$4,053	$0.44	$0.00	H.11
	GTUA Regional Water System	2030	572	$0	$4.75	$2.93	H.73
	New Well(s) in Trinity Aquifer	2020	247	$2,730,000	$4.18	$1.80	H.14
Oak Ridge South Gale WSC	Conservation	2020	9	$6,787	$0.73	$0.00	H.11
	Denison	2020	225	$0	$3.00	$3.00	None
Pink Hill WSC	Conservation	2020	10	$10,957	$1.18	$0.00	H.11
	New Well(s) in Woodbine Aquifer	2030	124	$1,088,000	$3.72	$1.83	H.14

WWP or WUG	Strategy	Online by:	Quantity (Ac-Ft/Yr)[b]	Capital Costs[c]	Unit Cost ($/1000 gal) With Debt Service	Unit Cost ($/1000 gal) After Debt Service	Table
	New Well(s) in Trinity Aquifer	2030	124	$1,088,000	$3.72	$1.83	H.14
Pottsboro	Conservation	2020	211	$26,823	$1.41	$0.82	H.11
	Denison	2020	1,009	$0	$3.00	$3.00	None
	Connect to Sherman	2070	915	$0	$3.48	$3.48	None
Red River Authority of Texas	Conservation	2020	9	$30,217	$2.17	$0.00	H.11
South Grayson SUD[a]	Conservation	2020	17	$7,852	$0.34	$0.00	H.11
	Connect to Sherman	2030	337	$0	$3.48	$3.48	None
Southmayd	Conservation	2020	6	$10,849	$2.34	$0.00	H.11
	Connect to Sherman	2020	223	$0	$3.48	$3.48	None
Southwest Fannin County SUD[a]	Conservation	See Fannin County.					
	New Well in Woodbine with Transmission Facilities						
	Fannin County WSP						
Starr WSC	Conservation	2020	10	$14,384	$1.55	$0.00	H.11
Tioga	Conservation	2020	95	$14,836	$0.19	$0.00	H.11
	Connect to Sherman	2050	329	$0	$3.48	$3.48	None
	ALTERNATIVE Grayson County Water Supply Project	*2050*	*329*	*See GTUA in **Chapter 5D**.*			
Tom Bean	Conservation	2020	168	$9,742	$1.05	$0.99	H.11
	Connect to Sherman	2060	185	$0	$3.48	$3.48	None
Two Way SUD[a]	Conservation	2020	46	$39,344	$1.70	$0.11	H.11
	GTUA Regional Water System	2030	1,636	$0	$4.75	$2.93	None
Van Alstyne	Conservation	2020	181	$41,490	$0.37	$0.04	H.11
	Sherman through GTUA (CGMA)	2030	280	$0	$3.48	$3.48	None
	NTMWD through GTUA (CGMA)	2040	1,067	$0	$0.50	$0.50	None
	CGMA Supplies	*2040*	*1,347*	*See GTUA in **Chapter 5D**.*			

WWP or WUG	Strategy	Online by:	Quantity (Ac-Ft/Yr)[b]	Capital Costs[c]	Unit Cost ($/1000 gal) With Debt Service	Unit Cost ($/1000 gal) After Debt Service	Table
	Water System Improvements	*2040*	*1,067*	*$2,844,000*	*$0.72*	*$0.15*	*H.129*
Westminster WSC[a]	Conservation	See Collin County.					
Whitesboro	Conservation	2020	15	$44,649	$2.41	$0.00	H.11
	GTUA Regional Water System	2030	462	$0	$4.75	$2.93	None
Whitewright[a]	Conservation	2020	6	$21,871	$2.36	$0.00	H.11
	Connect to Sherman	2040	96	$0	$3.48	$3.48	None
Woodbine WSC[a]	Conservation	See Cooke County.					
	GTUA Regional Water System						
County Other and Non-Municipal							
County Other, Grayson	Conservation	2020	47	$17,821	$0.64	$0.00	H.11
	Denison	2020	205	$0	$3.00	$3.00	None
	Sherman	2020	1,719	$0	$3.48	$3.48	None
Irrigation, Grayson	None	None					
Livestock, Grayson	None	None					
Manufacturing, Grayson	Sherman	2060	1,144	$0	$3.48	$3.48	None
	NTMWD through GTUA (CGMA)	2030	13	$0	$0.50	$0.50	None
	Sherman through GTUA (CGMA)	2030	9	$0	$3.48	$3.48	None
	CGMA Supplies	*2030*	*22*	*See GTUA in **Chapter 5D**.*			
	ALTERNATIVE Direct Reuse from Sherman	*2020*	*561*	*$8,289,000*	*$3.80*	*$0.61*	*H.130*
Mining, Grayson	New Well(s) in Trinity Aquifer	2020	100	$806,000	$2.04	$0.29	H.14
Steam Electric Power, Grayson	None	None					

[a]Water User Groups extend into more than one county
[b]Quantities listed are for the WUG only. They do not include the WUG's customers.
[c]Purchases from wholesale water providers that require no new infrastructure have no capital costs. The unit costs shown in the table represent the cost to purchase water from the WWP.

5E.9 Henderson County



Henderson County is located in the southeast portion of Region C. **Figure 5E.18** shows the service areas for water providers in the county. Henderson County is the only county in Region C that is split with another regional planning group. The western half of the county is located in Region C while the eastern half of the county is located in the East Texas Region (Region I). There are several reservoirs in the county, including Cedar Creek Reservoir, Forest Grove Reservoir, Lake Athens and Lake Palestine.

Although Henderson County is not the most populous county in Region C (11th out of 16), the county's population is expected to double between 2050 and 2070. Demands for the county are predominately municipal and the largest non-municipal demand in the county is for Steam Electric Power. An overall summary of the county's projections is shown in **Table 5E.230** and water management strategies for individual WWPs and WUGs are discussed on the following pages.

Henderson County Quick Facts

2010 Population: 55,743

Projected 2070 Population: 141,881

Projected 2070 Demand: 22 MGD

County Seat: Athens

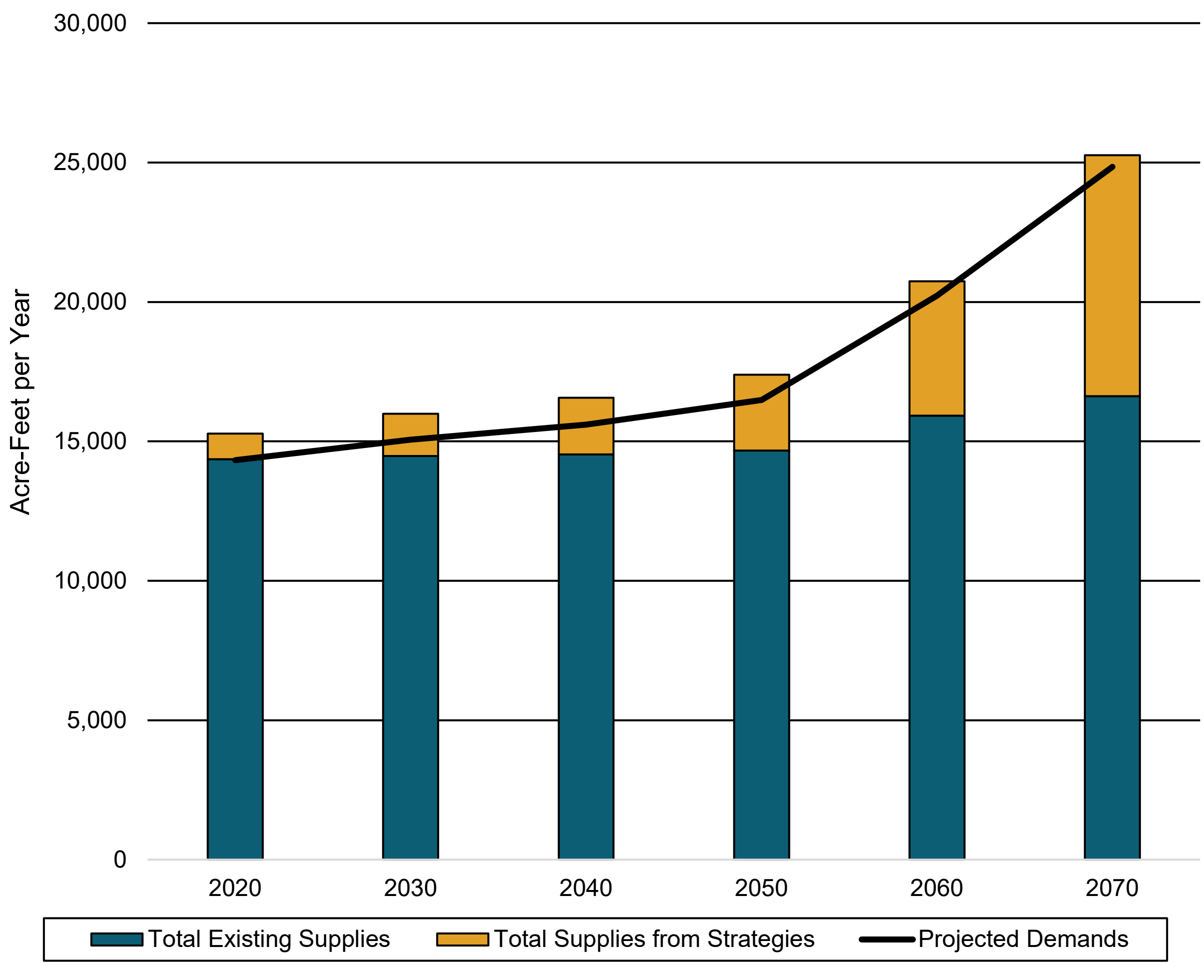
Economy: Agribusiness; manufacturing; minerals; tourism

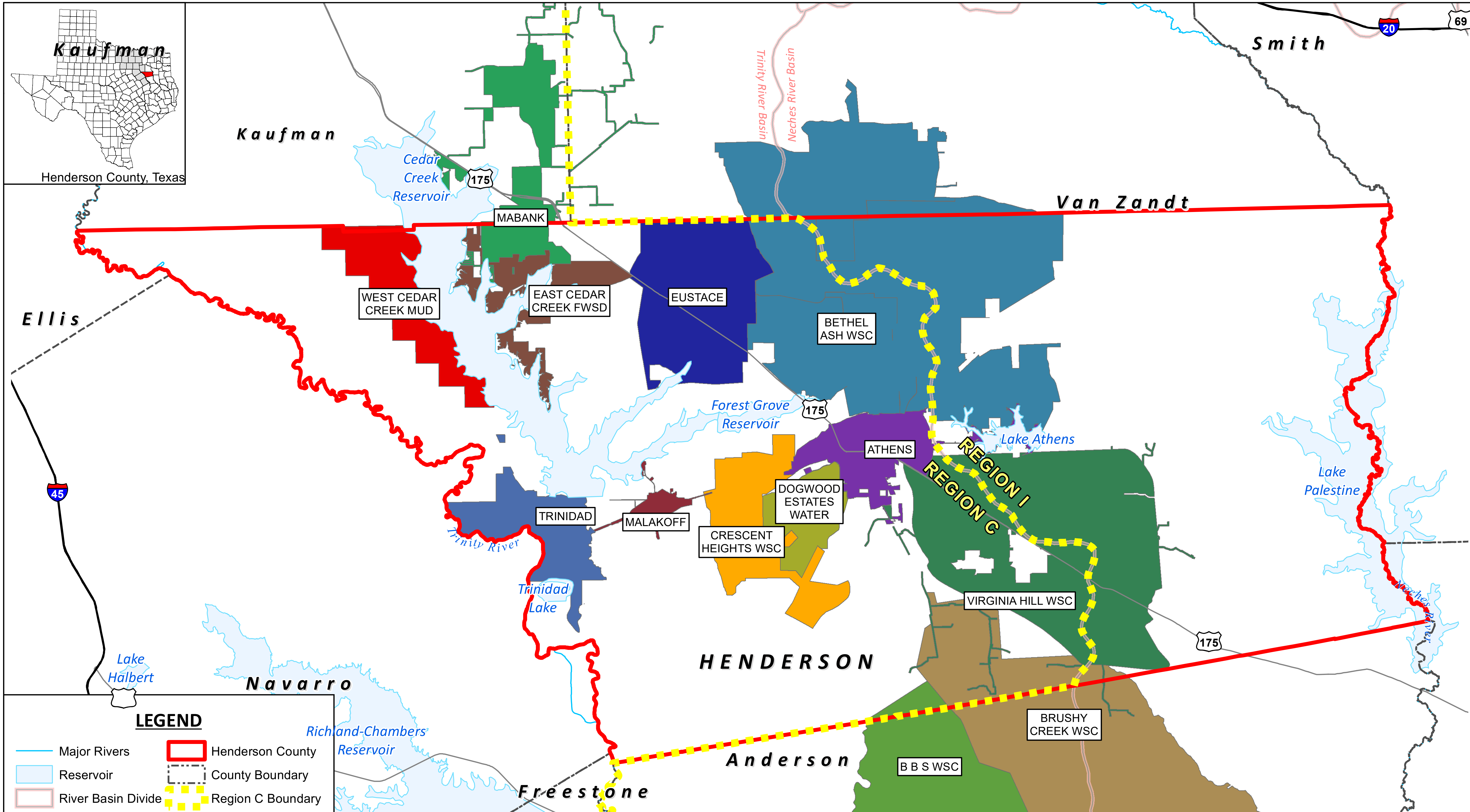
River Basins: Trinity (61%), Sabine (39%)

Table 5E.230 Summary of Henderson County

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**67,579**	**72,592**	**78,504**	**85,901**	**110,493**	**141,881**
Projected Demands	**14,326**	**15,058**	**15,595**	**16,488**	**20,224**	**24,847**
Municipal	7,534	8,015	8,577	9,467	13,208	17,841
Irrigation	582	582	582	582	582	582
Livestock	1,261	1,261	1,261	1,261	1,261	1,261
Manufacturing	806	985	985	985	985	985
Mining	434	506	481	484	479	469
Steam Electric	3,709	3,709	3,709	3,709	3,709	3,709
Total Existing Supplies	**14,362**	**14,473**	**14,529**	**14,672**	**15,919**	**16,627**
Need (Demand - Supply)	**0**	**585**	**1,066**	**1,816**	**4,305**	**8,220**
Total Supplies from Strategies	**915**	**1,515**	**2,033**	**2,721**	**4,828**	**8,635**
Reserve (Shortage)	**951**	**930**	**967**	**905**	**523**	**415**

Figure 5E.17 Summary of Henderson County





REGION C
Water Planning for North Texas

2021 Region C Water Plan
HENDERSON COUNTY, TEXAS
FIGURE 5E.18

1 in = 4 miles
0 1 2 4 6
Miles
N W E S
Data Source(s): ESRI, USGS, TNRIS

TR116409: H:\WR_PLANNING\1 - Working\5E_County WMS\Henderson.mxd

5E.9.1 Wholesale Water Providers and Water User Groups

Water management strategies for Henderson County wholesale water providers (WWPs) and water user groups (WUGs) are discussed below (in alphabetical order). The costs and summary for Henderson County are presented in **Section 5E.9.2.**

Athens Municipal Water Authority

Athens Municipal Water Authority is a wholesale water provider and supplies water to meet municipal and manufacturing demands in the City of Athens. Athens MWA also supplies local demand for lawn irrigation around Lake Athens and is contracted to supply 3,023 acre-feet per year for the Athens Fish Hatchery, located at Lake Athens (and in Region I, the East Texas Region).

Athens MWA has a right to divert 8,500 acre-feet per year from Lake Athens. Athens MWA also owns a groundwater well on its water treatment plant property. The fish hatchery returns approximately 95 percent of the water it diverts to Lake Athens, which serves to increase the supply from the lake, but the hatchery is under no contractual obligation to continue this practice.

Recognizing the limitations of its existing supplies, Athens MWA has obtained a reuse permit that allows the City of Athens to discharge its treated wastewater effluent to Lake Athens for reuse. The reuse permit is for 2,677 acre-feet per year, but a recent study shows that this strategy is less economically feasible than other alternatives. At this time, Athens MWA and the City of Athens are not pursuing reuse of City of Athens wastewater through Lake Athens. There are three recommended water management strategies for Athens MWA: expand groundwater supply, new well(s) in the Carrizo-Wilcox aquifer and infrastructure improvements at the WTP. The infrastructure improvements include replacement of the aged booster pump and additional storage. Additionally, Athens MWA has already obtained permits to develop twelve additional wells. The current modeled available groundwater for the Carrizo-Wilcox aquifer in Henderson County limits the supply from the permitted twelve additional wells. Therefore, the total supply from the permitted wells was split into two strategies; one that is recommended and within the MAG and an alternate strategy that includes the remaining permitted quantity that exceeds the MAG. Since these wells are already permitted, it is likely that all twelve wells can be developed. The GCD is tasked with managing the aquifer to the Desired Future Conditions (DFCs), not the MAG. However, it is recommended that the GCD consider working with the GMA to adjust the DFC and MAG values to recognize existing permitted wells.

Table 5E.231 shows the recommended plan for Athens MWA.

Table 5E.231 Summary of Wholesale Water Provider and Customers – Athens MWA (Regions C & I)

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Demands						
Athens	1,594	1,865	2,093	2,427	5,094	8,188
Manufacturing, Henderson	484	591	591	591	591	591
Irrigation, Henderson (Region I)	170	170	170	170	170	170
Livestock, Henderson (TPWD Fish Hatchery)	3,023	3,023	3,023	3,023	3,023	3,023
Total Projected Demand	***5,271***	***5,649***	***5,877***	***6,211***	***8,878***	***11,972***
Treated Water Demand[a]	*2,078*	*2,456*	*2,684*	*3,018*	*5,685*	*8,779*
Raw Water Demand	*3,193*	*3,193*	*3,193*	*3,193*	*3,193*	*3,193*
Currently Available Supplies						
Lake Athens (Firm Yield)	*5,950*	*5,864*	*5,778*	*5,692*	*5,606*	5,520
Existing Wells in Carrizo-Wilcox in Region I	*886*	*886*	*886*	*886*	*886*	*886*
Total Currently Available Supplies	***6,836***	***6,750***	***6,664***	***6,578***	***6,492***	***6,406***
Need (Demand – Supply)	***0***	***0***	***0***	***0***	***2,386***	***5,566***
Water Management Strategies						
Conservation	29	192	228	265	483	753
Expanded Groundwater Supply	200	200	200	200	200	200
New Well(s) in Carrizo-Wilcox	400	400	2,000	2,000	2,000	2,000
Fish Hatchery Reuse	2,872	2,872	2,872	2,872	2,872	2,872
Infrastructure Improvements at WTP	*450*	*450*	*450*	*450*	*450*	*450*
Total Supplies from Strategies	***3,501***	***3,664***	***5,300***	***5,337***	***5,555***	***5,825***
Reserve (Shortage)	**5,066**	**4,765**	**6,087**	**5,704**	**3,169**	**259**
Alternative Strategies						
New Well in Carrizo-Wilcox	*1,262*	*1,262*	*1,262*	*1,262*	*1,262*	*1,262*

[a]Treated demands are demands for Athens and part of Henderson County manufacturing less Athens groundwater supplies.

Athens

The City of Athens is located in central Henderson County, and its population of about 12,800 is divided between the Trinity River Basin (Region C) and the Neches River Basin (the East Texas Region). Athens purchases treated water from the Athens Municipal Water Authority (a wholesale water provider that treats water from Lake Athens) and uses groundwater from the Carrizo-Wilcox aquifer. Water management strategies for Athens include conservation and additional water from Athens MWA. Plans for Athens MWA, which provides most of Athens' water supply, are discussed under Athens MWA. **Table 5E.232** shows the projected population and demand, the current supplies, and the water management strategies for Athens.

Table 5E.232 Summary of Water User Group – Athens (Regions C & I)

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**14,515**	**16,200**	**17,605**	**19,458**	**33,247**	**49,212**
Projected Demands						
Municipal Demand	2,962	3,233	3,461	3,795	6,462	9,556
Manufacturing, Henderson	484	591	591	591	591	591
Total Projected Demand	***3,446***	***3,824***	***4,052***	***4,386***	***7,053***	***10,147***
Currently Available Supplies						
Carrizo-Wilcox Aquifer	1,368	1,368	1,368	1,368	1,368	1,368
Athens MWA	2,078	2,456	2,684	3,018	4,252	4,816
Total Currently Available Supplies	***3,446***	***3,824***	***4,052***	***4,386***	***5,620***	***6,184***
Need (Demand – Supply)	***0***	***0***	***0***	***0***	***1,433***	***3,963***
Water Management Strategies						
Water Conservation	29	192	228	265	483	753
Athens MWA	0	0	0	0	950	3,210
Total Supplies from Strategies	***29***	***192***	***228***	***265***	***1,433***	***3,963***
Reserve (Shortage)	**29**	**192**	**228**	**265**	**0**	**0**

B B S Water Supply Corporation

B B S WSC supplies water to Henderson County in Region C and Anderson County in Region I. The WSC gets its water supply from the Carrizo-Wilcox aquifer. These sources are sufficient to meet future demands, and there are no water management strategies. **Table 5E.233** shows the projected population and demand, the current supplies, and the water management strategies for B B S WSC in Region C. Demands, supplies and strategies in the East Texas Region (Region I) are discussed in that region's water plan.

Table 5E.233 Summary of Water User Group – B B S WSC (Region C Only)

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**29**	**30**	**30**	**30**	**30**	**30**
Projected Demands						
Municipal Demand	3	3	3	3	3	3
Total Projected Demand	***3***	***3***	***3***	***3***	***3***	***3***
Currently Available Supplies						
Carrizo-Wilcox Aquifer	3	3	3	3	3	3
Total Currently Available Supplies	***3***	***3***	***3***	***3***	***3***	***3***
Need (Demand – Supply)	***0***	***0***	***0***	***0***	***0***	***0***
Water Management Strategies						
None	0	0	0	0	0	0
Total Supplies from Strategies	***0***	***0***	***0***	***0***	***0***	***0***
Reserve (Shortage)	**0**	**0**	**0**	**0**	**0**	**0**

Bethel Ash Water Supply Corporation

Bethel Ash WSC provides water for Henderson County (Region C and I) and Van Zandt County in Region D. **Table 5E.234** shows the projected population and demand, the current supplies, and the water management strategies for the portion of Bethel Ash WSC located in Region C. The Region I and Region D plan include strategies for the portion of Bethel Ash WSC in those regions. The current supply for the WSC in Region C is the Carrizo-Wilcox aquifer, and the only water management strategy in Region C is conservation.

Table 5E.234 Summary of Water User Group – Bethel Ash WSC (Region C Only)

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**2,115**	**2,385**	**2,609**	**2,907**	**3,163**	**3,411**
Projected Demands						
Municipal Demand	215	234	251	276	300	323
Total Projected Demand	***215***	***234***	***251***	***276***	***300***	***323***
Currently Available Supplies						
Carrizo-Wilcox Aquifer	323	323	323	323	323	323
Total Currently Available Supplies	***323***	***323***	***323***	***323***	***323***	***323***
Need (Demand – Supply)	***0***	***0***	***0***	***0***	***0***	***0***
Water Management Strategies						
Water Conservation	2	3	3	4	5	6
Total Supplies from Strategies	***2***	***3***	***3***	***4***	***5***	***6***
Reserve (Shortage)	**110**	**92**	**75**	**51**	**28**	**6**

Crescent Heights Water Supply Corporation

Crescent Heights WSC provides water to Henderson County. The WSC gets its water supply from the Carrizo-Wilcox aquifer and the only water management strategy is conservation. **Table 5E.235** shows the projected population and demand, the current supplies, and the water management strategies for Crescent Heights WSC.

Table 5E.235 Summary of Water User Group – Crescent Heights WSC

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**1,885**	**2,012**	**2,172**	**2,361**	**2,968**	**3,770**
Projected Demands						
Municipal Demand	163	166	174	186	233	296
Total Projected Demand	***163***	***166***	***174***	***186***	***233***	***296***
Currently Available Supplies						
Carrizo-Wilcox Aquifer	296	296	296	296	296	296
Total Currently Available Supplies	***296***	***296***	***296***	***296***	***296***	***296***
Need (Demand – Supply)	***0***	***0***	***0***	***0***	***0***	***0***
Water Management Strategies						
Water Conservation	2	2	2	2	4	6
Total Supplies from Strategies	***2***	***2***	***2***	***2***	***4***	***6***
Reserve (Shortage)	**135**	**132**	**124**	**112**	**67**	**6**

Dogwood Estates Water

Dogwood Estates Water gets its water supply from the Carrizo-Wilcox aquifer. The water management strategies include conservation and new groundwater well(s) in the Carrizo-Wilcox aquifer. **Table 5E.236** shows the projected population and demand, the current supplies, and the water management strategies for Dogwood Estates Water.

Table 5E.236 Summary of Water User Group – Dogwood Estates Water

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**1,205**	**1,286**	**1,388**	**1,509**	**1,897**	**2,409**
Projected Demands						
Municipal Demand	183	190	202	217	273	346
Total Projected Demand	***183***	***190***	***202***	***217***	***273***	***346***
Currently Available Supplies						
Carrizo-Wilcox Aquifer	195	195	195	195	195	195
Total Currently Available Supplies	***195***	***195***	***195***	***195***	***195***	***195***
Need (Demand – Supply)	***0***	***0***	***7***	***22***	***78***	***151***
Water Management Strategies						
Water Conservation	2	2	2	3	5	7
New Well(s) in Carrizo-Wilcox Aquifer	0	0	5	19	73	144
Total Supplies from Strategies	***2***	***2***	***7***	***22***	***78***	***151***
Reserve (Shortage)	**14**	**7**	**0**	**0**	**0**	**0**

East Cedar Creek Fresh Water Supply District

East Cedar Creek FWSD supplies water to retail customers on the east side of Cedar Creek Reservoir in Henderson County. The FWSD gets its water supply from Tarrant Regional Water District (TRWD), and the water management strategies are conservation and additional supplies from TRWD. **Table 5E.237** shows the projected population and demand, the current supplies, and the water management strategies for East Cedar Creek FWSD.

Table 5E.237 Summary of Water User Group – East Cedar Creek FWSD

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**20,100**	**22,320**	**24,840**	**27,570**	**30,630**	**34,050**
Projected Demands						
Municipal Demand	1,351	1,500	1,669	1,853	2,059	2,288
Total Projected Demand	***1,351***	***1,500***	***1,669***	***1,853***	***2,059***	***2,288***
Currently Available Supplies						
TRWD	1,155	1,155	1,155	1,155	1,155	1,155
Total Currently Available Supplies	***1,155***	***1,155***	***1,155***	***1,155***	***1,155***	***1,155***
Need (Demand – Supply)	***196***	***345***	***514***	***698***	***904***	***1,133***
Water Management Strategies						
Water Conservation	14	22	21	30	39	52
TRWD	182	323	493	668	865	1,081
Total Supplies from Strategies	***196***	***345***	***514***	***698***	***904***	***1,133***
Reserve (Shortage)	**0**	**0**	**0**	**0**	**0**	**0**

Eustace

Eustace is located in northern Henderson County. The city's current supply is groundwater from the Carrizo-Wilcox aquifer. Conservation and new well(s) in the Carrizo-Wilcox aquifer are the only recommended water management strategies. **Table 5E.238** shows the projected population and demand, the current supplies, and the water management strategies for Eustace.

Table 5E.238 Summary of Water User Group – City of Eustace

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**1,170**	**1,277**	**1,383**	**2,041**	**2,659**	**3,191**
Projected Demands						
Municipal Demand	126	132	140	203	263	315
Total Projected Demand	***126***	***132***	***140***	***203***	***263***	***315***
Currently Available Supplies						
Carrizo-Wilcox Aquifer	159	159	159	159	159	159
Total Currently Available Supplies	***159***	***159***	***159***	***159***	***159***	***159***
Need (Demand – Supply)	***0***	***0***	***0***	***44***	***104***	***156***
Water Management Strategies						
Water Conservation	1	2	1	3	4	6
New Well(s) in Carrizo-Wilcox	0	0	0	41	100	150
Total Supplies from Strategies	***1***	***2***	***1***	***44***	***104***	***156***
Reserve (Shortage)	**34**	**29**	**20**	**0**	**0**	**0**

Henderson County Irrigation (Region C Only)

Irrigation demand projections include the water necessary for irrigation activities, including field crops, orchards, pasture, turf grass, vineyards, golf courses irrigated by raw water, and limited aquaculture operations. **Table 5E.239** shows the projected demand, the current supplies, and the water management strategies for Henderson County Irrigation in Region C (the portion in the Trinity River Basin). The current supplies are groundwater from the Carrizo-Wilcox aquifer, direct reuse through Pinnacle, and local supplies (Trinity run-of-river). The only recommended water management strategy is conservation.

Table 5E.239 Summary of Water User Group – Henderson County Irrigation (Region C Only)

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Demands						
Total Projected Demand	**582**	**582**	**582**	**582**	**582**	**582**
Currently Available Supplies						
Carrizo-Wilcox Aquifer	135	135	135	135	135	135
Direct Reuse from Pinnacle	32	32	32	32	32	32
Local Supplies	415	415	415	415	415	415
Total Currently Available Supplies	***582***	***582***	***582***	***582***	***582***	***582***
Need (Demand – Supply)	***0***	***0***	***0***	***0***	***0***	***0***
Water Management Strategies						
None	0	0	0	0	0	0
Total Supplies from Strategies	***0***	***0***	***0***	***0***	***0***	***0***
Reserve (Shortage)	**0**	**0**	**0**	**0**	**0**	**0**

Henderson County Livestock (Region C Only)

Livestock water use is defined as water used in the production of livestock, both for consumption and for cleaning and environmental purposes. **Table 5E.240** shows the projected demand, current supplies, and water management strategies for Henderson County Livestock in Region C (the portion in the Trinity River Basin). The current supplies are local surface water supplies and groundwater (Carrizo-Wilcox and Queen City aquifers). The only recommended water management strategy is new well(s) in the Carrizo-Wilcox aquifer.

Table 5E.240 Summary of Water User Group – Henderson County Livestock (Region C Only)

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Demands						
Total Projected Demand	**1,261**	**1,261**	**1,261**	**1,261**	**1,261**	**1,261**
Currently Available Supplies						
Carrizo-Wilcox Aquifer	13	13	13	13	13	13
Queen City Aquifer	500	500	500	500	500	500
Local Supplies	345	345	345	345	345	345
Total Currently Available Supplies	***858***	***858***	***858***	***858***	***858***	***858***
Need (Demand – Supply)	***403***	***403***	***403***	***403***	***403***	***403***
Water Management Strategies						
New Well(s) in Carrizo-Wilcox Aquifer	403	403	403	403	403	403
Total Supplies from Strategies	***403***	***403***	***403***	***403***	***403***	***403***
Reserve (Shortage)	**0**	**0**	**0**	**0**	**0**	**0**

Henderson County Manufacturing (Region C Only)

Manufacturing water use is defined as water used to produce manufactured goods. **Table 5E.241** shows the projected demand, the current supplies, and the water management strategies for Henderson County Manufacturing in Region C (the portion in the Trinity River Basin). Current supplies include groundwater (Carrizo-Wilcox aquifer, directly and through Malakoff) and water from Athens. Additional supply from Athens is the only recommended water management strategy for this water user group. Conservation was considered for this water user group, but it is not recommended because of the uncertainty in the ability to implement conservation measures given the multiple entities, facilities, and various manufacturing processes that make up this WUG.

Table 5E.241 Summary of Water User Group – Henderson County Manufacturing (Region C)

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Demands						
Total Projected Demand	**806**	**985**	**985**	**985**	**985**	**985**
Currently Available Supplies						
Carrizo-Wilcox Aquifer	396	396	396	396	396	396
Carrizo-Wilcox Aquifer through Malakoff	8	10	10	10	10	10
Athens through Athens MWA	484	591	591	591	591	591
Total Currently Available Supplies	***888***	***997***	***997***	***997***	***997***	***997***
Need (Demand – Supply)	***0***	***0***	***0***	***0***	***0***	***0***
Water Management Strategies						
None	0	0	0	0	0	0
Total Supplies from Strategies	***0***	***0***	***0***	***0***	***0***	***0***
Reserve (Shortage)	**82**	**12**	**12**	**12**	**12**	**12**

Henderson County Mining (Region C Only)

Mining water demand includes water used for oil and gas development, as well as extraction of coal and lignite, sand aggregate, and other resources. **Table 5E.242** shows the projected demand, the current supplies, and the water management strategies for Henderson County Mining in Region C (the portion in the Trinity River Basin). The current supply is from Tarrant Regional Water District (TRWD) and groundwater (Carrizo-Wilcox aquifer). The only recommended water management strategy for this water user group is additional supply from TRWD. Conservation was considered for this water user group, but it is not recommended because of the uncertainty in the ability to implement conservation measures given the multiple companies, facilities, and types of processes that make up this WUG.

Table 5E.242 Summary of Water User Group – Henderson County Mining (Region C Only)

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Demands						
Total Projected Demand	**434**	**506**	**481**	**484**	**479**	**469**
Currently Available Supplies						
Carrizo-Wilcox Aquifer	354	354	354	354	354	354
TRWD	130	133	113	102	93	85
Total Currently Available Supplies	***484***	***487***	***467***	***456***	***447***	***439***
Need (Demand – Supply)	***0***	***19***	***14***	***28***	***32***	***30***
Water Management Strategies						
TRWD	0	19	31	43	51	56
Total Supplies from Strategies	***0***	***19***	***31***	***43***	***51***	***56***
Reserve (Shortage)	**50**	**0**	**17**	**15**	**19**	**26**

Henderson County Other (Region C Only)

Henderson County Other includes individual domestic supplies and other water suppliers too small to be classified as water user groups. The entities included under Henderson County Other in Region C receive their water supply from Tarrant Regional Water District (TRWD) and groundwater (Carrizo-Wilcox aquifer). Water management strategies for these entities include conservation and additional water from TRWD. **Table 5E.243** shows the projected population and demand, the current supplies, and the water management strategies for Henderson County Other.

Table 5E.243 Summary of Water User Group – Henderson County Other (Region C Only)

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**3,314**	**2,557**	**2,770**	**1,706**	**656**	**1,398**
Projected Demands						
Municipal Demand	304	220	226	139	53	113
Total Projected Demand	***304***	***220***	***226***	***139***	***53***	***113***
Currently Available Supplies						
Carrizo-Wilcox Aquifer	53	53	53	53	53	53
TRWD	251	147	135	61	0	36
Total Currently Available Supplies	***304***	***200***	***188***	***114***	***53***	***89***
Need (Demand – Supply)	***0***	***20***	***38***	***25***	***0***	***24***
Water Management Strategies						
Water Conservation	3	2	2	2	1	2
TRWD	0	18	36	23	0	22
Total Supplies from Strategies	***3***	***20***	***38***	***25***	***1***	***24***
Reserve (Shortage)	**3**	**0**	**0**	**0**	**1**	**0**

Henderson County Steam Electric Power (Region C Only)

Steam electric power demands do not include water that is used in cogeneration facilities (which is in manufacturing projections), facilities which do not require water for production, or hydro-electric generation facilities. Henderson County's Steam Electric Power demand is attributed to the Luminant Generation Company LLC. **Table 5E.244** shows the projected demand, the current supplies, and the water management strategies for Henderson County Steam Electric Power in Region C (the portion in the Trinity River Basin). The current supply for this water user group is Lake Trinidad and Cedar Creek Reservoir through Tarrant Regional Water District (TRWD). The water management strategy is additional water from TRWD. Conservation was considered for this water user group, but it is not recommended because the steam electric demand projections themselves considered items such as future efficiency programs.

Table 5E.244 Summary of Water User Group - Henderson County SEP (Region C Only)

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Demands						
Total Projected Demand	**3,709**	**3,709**	**3,709**	**3,709**	**3,709**	**3,709**
Currently Available Supplies						
Lake Trinidad	3,050	3,050	3,050	3,050	3,050	3,050
Cedar Creek through TRWD	659	581	516	464	428	396
Total Currently Available Supplies	***3,709***	***3,631***	***3,566***	***3,514***	***3,478***	***3,446***
Need (Demand – Supply)	***0***	***78***	***143***	***195***	***231***	***263***
Water Management Strategies						
TRWD	0	78	143	195	231	263
Total Supplies from Strategies	***0***	***78***	***143***	***195***	***231***	***263***
Reserve (Shortage)	**0**	**0**	**0**	**0**	**0**	**0**

Mabank

Mabank is located in southeastern Kaufman County and northern Henderson County in Region C and Van Zandt County in Region D. Projected demands and water management strategies for Mabank are discussed under Kaufman County in **Section 5E.11.**

Malakoff

Malakoff is located in western Henderson County. The city provides a small amount of retail water supply to Henderson County Manufacturing. The city gets its water supply from the Carrizo-Wilcox aquifer and from purchasing raw water from the Tarrant Regional Water District (TRWD). The water management strategies for Malakoff include conservation and additional water from TRWD. **Table 5E.245** shows the projected population and demand, the current supplies, and the water management strategies for Malakoff.

Table 5E.245 Summary of Water User Group – City of Malakoff

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**2,432**	**2,512**	**2,580**	**2,668**	**2,824**	**3,026**
Projected Demands						
Municipal Demand	274	272	270	274	289	309
Manufacturing, Henderson	*8*	*10*	*10*	*10*	*10*	*10*
Total Projected Demand	***282***	***282***	***280***	***284***	***299***	***319***
Currently Available Supplies						
Carrizo-Wilcox Aquifer	254	254	254	254	254	254
TRWD	28	25	20	21	30	39
Total Currently Available Supplies	***282***	***279***	***274***	***275***	***283***	***293***
Need (Demand – Supply)	***0***	***3***	***6***	***9***	***15***	***26***
Water Management Strategies						
Water Conservation	2	3	3	4	5	6
TRWD	0	0	3	5	10	20
Total Supplies from Strategies	***2***	***3***	***6***	***9***	***15***	***26***
Reserve (Shortage)	**2**	**0**	**0**	**0**	**0**	**0**

Trinidad

Trinidad is located in western Henderson County. The city gets its water supply from Trinidad City Lake, which is adequate to meet projected demands. The only water management strategy for Trinidad is conservation. **Table 5E.246** shows the projected population and demand, the current supplies, and the water management strategies for the city.

Table 5E.246 Summary of Water User Group – City of Trinidad

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**1,026**	**1,026**	**1,026**	**1,026**	**1,158**	**1,390**
Projected Demands						
Municipal Demand	105	99	96	96	107	128
Total Projected Demand	***105***	***99***	***96***	***96***	***107***	***128***
Currently Available Supplies						
Trinidad City Lake	450	450	450	450	450	450
Total Currently Available Supplies	***450***	***450***	***450***	***450***	***450***	***450***
Need (Demand – Supply)	***0***	***0***	***0***	***0***	***0***	***0***
Water Management Strategies						
Water Conservation	1	1	1	1	2	3
Total Supplies from Strategies	***1***	***1***	***1***	***1***	***2***	***3***
Reserve (Shortage)	**346**	**352**	**355**	**355**	**345**	**325**

Virginia Hill Water Supply Corporation

Virginia Hill WSC serves southern Henderson County. This water user group is split between Regions C and I. **Table 5E.247** shows the projected population and demand, the current supplies, and the water management strategies for Virginia Hill WSC. The WSC gets its water supply from the Carrizo-Wilcox aquifer, and the supply is sufficient to meet the projected demand. The only water management strategy for Virginia Hill WSC is conservation.

Table 5E.247 Summary of Water User Group – Virginia Hill Water Supply Corporation

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**4,106**	**4,710**	**5,217**	**5,883**	**6,485**	**7,192**
Projected Demands						
Municipal Demand	396	433	465	517	567	628
Total Projected Demand	***396***	***433***	***465***	***517***	***567***	***628***
Currently Available Supplies						
Carrizo-Wilcox Aquifer	628	628	628	628	628	628
Total Currently Available Supplies	***628***	***628***	***628***	***628***	***628***	***628***
Need (Demand – Supply)	***0***	***0***	***0***	***0***	***0***	***0***
Water Management Strategies						
Water Conservation	2	3	3	4	6	7
Total Supplies from Strategies	***2***	***3***	***3***	***4***	***6***	***7***
Reserve (Shortage)	**234**	**198**	**166**	**115**	**67**	**7**

West Cedar Creek Municipal Utility District

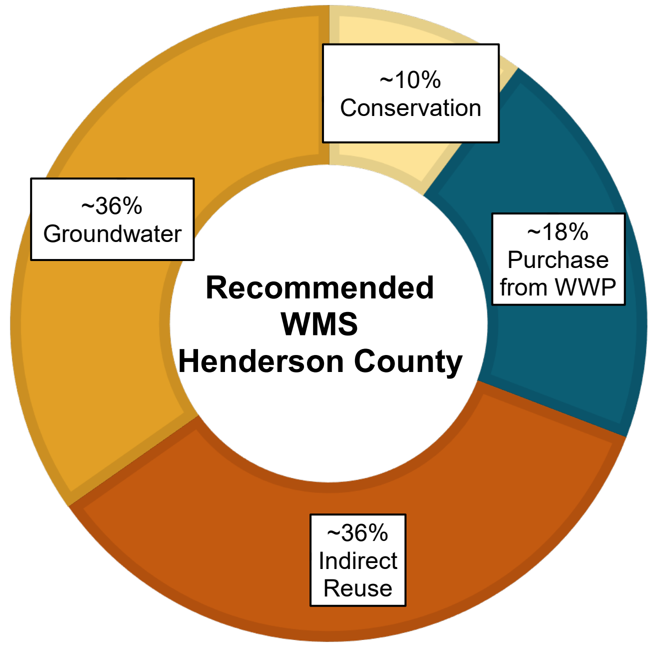
West Cedar Creek MUD supplies water to northwestern Henderson County and southern Kaufman County. The MUD gets its water supply from Tarrant Regional Water District (TRWD), and the recommended water management strategies include conservation and additional supplies from TRWD. **Table 5E.248** shows the projected population and demand, the current supplies, and the water management strategies for West Cedar Creek MUD.

Table 5E.248 Summary of Water User Group – West Cedar Creek MUD

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**18,066**	**18,966**	**19,826**	**21,431**	**26,205**	**32,105**
Projected Demands						
Municipal Demand	1,214	1,274	1,333	1,440	1,762	2,158
Total Projected Demand	***1,214***	***1,274***	***1,333***	***1,440***	***1,762***	***2,158***
Currently Available Supplies						
TRWD	1,214	1,122	1,042	1,015	1,144	1,296
Total Currently Available Supplies	***1,214***	***1,122***	***1,042***	***1,015***	***1,144***	***1,296***
Need (Demand – Supply)	***0***	***152***	***291***	***425***	***618***	***862***
Water Management Strategies						
Water Conservation	12	17	16	23	33	48
TRWD	0	135	275	402	585	814
Total Supplies from Strategies	***12***	***152***	***291***	***425***	***618***	***862***
Reserve (Shortage)	**12**	**0**	**0**	**0**	**0**	**0**

5E.9.2 Summary of Costs for Henderson County

Table 5E.249 summarizes the costs of the water management strategies recommended for the WUGs and WWPs who have the majority of their demand located in Henderson County. Total quantities from **Table 5E.249** will not necessarily match total county demands. This is due mainly to water users whose sum of strategies results in a reserve as well as due to water users located in multiple counties (or wholesale water providers who develop strategies and then sell water to users in other counties). Quantities from infrastructure projects needed to deliver and/or treat water (shown in *gray italics*) are not included since the supplies are associated with other strategies. To avoid double-counting quantities of supplies, the quantities in gray italics are **not** included in the total.



The majority of the future supplies needed to meet demands within Henderson County are projected to come through additional groundwater and indirect reuse to Lake Athens. Other strategies include conservation and purchases from WWPs.

Table 5E.250 summarizes the recommended and alternative water management strategies for suppliers in Henderson County. More detailed cost estimates are located in **Appendix H.**

Table 5E.249 Summary of Recommended Water Management Strategies for Henderson County

Type of Strategy	Quantity (Ac-Ft/Yr)	Capital Costs
Conservation[a]	848	$594,597
Purchase from WWP	1,456	$0
Additional Infrastructure	*450*	*$65,000*
Indirect Reuse	2,872	$0
Groundwater	2,897	$23,958,000
Total	**8,073**	**$24,617,597**

[a]The conservation quantities represent the sum of the individual water user groups who have the majority of their service areas located in the county, not the total conservation in the county.

Table 5E.250 Costs for Recommended Water Management Strategies for Henderson County

WWP or WUG	Strategy	Online by:	Quantity (Ac-Ft/Yr)[b]	Capital Costs[c]	Unit Cost ($/1000 gal) With Debt Service	Unit Cost ($/1000 gal) After Debt Service	Table
WWPs							
Athens MWA	Conservation (retail)	2020	Included under WUGs.				
	Expanded Groundwater Supply	2020	200	$2,573,000	$3.34	$0.57	H.14
	New well(s) in Carrizo-Wilcox	2060	2,000	$15,151,000	$2.89	$1.26	H.14
	Fish Hatchery Reuse	2020	2,872	$0	$0.10	$0.10	None
	Infrastructure Improvements at WTP	*2020*	*450*	*$65,000*	*$0.39*	*$0.35*	*H.131*
	ALTERNATIVE New Well(s) in Carrizo-Wilcox Aquifer	*2020*	*1,262*	*$9,207,000*	*$2.85*	*$1.27*	*H.14*
WUGs							
Athens[a]	Conservation	2020	753	$418,536	$3.12	$0.66	H.11
	Other WMSs	See Athens MWA.					
B B S WSC	None	None					
Bethel Ash WSC[a]	Conservation	2020	6	$5,087	$0.55	$0.00	H.11
Crescent Heights WSC	Conservation	2020	6	$8,820	$0.95	$0.00	H.11
Dogwood Estates Water	Conservation	2020	7	$4,765	$0.51	$0.00	H.11
	New well(s) in Carrizo-Wilcox	2040	144	$1,296,000	$3.55	$1.60	H.14
East Cedar Creek FWSD	Conservation	2020	52	$110,198	$1.70	$0.00	H.11
	TRWD	2020	1,081	$0	$1.26	$1.26	None
Eustace	Conservation	2020	6	$7,675	$1.66	$0.00	H.11
	New well(s) in Carrizo-Wilcox	2050	150	$1,469,000	$3.60	$1.48	H.14
Mabank[a]	Conservation	See Kaufman County.					
	TRWD						
	WTP Expansions						
Malakoff	Conservation	2020	6	$22,166	$2.39	$0.00	H.11
	TRWD	2040	20	$0	$1.26	$1.26	None
Trinidad	Conservation	2020	3	$5,961	$1.29	$0.00	H.11

WWP or WUG	Strategy	Online by:	Quantity (Ac-Ft/Yr)[b]	Capital Costs[c]	Unit Cost ($/1000 gal) With Debt Service	Unit Cost ($/1000 gal) After Debt Service	Table
Virginia Hill WSC[a] (Region C and I portions)	Conservation	2020	7	$6,596	$0.71	$0.00	H.11
West Cedar Creek MUD[a]	Conservation	See Kaufman County.					
	TRWD						
County Other and Non-Municipal							
County Other, Henderson (Region C only)	Conservation	2020	2	$4,793	$0.34	$0.00	H.11
	TRWD	2030	36	$0	$1.26	$1.26	None
Irrigation, Henderson (Region C only)	None	None					
Livestock, Henderson (Region C only)	New well(s) in Carrizo-Wilcox	2020	403	$3,469,000	$2.27	$0.41	H.14
Mining, Henderson (Region C only)	TRWD	2030	56	$0	$1.26	$1.26	None
Steam Electric Power, Henderson (Region C only)	TRWD (Cedar Creek Reservoir)	2030	263	$0	$1.63	$1.63	None

[a]Water User Groups extend into more than one county or into the Region I part of Henderson County.

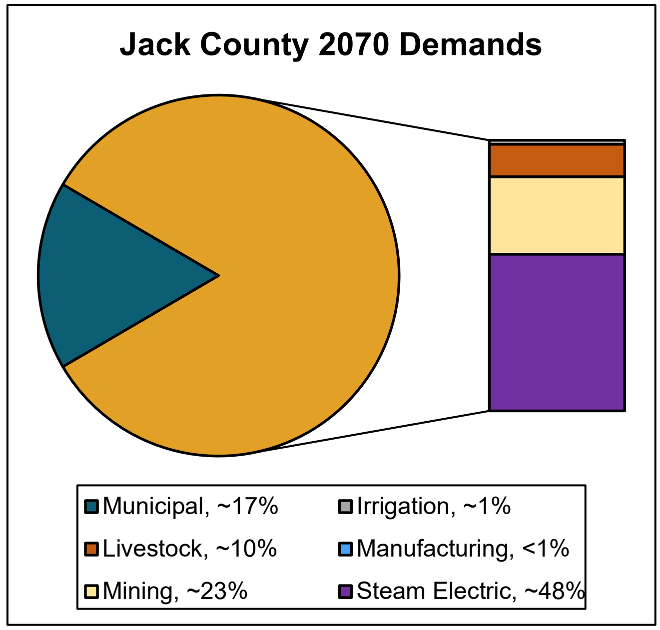
[b]Quantities listed are for the WUG only. They do not include the WUG's customers.
[c]Purchases from wholesale water providers that require no new infrastructure have no capital costs. The unit costs shown in the table represent the cost to purchase water from the WWP.

5E.10 Jack County

Jack County is located in the western portion of Region C. **Figure 5E.20** shows the service area for water suppliers in Jack County.

Population growth for Jack County is projected to increase by about 1,500 by 2070.

Non-municipal water use represents over 80 percent of the total demand. Steam Electric Demand is the largest projected demand for Jack County. Mining and municipal are the second and third largest projected demands for the county.



Tarrant Regional Water District (TRWD) is a major water provider that supplies water to Jack County. An overall summary of the county's projections is shown in **Table 5E.251**, and water management strategies for individual WWPs and WUGs are discussed on the following pages.

Jack County Quick Facts

2010 Population: 9,034

Projected 2070 Population: 11,291

Projected 2070 Demand: 7 MGD

County Seat: Jacksboro

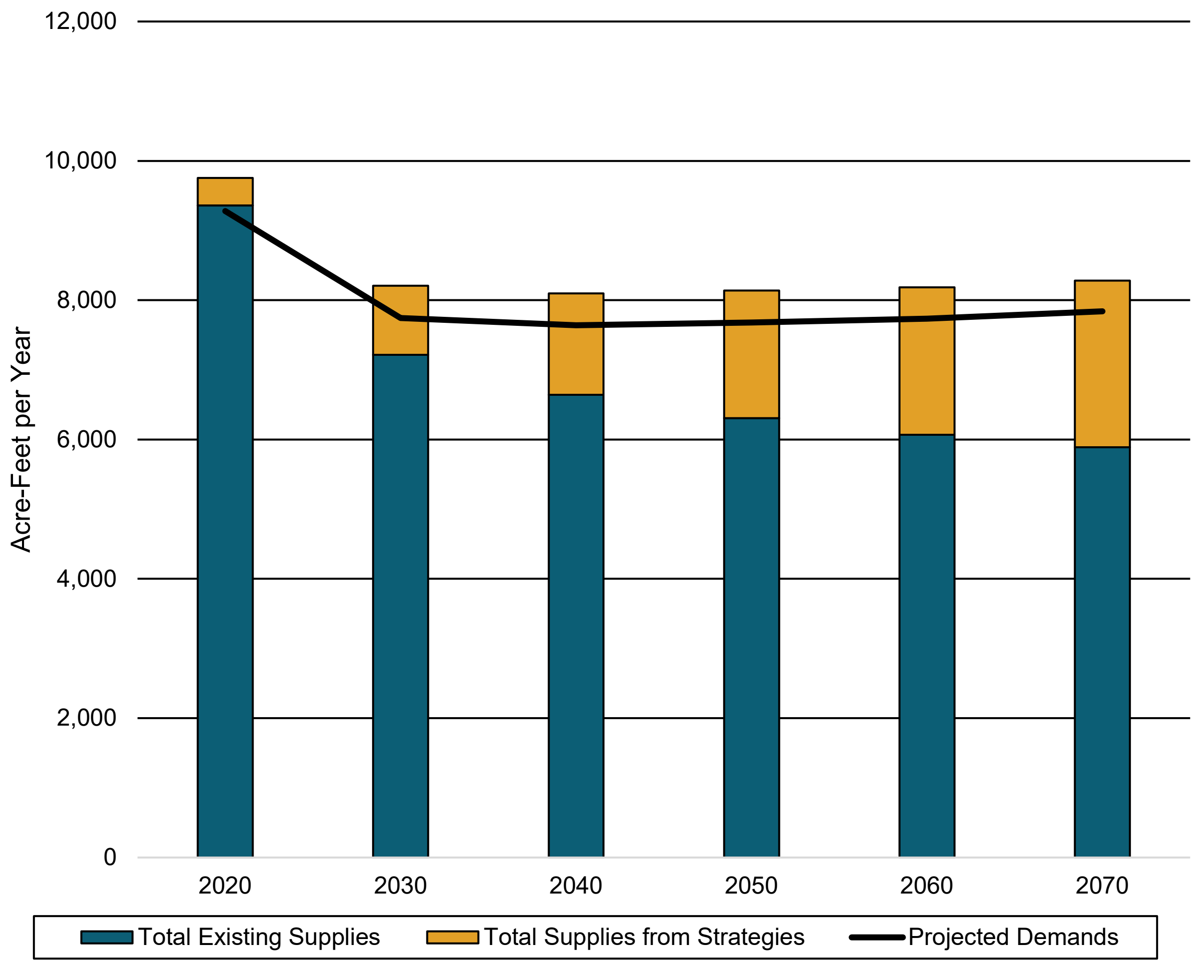
Economy: Petroleum production, oil-field services, livestock, manufacturing tourism

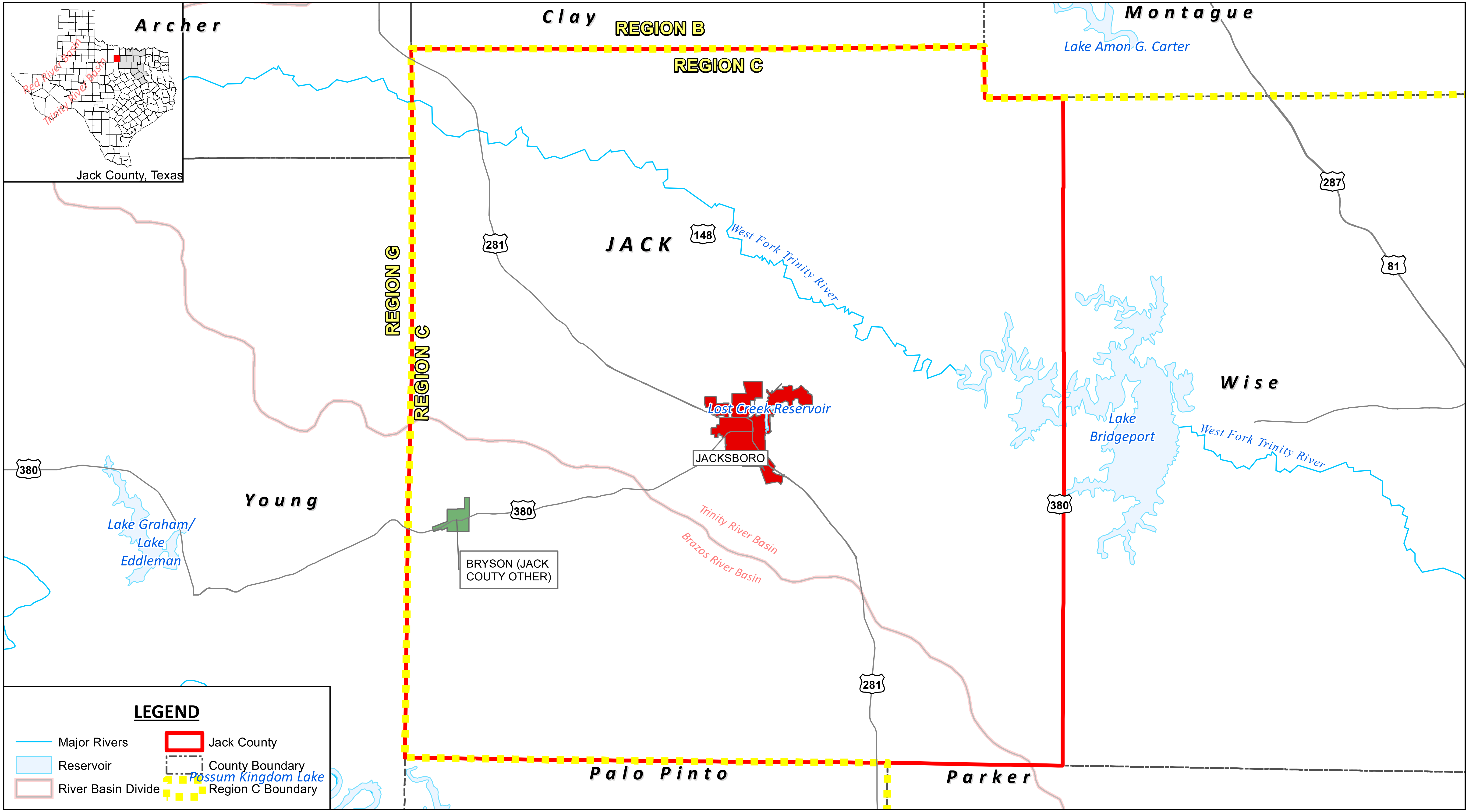
River Basins: Trinity (71%), Brazos (29%)

Table 5E.251 Summary of Jack County

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**9,751**	**10,409**	**10,817**	**11,033**	**11,190**	**11,291**
Projected Demands	**9,279**	**7,744**	**7,640**	**7,681**	**7,733**	**7,839**
Municipal	1,227	1,267	1,286	1,294	1,309	1,321
Irrigation	98	98	98	98	98	98
Livestock	785	785	785	785	785	785
Manufacturing	1	1	1	1	1	1
Mining	3,396	1,821	1,698	1,731	1,768	1,862
Steam Electric	3,772	3,772	3,772	3,772	3,772	3,772
Total Existing Supplies	**9,358**	**7,216**	**6,642**	**6,306**	**6,067**	**5,887**
Need (Demand - Supply)	**0**	**528**	**998**	**1,375**	**1,666**	**1,952**
Total Supplies from Strategies	**397**	**993**	**1,456**	**1,833**	**2,118**	**2,395**
Reserve (Shortage)	**476**	**465**	**458**	**458**	**452**	**443**

Figure 5E.19 Summary of Jack County





REGION C
Water Planning for North Texas

2021 Region C Water Plan
JACK COUNTY, TEXAS
FIGURE 5E.20

1 in = 4 miles
0 1 2 4 6
Miles

N W E S

Data Source(s): ESRI, USGS, TNRIS

TR116409: H:\WR_PLANNING\1 - Working\5E_County WMS\Jack1.mxd

5E.10.1 Wholesale Water Providers and Water User Groups

There are no wholesale water providers in Jack County. Water management strategies for Jack County water user groups are discussed below (in alphabetical order). The costs for Jack County water user groups and a summary for Jack County are presented in **Section 5E.10.2.**

Jack County Irrigation

Irrigation demand projections include the water necessary for irrigation activities, including field crops, orchards, pasture, turf grass, vineyards, golf courses irrigated by raw water, and limited aquaculture operations. **Table 5E.252** shows the projected demand, the current supplies, and the water management strategies for Jack County Irrigation. The available sources of supply are local supplies (Trinity run-of-river), direct reuse, and groundwater (Cross Timbers aquifer). Current supplies are sufficient to meet future needs, and the only water management strategy is conservation.

Table 5E.252 Summary of Water User Group – Jack County Irrigation

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Demands						
Total Projected Demand	**98**	**98**	**98**	**98**	**98**	**98**
Currently Available Supplies						
Cross Timbers Aquifer	55	55	55	55	55	55
Direct Reuse from Bryson	27	26	26	25	25	24
Local Supplies	110	110	110	110	110	110
Total Currently Available Supplies	***192***	***191***	***191***	***190***	***190***	***189***
Need (Demand – Supply)	***0***	***0***	***0***	***0***	***0***	***0***
Water Management Strategies						
None	0	0	0	0	0	0
Total Supplies from Strategies	***0***	***0***	***0***	***0***	***0***	***0***
Reserve (Shortage)	**94**	**93**	**93**	**92**	**92**	**91**

Jack County Livestock

Livestock water use is defined as water used in the production of livestock, both for consumption and for cleaning and environmental purposes. **Table 5E.253** shows the projected demand, current supplies, and water management strategies for Jack County Livestock. The current supplies are local surface water supplies and groundwater (Cross Timbers aquifer). These sources are sufficient to meet future demands, and there are no water management strategies.

Table 5E.253 Summary of Water User Group – Jack County Livestock

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Demands						
Total Projected Demand	**785**	**785**	**785**	**785**	**785**	**785**
Currently Available Supplies						
Cross Timbers Aquifer	130	130	130	130	130	130
Local Supplies	802	802	802	802	802	802
Total Currently Available Supplies	***932***	***932***	***932***	***932***	***932***	***932***
Need (Demand – Supply)	***0***	***0***	***0***	***0***	***0***	***0***
Water Management Strategies						
None	0	0	0	0	0	0
Total Supplies from Strategies	***0***	***0***	***0***	***0***	***0***	***0***
Reserve (Shortage)	**147**	**147**	**147**	**147**	**147**	**147**

Jack County Manufacturing

Manufacturing water use is defined as water used to produce manufactured goods. **Table 5E.254** shows the projected demand and current supplies for Jack County Manufacturing. Current supplies are treated water from Jacksboro (originating from the Lost Creek Reservoir/Lake Jacksboro system) and are sufficient to meet projected demands. There are no water management strategies for this water user group.

Table 5E.254 Summary of Water User Group – Jack County Manufacturing

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Demands						
Total Projected Demand	**1**	**1**	**1**	**1**	**1**	**1**
Currently Available Supplies						
Lost Creek through Jacksboro	1	1	1	1	1	1
Total Currently Available Supplies	***1***	***1***	***1***	***1***	***1***	***1***
Need (Demand – Supply)	***0***	***0***	***0***	***0***	***0***	***0***
Water Management Strategies						
None	0	0	0	0	0	0
Total Supplies from Strategies	***0***	***0***	***0***	***0***	***0***	***0***
Reserve (Shortage)	**0**	**0**	**0**	**0**	**0**	**0**

Jack County Mining

Mining water demand includes water used for oil and gas development, as well as extraction of coal and lignite, sand aggregate, and other resources. **Table 5E.255** shows the projected demand, the current supplies, and the water management strategies for Jack County Mining. Jack County Mining is supplied from local supplies, groundwater (Cross Timbers aquifer), and Tarrant Regional Water District (TRWD). In the past, the City of Jacksboro has sold potable water to mining users (mostly oil and gas), but prior to 2020 Jacksboro will discontinue sale of potable water and begin selling reuse water to mining users. The water management strategies for this water user group includes water from the conversion of Jacksboro's permitted indirect reuse from irrigation to mining and connection to TRWD system. Conservation was considered for this water user group, but it is not recommended because of the uncertainty in the ability to implement conservation measures given the multiple companies, facilities, and types of processes that make up this WUG. A reuse strategy has been recommended in lieu of a conservation strategy.

Table 5E.255 Summary of Water User Group – Jack County Mining

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Demands						
Total Projected Demand	**3,396**	**1,821**	**1,698**	**1,731**	**1,768**	**1,862**
Currently Available Supplies						
Cross Timbers Aquifer	204	204	204	204	204	204
Local Supplies	370	370	370	370	370	370
TRWD	2,690	972	761	708	673	677
Total Currently Available Supplies	***3,264***	***1,546***	***1,335***	***1,282***	***1,247***	***1,251***
Need (Demand – Supply)	***132***	***275***	***363***	***449***	***521***	***611***
Water Management Strategies						
Jacksboro Indirect Reuse to Mining	330	342	348	351	356	359
TRWD	0	131	213	296	363	450
Total Supplies from Strategies	***330***	***473***	***561***	***647***	***719***	***809***
Reserve (Shortage)	**198**	**198**	**198**	**198**	**198**	**198**

Jack County Other

Jack County Other includes individual domestic supplies and other water suppliers too small to be classified as water user groups. The entities included under Jack County Other currently receive their water supply from Lake Graham through Graham and groundwater (Cross Timbers aquifer). Water management strategies for these entities include conservation and water from Jacksboro and Walnut Creek SUD. **Table 5E.256** shows the projected population and demand, the current supplies, and the water management strategies for Jack County Other.

Table 5E.256 Summary of Water User Group – Jack County Other

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**4,878**	**5,207**	**5,411**	**5,519**	**5,597**	**5,648**
Projected Demands						
Municipal Demand	545	560	566	568	574	580
Total Projected Demand	***545***	***560***	***566***	***568***	***574***	***580***
Currently Available Supplies						
Lake Graham through Graham	46	46	46	46	46	46
Cross Timbers Aquifer	469	469	469	469	469	469
Total Currently Available Supplies	***515***	***515***	***515***	***515***	***515***	***515***
Need (Demand – Supply)	***30***	***45***	***51***	***53***	***59***	***65***
Water Management Strategies						
Water Conservation	5	7	6	8	10	12
Jacksboro (Lost Creek/Jacksboro System)	7	7	7	7	7	7
Walnut Creek SUD	55	56	57	57	57	58
Total Supplies from Strategies	***67***	***70***	***70***	***72***	***74***	***77***
Reserve (Shortage)	**37**	**25**	**19**	**19**	**15**	**12**

Jack County Steam Electric Power

Steam electric power demands do not include water that is used in cogeneration facilities (which is included in manufacturing projections), facilities which do not require water for production, or hydro-electric generation facilities. Jack County's Steam Electric Power demand is attributed to the Brazos Electric Power Coop Inc. and is currently supplied by Tarrant Regional Water District (TRWD). The water management strategy for Jack County Steam Electric Power is additional water from TRWD. Conservation was considered for this water user group, but it is not recommended because the steam electric demand projections themselves considered items such as future efficiency programs. **Table 5E.257** shows the projected demand, the current supplies, and the water management strategies for Jack County Steam Electric Power.

Table 5E.257 Summary of Water User Group – Jack County SEP

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Demands						
Total Projected Demand	**3,772**	**3,772**	**3,772**	**3,772**	**3,772**	**3,772**
Currently Available Supplies						
TRWD	3,772	3,324	2,948	2,660	2,449	2,266
Total Currently Available Supplies	***3,772***	***3,324***	***2,948***	***2,660***	***2,449***	***2,266***
Need (Demand – Supply)	***0***	***448***	***824***	***1,112***	***1,323***	***1,506***
Water Management Strategies						
TRWD	0	448	824	1,112	1,323	1,506
Total Supplies from Strategies	***0***	***448***	***824***	***1,112***	***1,323***	***1,506***
Reserve (Shortage)	**0**	**0**	**0**	**0**	**0**	**0**

Jacksboro

Jacksboro, the county seat of Jack County, is located in the center of the county. The city obtains its water supply from the Lost Creek Reservoir/Lake Jacksboro System, which it owns and operates. Jacksboro has an indirect reuse permit to discharge its treated effluent to Little Cleveland Creek, and reuse it for irrigation purposes. The city is in the process of amending the permit to allow mining use. After conservation, the city has sufficient supplies for its potable water demands. Water conservation, supplies for Jack County Other through the Lost Creek/Jacksboro System, and Jacksboro indirect reuse to mining are the recommended water management strategies for the city. **Table 5E.258** shows the projected population and demand, the current supplies, and the water management strategies for Jacksboro.

Table 5E.258 Summary of Water User Group – City of Jacksboro

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**4,873**	**5,202**	**5,406**	**5,514**	**5,593**	**5,643**
Projected Demands						
Municipal Demand	682	707	720	726	735	741
County Other, Jack	*7*	*7*	*7*	*7*	*7*	*7*
Manufacturing, Jack	*1*	*1*	*1*	*1*	*1*	*1*
Mining, Jack (Reuse Demand)	*330*	*342*	*348*	*351*	*356*	*359*
Total Projected Demand	***1,020***	***1,057***	***1,076***	***1,085***	***1,099***	***1,108***
Currently Available Supplies						
Lost Creek/Jacksboro System	682	707	720	726	733	733
Lost Creek/Jacksboro System, Jack County Manufacturing	1	1	1	1	1	1
Total Currently Available Supplies	***683***	***708***	***721***	***727***	***734***	***734***
Need (Demand – Supply)	***337***	***349***	***355***	***358***	***365***	***374***
Water Management Strategies						
Water Conservation	5	9	7	10	12	15
Lost Creek/Jacksboro System to Jack County Other	7	7	7	7	7	7
Jacksboro Indirect Reuse to Mining	330	342	348	351	356	359
Total Supplies from Strategies	***342***	***358***	***362***	***368***	***375***	***381***
Reserve (Shortage)	**5**	**9**	**7**	**10**	**10**	**7**

5E.10.2 Summary of Costs for Jack County

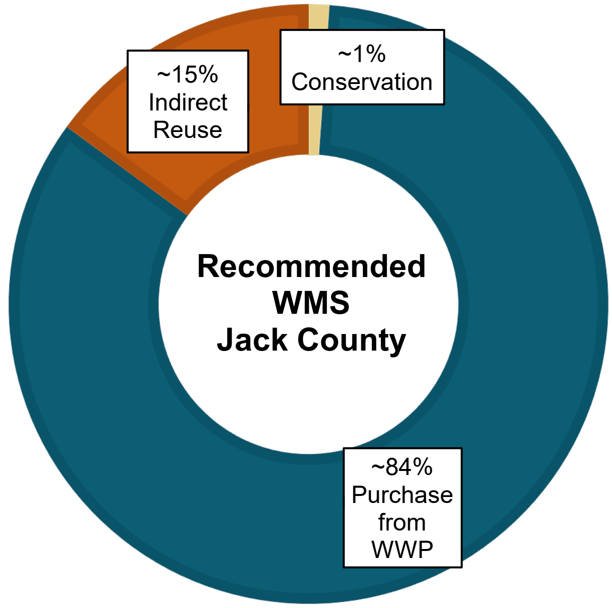


Table 5E.259 summarizes the costs of the water management strategies recommended for the WUGs and WWPs who have the majority of their demand located in Jack County. Total quantities from **Table 5E.259** will not necessarily match total county demands. This is due mainly to water users whose sum of strategies results in a reserve as well as due to water users located in multiple counties (or wholesale water providers who develop strategies and then sell water to users in other counties). Quantities from infrastructure projects needed to deliver and/or treat water (shown in *gray italics*) are not included since the supplies are associated with other strategies. To avoid double-counting quantities of supplies, the quantities in gray italics are **not** included in the total.

The majority of the future supplies needed to meet demands within Jack County are projected to come through purchases from wholesale water providers. Other strategies include conservation, and indirect reuse for mining.

Table 5E.260 summarizes the recommended water management strategies within Jack County for individual WUGs and WWPs. Alternative strategies are also included. More detailed cost estimates are located in **Appendix H.**

Table 5E.259 Summary of Recommended Water Management Strategies for Jack County

Type of Strategy	Quantity (Ac-Ft/Yr)	Capital Costs
Conservation[a]	27	$29,991
Purchase from WWP	2,021	$0
Additional Infrastructure	*65*	*$7,154,000*
Indirect Reuse	359	$0
Total	**2,407**	**$7,183,991**

[a]The conservation quantities represent the sum of the individual water user groups who have the majority of their service areas located in the county, not the total conservation in the county.

Table 5E.260 Costs for Recommended Water Management Strategies for Jack County

WWP or WUG	Strategy	Online by:	Quantity (Ac-Ft/Yr)[b]	Capital Costs[c]	Unit Cost ($/1000 gal) With Debt Service	Unit Cost ($/1000 gal) After Debt Service	Table
WWPs							
There are no wholesale water providers in Jack County.							
WUGs							
Jacksboro	Conservation	2020	15	$17,449	$0.75	$0.00	H.11
County Other and Non-Municipal							
County Other, Jack	Conservation	2020	12	$12,542	$0.54	$0.00	H.11
	Jacksboro (Lost Creek/Lake Jacksboro)	2020	7	$0	$3.00	$3.00	None
	Infrastructure to connect to Jacksboro	*2020*	*7*	*$2,152,000*	*$72.79*	*$6.42*	*H.132*
	Walnut Creek SUD	2020	58	$0	$6.11	$6.11	None
	Infrastructure to connect to Walnut Creek SUD	*2020*	*58*	*$5,002,000*	*$21.57*	*$2.95*	*H.133*
Irrigation, Jack	None	None					
Livestock, Jack	None	None					
Manufacturing, Jack	None	None					
Mining, Jack	Indirect reuse (Jacksboro)	2020	359	$0	$3.00	$3.00	None
	TRWD	2030	450	$0	$1.26	$1.26	None
Steam Electric Power, Jack	TRWD	2030	1,506	$0	$1.26	$1.26	None

[a]Water User Groups extend into more than one county

[b]Quantities listed are for the WUG only. They do not include the WUG's customers.
[c]Purchases from wholesale water providers that require no new infrastructure have no capital costs. The unit costs shown in the table represent the cost to purchase water from the WWP.

5E.11 Kaufman County

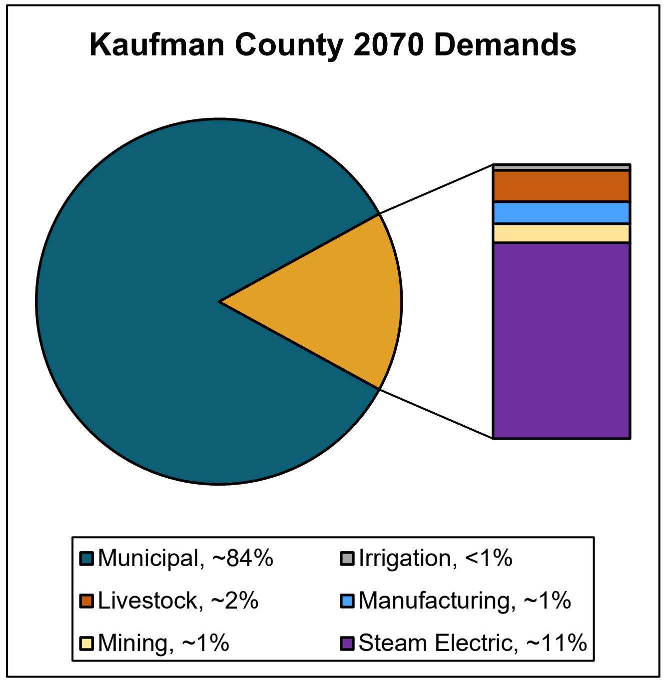
Kaufman County is located in the southeastern portion of Region C.

Figure 5E.22 shows the service areas for water user groups in Kaufman County.

The population of Kaufman County is projected to more than triple between 2020 and 2070.

Municipal demand is the largest projected demand in the county. The second largest projected demand is for steam electric power. Irrigation, livestock, mining and manufacturing demands account for less than 5% of the total county demand.

An overall summary of the county's projections is shown in **Table 5E.261**, and water management strategies for individual WWPs and WUGs are discussed on the following pages.



Kaufman County Quick Facts

2010 Population: 103,350

Projected 2070 Population: 566,840

Projected 2070 Demand: 77 MGD

County Seat: Kaufman

Economy: Manufacturing; government/services

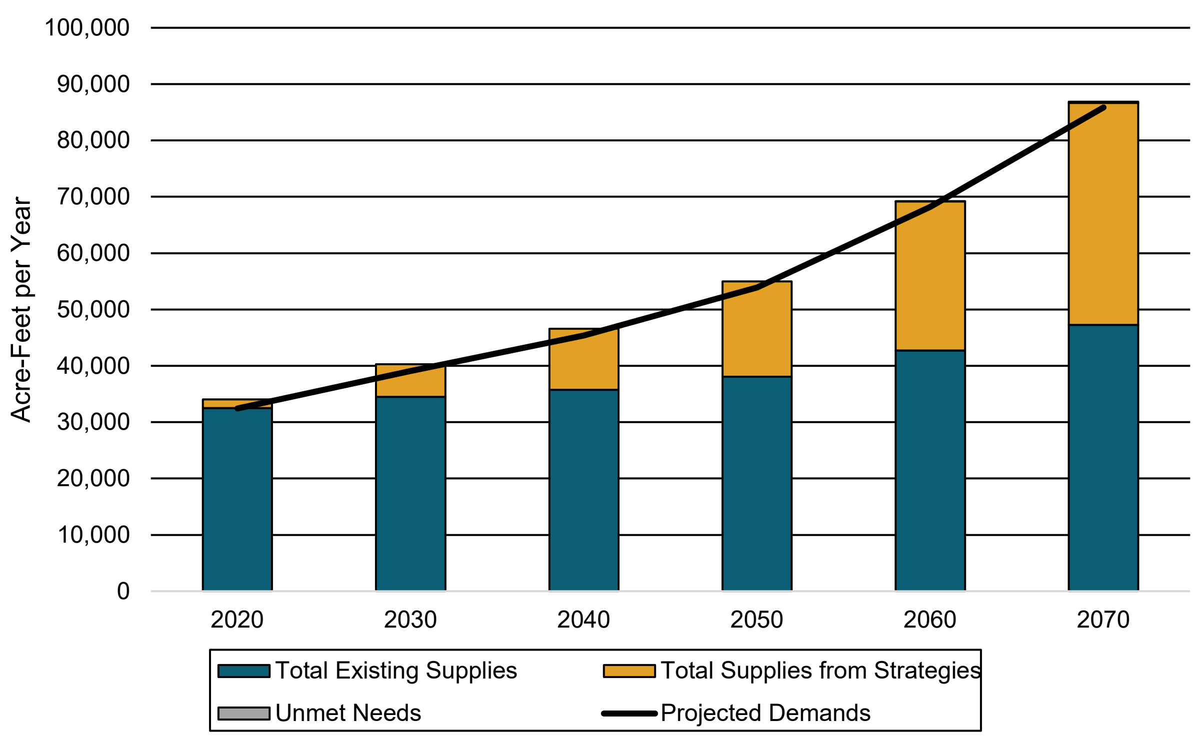
River Basins: Trinity (95%), Sabine (5%)

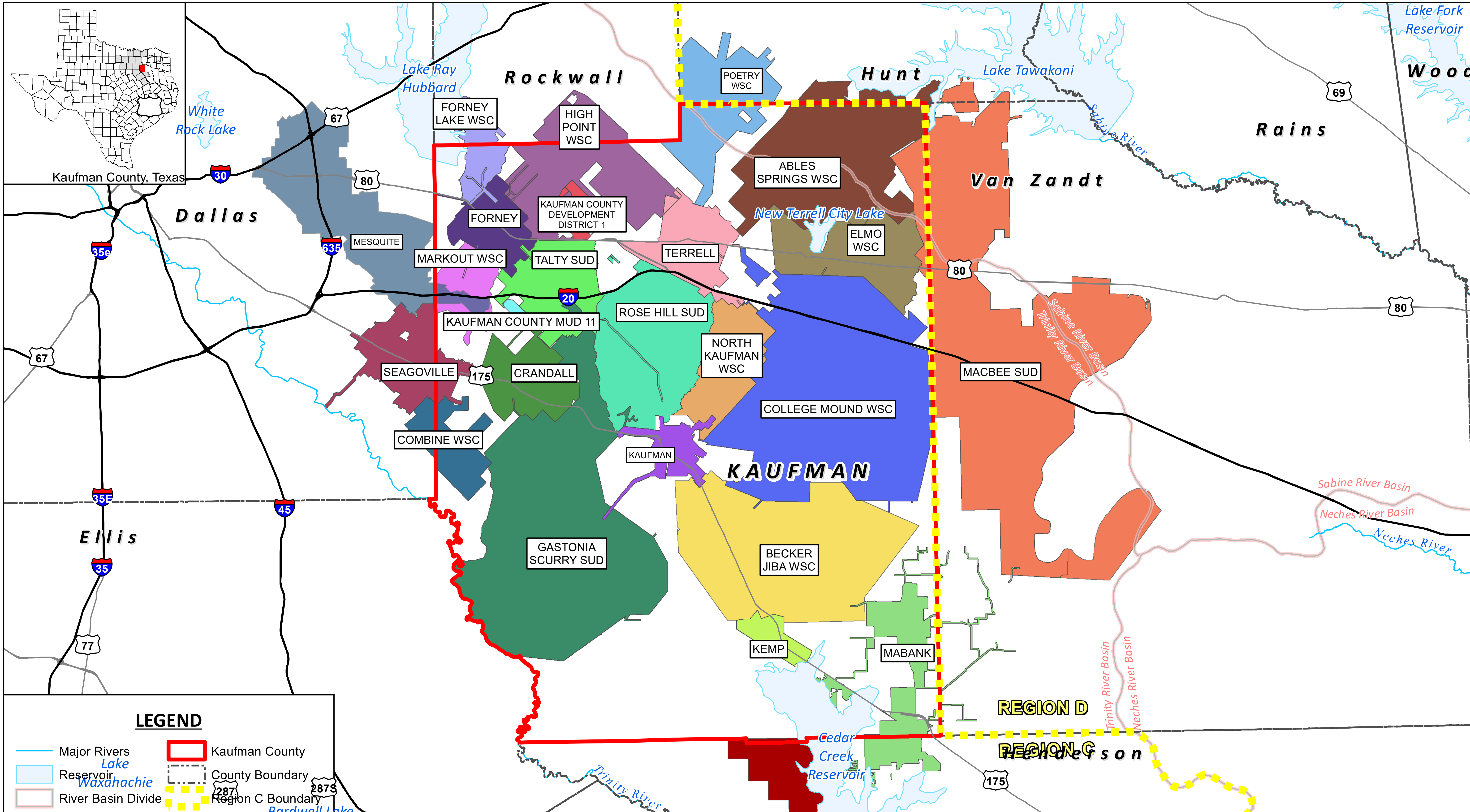
Table 5E.261 Summary of Kaufman County

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**146,389**	**195,107**	**242,354**	**306,833**	**423,277**	**566,840**
Projected Demands	**32,432**	**39,103**	**45,389**	**53,921**	**68,234**	**85,866**
Municipal	19,542	25,960	32,141	40,518	54,694	72,158
Irrigation	285	285	285	285	285	285
Livestock	1,570	1,570	1,570	1,570	1,570	1,570
Manufacturing	946	1,109	1,109	1,109	1,109	1,109
Mining	296	386	491	646	783	951
Steam Electric	9,793	9,793	9,793	9,793	9,793	9,793
Total Existing Supplies	**32,530**	**34,518**	**35,770**	**38,048**	**42,742**	**47,271**
Need (Demand - Supply)	**0**	**4,585**	**9,619**	**15,873**	**25,492**	**38,595**
Total Supplies from Strategies	**1,534**	**5,750**	**10,831**	**16,952**	**26,437**	**39,373**
Reserve (Shortage)	**1,632**	**1,165**	**1,212**	**1,079**	**945**	**778**
Unmet Needs[a]	**0**	**0**	**0**	**0**	**58**	**226**

[a]Unmet needs are for Kaufman County Mining

Figure 5E.21 Summary of Kaufman County





2021 Region C Water Plan

KAUFMAN COUNTY, TEXAS

FIGURE 5E.22

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5E.11.1 Wholesale Water Providers and Water User Groups

Water management strategies for Kaufman County wholesale water providers (WWPs) and water user groups (WUGs) are discussed below (in alphabetical order). The costs and a summary for Kaufman County are presented in **Section 5E.11.2.**

Ables Springs Water Supply Corporation

Ables Springs WSC supplies northeastern Kaufman County in Region C, and part of Hunt and Van Zandt Counties in Region D. The water supply for this WSC is treated water from the North Texas Municipal Water District (NTMWD). Water management strategies for Ables Springs WSC include conservation and purchasing additional water from NTMWD. **Table 5E.262** shows the projected population and demand, the current supplies, and the water management strategies for Ables Springs WSC.

Table 5E.262 Summary of Water User Group – Ables Springs WSC (Regions C and D)

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**5,401**	**6,945**	**8,721**	**11,300**	**14,383**	**18,187**
Projected Demands						
Municipal Demand	363	466	586	759	967	1,222
Total Projected Demand	***363***	***466***	***586***	***759***	***967***	***1,222***
Currently Available Supplies						
NTMWD	361	393	458	537	617	715
Total Currently Available Supplies	***361***	***393***	***458***	***537***	***617***	***715***
Need (Demand – Supply)	***2***	***73***	***128***	***222***	***350***	***507***
Water Management Strategies						
Water Conservation	3	5	5	8	13	19
NTMWD	0	68	123	214	337	488
Total Supplies from Strategies	***3***	***73***	***128***	***222***	***350***	***507***
Reserve (Shortage)	**1**	**0**	**0**	**0**	**0**	**0**

Becker Jiba Water Supply Corporation

Becker Jiba WSC supplies water to Kaufman County. The WSC gets its water supply from North Texas Municipal Water District (NTMWD) through Kaufman. The water management strategies include conservation and additional supplies from NTMWD. **Table 5E.263** shows the projected population and demand, the current supplies, and the water management strategies for Becker Jiba WSC.

Table 5E.263 Summary of Water User Group – Becker Jiba WSC

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**3,547**	**4,590**	**5,626**	**7,933**	**11,093**	**14,800**
Projected Demands						
Municipal Demand	323	401	480	669	933	1,243
Total Projected Demand	***323***	***401***	***480***	***669***	***933***	***1,243***
Currently Available Supplies						
NTMWD through Kaufman	321	339	374	473	594	727
Total Currently Available Supplies	***321***	***339***	***374***	***473***	***594***	***727***
Need (Demand – Supply)	***2***	***62***	***106***	***196***	***339***	***516***
Water Management Strategies						
Water Conservation	3	5	5	9	17	28
NTMWD through Kaufman	0	57	101	187	322	488
Total Supplies from Strategies	***3***	***62***	***106***	***196***	***339***	***516***
Reserve (Shortage)	**1**	**0**	**0**	**0**	**0**	**0**

College Mound Water Supply Corporation

College Mound WSC supplies eastern Kaufman County. The water supply for this WSC is purchased water from North Texas Municipal Water District (NTMWD), both directly from NTWMD and through Terrell. Water management strategies for College Mound WSC include conservation and purchasing additional water from NTMWD, including additional delivery infrastructure from Terrell. **Table 5E.264** shows the projected population and demand, the current supplies, and the water management strategies for College Mound WSC.

Table 5E.264 Summary of Water User Group – College Mound WSC

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**11,510**	**14,270**	**17,206**	**21,584**	**31,717**	**40,174**
Projected Demands						
Municipal Demand	774	959	1,156	1,451	2,132	2,700
Total Projected Demand	***774***	***959***	***1,156***	***1,451***	***2,132***	***2,700***
Currently Available Supplies						
NTMWD	461	486	542	616	815	947
NTMWD through Terrell	309	325	350	354	357	358
Total Currently Available Supplies	***770***	***811***	***892***	***970***	***1,172***	***1,305***
Need (Demand – Supply)	***4***	***148***	***264***	***481***	***960***	***1,395***
Water Management Strategies						
Water Conservation	8	13	15	23	41	61
NTMWD	0	81	143	241	439	636
NTMWD through Terrell	0	54	106	217	480	698
Additional Delivery Infrastructure from Terrell	*0*	*0*	*0*	*0*	*0*	*109*
Total Supplies from Strategies	***8***	***148***	***264***	***481***	***960***	***1,395***
Reserve (Shortage)	**4**	**0**	**0**	**0**	**0**	**0**

Combine Water Supply Corporation

Combine WSC provides water in Kaufman and Dallas Counties. The WSC gets its water supply from Dallas Water Utilities (DWU) through Seagoville. Water management strategies for Combine WSC include conservation and additional supplies from DWU. **Table 5E.265** shows the projected population and demand, the current supplies, and the water management strategies for Combine WSC.

Table 5E.265 Summary of Water User Group – Combine WSC

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**3,714**	**4,489**	**5,307**	**6,478**	**7,716**	**9,045**
Projected Demands						
Municipal Demand	352	408	470	565	671	786
Total Projected Demand	***352***	***408***	***470***	***565***	***671***	***786***
Currently Available Supplies						
DWU through Seagoville	327	325	333	366	411	450
Total Currently Available Supplies	***327***	***325***	***333***	***366***	***411***	***450***
Need (Demand – Supply)	***25***	***83***	***137***	***199***	***260***	***336***
Water Management Strategies						
Water Conservation	3	5	5	8	11	16
DWU through Seagoville	22	78	132	191	249	320
Total Supplies from Strategies	***25***	***83***	***137***	***199***	***260***	***336***
Reserve (Shortage)	**0**	**0**	**0**	**0**	**0**	**0**

Crandall

Crandall is located in western Kaufman County. The city's water supply is purchased from North Texas Municipal Water District (NTMWD) through the Kaufman Four One delivery point. Crandall plans to continue using NTMWD water. Water management strategies for Crandall include conservation and purchasing additional water from NTMWD. **Table 5E.266** shows the projected population and demand, the current supplies, and the water management strategies for Crandall.

Table 5E.266 Summary of Water User Group – City of Crandall

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**4,209**	**5,218**	**6,292**	**7,840**	**7,920**	**7,920**
Projected Demands						
Municipal Demand	763	926	1,104	1,368	1,381	1,381
Total Projected Demand	***763***	***926***	***1,104***	***1,368***	***1,381***	***1,381***
Currently Available Supplies						
NTMWD through Kaufman Four One	605	605	605	605	605	605
Total Currently Available Supplies	***605***	***605***	***605***	***605***	***605***	***605***
Need (Demand – Supply)	***158***	***321***	***499***	***763***	***776***	***776***
Water Management Strategies						
Water Conservation	39	58	66	86	92	97
NTMWD	119	263	433	677	684	679
Total Supplies from Strategies	***158***	***321***	***499***	***763***	***776***	***776***
Reserve (Shortage)	**0**	**0**	**0**	**0**	**0**	**0**

Elmo Water Supply Corporation

Elmo WSC supplies water in Kaufman County. The WSC gets its water supply from North Texas Municipal Water District (NTMWD) through Terrell. The water management strategies are conservation and additional water from NTMWD through Terrell. **Table 5E.267** shows the projected population and demand, the current supplies, and the water management strategies for Elmo WSC.

Table 5E.267 Summary of Water User Group – Elmo WSC

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**2,566**	**3,320**	**4,071**	**5,418**	**7,576**	**10,110**
Projected Demands						
Municipal Demand	216	268	320	421	586	782
Total Projected Demand	***216***	***268***	***320***	***421***	***586***	***782***
Currently Available Supplies						
NTMWD through Terrell	215	226	250	297	374	457
Total Currently Available Supplies	***215***	***226***	***250***	***297***	***374***	***457***
Need (Demand – Supply)	***1***	***42***	***70***	***124***	***212***	***325***
Water Management Strategies						
Water Conservation	2	3	3	6	10	17
NTMWD through Terrell	0	39	67	118	202	308
Total Supplies from Strategies	***2***	***42***	***70***	***124***	***212***	***325***
Reserve (Shortage)	**1**	**0**	**0**	**0**	**0**	**0**

Forney

The City of Forney is located in northwestern Kaufman County. Forney is a wholesale water provider (WWP) that currently purchases treated water from the North Texas Municipal Water District (NTMWD). Forney also purchases reuse water from Garland, which it then sells as a supply for Kaufman County Steam Electric Power. Forney currently provides wholesale supplies to all or portions of High Point WSC, Talty SUD, Kaufman County Development District 1, Markout WSC, Kaufman County Manufacturing (through retail service within the city), and a Kaufman County Steam Electric provider. NTMWD plans to continue providing water to Forney and its retail customers. The recommended water management strategies for Forney include implementing water conservation measures and purchasing additional water from NTMWD, including additional delivery infrastructure from NTMWD.

A summary of the recommended water plan for Forney is shown in **Table 5E.268**.

Table 5E.268 Summary of Wholesale Water Provider and Customers – City of Forney

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Demands						
Forney	3,090	3,554	4,509	5,634	8,343	11,114
High Point WSC	*221*	*262*	*308*	*378*	*568*	*734*
Talty SUD	*1,800*	*2,061*	*2,363*	*3,312*	*4,609*	*6,352*
Kaufman County Development District	*879*	*1,120*	*1,361*	*1,804*	*2,520*	*3,361*
Markout WSC	*415*	*526*	*637*	*843*	*1,177*	*1,569*
Manufacturing, Kaufman	*653*	*765*	*765*	*765*	*765*	*765*
Steam Electric, Kaufman (treated)	*1,121*	*1,121*	*1,121*	*1,121*	*1,121*	*1,121*
Steam Electric, Kaufman (raw)	*8,672*	*8,672*	*8,672*	*8,672*	*8,672*	*8,672*
Total Projected Demand	***16,851***	***18,081***	***19,736***	***22,529***	***27,775***	***33,688***
Currently Available Supplies						
Garland Reuse (limited to SEP demand)	8,672	8,672	8,672	8,672	8,672	8,672
NTMWD	8,029	7,810	8,408	9,412	11,470	12,992
Total Currently Available Supplies	***16,701***	***16,482***	***17,080***	***18,084***	***20,142***	***21,664***
Need (Demand – Supply)	***150***	***1,599***	***2,656***	***4,445***	***7,633***	***12,024***
Water Management Strategies						
Conservation (retail)	93	125	151	206	329	474
Conservation (wholesale)	159	238	271	389	579	830
Additional NTMWD	0	1,236	2,234	3,850	6,725	10,720
Additional Delivery Infrastructure from NTWMD (pump station)	*0*	*0*	*0*	*270*	*5,203*	*10,720*
Total Supplies from Strategies	***252***	***1,599***	***2,656***	***4,445***	***7,633***	***12,024***
Reserve (Shortage)	**102**	**0**	**0**	**0**	**0**	**0**

Forney Lake Water Supply Corporation

Forney Lake WSC supplies water to northwestern Kaufman County and southwestern Rockwall County. The water supply for this WSC is purchased water from North Texas Municipal Water District (NTMWD). Water management strategies for Forney Lake WSC are conservation and purchasing additional water from NTMWD. **Table 5E.269** shows the projected population and demand, the current supplies, and the water management strategies for Forney Lake WSC.

Table 5E.269 Summary of Water User Group – Forney Lake Water Supply Corporation

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**7,775**	**9,653**	**11,665**	**14,558**	**24,164**	**34,284**
Projected Demands						
Municipal Demand	1,261	1,544	1,854	2,306	3,819	5,414
Total Projected Demand	***1,261***	***1,544***	***1,854***	***2,306***	***3,819***	***5,414***
Currently Available Supplies						
NTMWD	1,254	1,304	1,448	1,631	2,433	3,166
Total Currently Available Supplies	***1,254***	***1,304***	***1,448***	***1,631***	***2,433***	***3,166***
Need (Demand – Supply)	***7***	***240***	***406***	***675***	***1,386***	***2,248***
Water Management Strategies						
Water Conservation	61	87	105	142	249	370
NTMWD	0	153	301	533	1,137	1,878
Total Supplies from Strategies	***61***	***240***	***406***	***675***	***1,386***	***2,248***
Reserve (Shortage)	**54**	**0**	**0**	**0**	**0**	**0**

Gastonia Scurry Special Utility District

Gastonia Scurry SUD supplies water to western Kaufman County. The water supply for this SUD is purchased water from North Texas Municipal Water District (NTMWD). Water management strategies for Gastonia Scurry SUD include conservation and purchasing additional water from NTMWD. **Table 5E.270** shows the projected population and demand, the current supplies, and the water management strategies for Gastonia Scurry SUD.

Table 5E.270 Summary of Water User Group – Gastonia Scurry SUD

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**10,568**	**13,088**	**15,739**	**20,150**	**33,704**	**52,565**
Projected Demands						
Municipal Demand	710	880	1,058	1,354	2,265	3,533
Total Projected Demand	***710***	***880***	***1,058***	***1,354***	***2,265***	***3,533***
Currently Available Supplies						
NTMWD	706	744	826	957	1,443	2,066
Total Currently Available Supplies	***706***	***744***	***826***	***957***	***1,443***	***2,066***
Need (Demand – Supply)	***4***	***136***	***232***	***397***	***822***	***1,467***
Water Management Strategies						
Water Conservation	7	12	14	21	44	80
NTMWD	0	124	218	376	778	1,387
Total Supplies from Strategies	***7***	***136***	***232***	***397***	***822***	***1,467***
Reserve (Shortage)	**3**	**0**	**0**	**0**	**0**	**0**

High Point Water Supply Corporation

High Point WSC supplies water to northwestern Kaufman County and southern Rockwall County. The water supplies for this WSC are purchased water from Forney and Terrell, both of which purchase treated water from North Texas Municipal Water District (NTWMD). Water management strategies for High Point WSC include conservation and purchasing additional water from Forney and Terrell, increasing contract amounts as appropriate. **Table 5E.271** shows the projected population and demand, the current supplies, and the water management strategies for High Point WSC.

Table 5E.271 Summary of Water User Group – High Point WSC

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**4,879**	**6,065**	**7,335**	**9,113**	**13,759**	**17,815**
Projected Demands						
Municipal Demand	442	523	615	756	1,135	1,468
Total Projected Demand	***442***	***523***	***615***	***756***	***1,135***	***1,468***
Currently Available Supplies						
NTMWD through Forney	220	221	241	268	362	429
NTMWD through Terrell	220	220	240	268	361	429
Total Currently Available Supplies	***440***	***441***	***481***	***536***	***723***	***858***
Need (Demand – Supply)	***2***	***82***	***134***	***220***	***412***	***610***
Water Management Strategies						
Water Conservation	3	6	6	10	20	33
NTMWD	0	76	128	210	392	577
Total Supplies from Strategies	***3***	***82***	***134***	***220***	***412***	***610***
Reserve (Shortage)	**1**	**0**	**0**	**0**	**0**	**0**

Kaufman

Kaufman is located in central Kaufman County. The city's water supply is purchased water from North Texas Municipal Water District (NTMWD). Water management strategies for Kaufman include conservation and additional water from NTMWD. **Table 5E.272** shows the projected population and demand, the current supplies, and the water management strategies for Kaufman.

Table 5E.272 Summary of Water User Group – City of Kaufman

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**7,754**	**9,593**	**11,744**	**18,512**	**24,201**	**29,700**
Projected Demands						
Municipal Demand	1,280	1,533	1,841	2,875	3,752	4,602
Becker Jiba WSC	*323*	*401*	*480*	*669*	*933*	*1,243*
North Kaufman WSC	*29*	*37*	*45*	*60*	*84*	*112*
Manufacturing, Kaufman	*9*	*11*	*11*	*11*	*11*	*11*
County Other, Kaufman	*98*	*176*	*194*	*195*	*802*	*1,835*
Total Projected Demand	***1,739***	***2,158***	***2,571***	***3,810***	***5,582***	***7,803***
Currently Available Supplies						
NTMWD	1,729	1,824	2,005	2,692	3,557	4,562
Total Currently Available Supplies	***1,729***	***1,824***	***2,005***	***2,692***	***3,557***	***4,562***
Need (Demand – Supply)	***10***	***334***	***566***	***1,118***	***2,025***	***3,241***
Water Management Strategies						
Water Conservation	58	82	30	61	109	178
NTMWD	0	252	536	1,057	1,916	3,063
Total Supplies from Strategies	***58***	***334***	***566***	***1,118***	***2,025***	***3,241***
Reserve (Shortage)	**48**	**0**	**0**	**0**	**0**	**0**

Kaufman County Development District 1

Kaufman County Development District 1 supplies water in Kaufman County and gets its water from North Texas Municipal Water District (NTMWD) through Forney. The water management strategies include conservation and additional NTMWD water through Forney. **Table 5E.273** shows the projected population and demand, the current supplies, and the water management strategies for Kaufman County Development District 1.

Table 5E.273 Summary of Water User Group – Kaufman County Development District 1

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**3,687**	**4,771**	**5,849**	**7,786**	**10,887**	**14,527**
Projected Demands						
Municipal Demand	879	1,120	1,361	1,804	2,520	3,361
Total Projected Demand	***879***	***1,120***	***1,361***	***1,804***	***2,520***	***3,361***
Currently Available Supplies						
NTMWD through Forney	874	947	1,063	1,275	1,606	1,965
Total Currently Available Supplies	***874***	***947***	***1,063***	***1,275***	***1,606***	***1,965***
Need (Demand – Supply)	***5***	***173***	***298***	***529***	***914***	***1,396***
Water Management Strategies						
Water Conservation	44	69	82	114	171	243
NTMWD through Forney	0	104	216	415	743	1,153
Total Supplies from Strategies	***44***	***173***	***298***	***529***	***914***	***1,396***
Reserve (Shortage)	**39**	**0**	**0**	**0**	**0**	**0**

Kaufman County Irrigation

Irrigation demand projections include the water necessary for irrigation activities, including field crops, orchards, pasture, turf grass, vineyards, golf courses irrigated by raw water, and limited aquaculture operations. Water supplies for Kaufman County Irrigation include purchased water from Tarrant Regional Water District (TRWD – Cedar Creek Lake), direct reuse (from the City of Crandall's WWTP for irrigation at Creekview golf course), local supplies (Trinity run-of-river), groundwater (Nacatoch aquifer), and Lake Ray Hubbard through Dallas Water Utilities (DWU). The water management strategies for Kaufman County Irrigation include additional raw water from TRWD and DWU. TRWD has a contract with Cedar Creek Country Club and DWU has a contract with Travis Ranch for irrigation. **Table 5E.274** shows the projected demand, the current supplies, and the water management strategies for Kaufman County Irrigation.

Table 5E.274 Summary of Water User Group – Kaufman County Irrigation

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Demands						
Total Projected Demand	**285**	**285**	**285**	**285**	**285**	**285**
Currently Available Supplies						
Cedar Creek Reservoir through TRWD	125	111	98	88	81	75
Direct Reuse	446	541	645	666	666	666
Local Supplies	64	64	64	64	64	64
Nacatoch Aquifer	89	89	89	89	89	89
Lake Ray Hubbard through DWU	27	26	23	21	20	19
Total Currently Available Supplies	***751***	***831***	***919***	***928***	***920***	***913***
Need (Demand – Supply)	***0***	***0***	***0***	***0***	***0***	***0***
Water Management Strategies						
TRWD	0	14	27	37	44	50
DWU	1	2	5	7	8	9
Total Supplies from Strategies	***0***	***16***	***32***	***44***	***52***	***59***
Reserve (Shortage)	**467**	**562**	**666**	**687**	**687**	**687**

Kaufman County Livestock

Livestock water use is defined as water used in the production of livestock, both for consumption and for cleaning and environmental purposes. The water supplies for Kaufman County Livestock are local surface water supplies and groundwater (Nacatoch aquifer). These supplies are sufficient and there are no water management strategies needed. **Table 5E.275** shows the projected demand, current supplies, and water management strategies for Kaufman County Livestock.

Table 5E.275 Summary of Water User Group – Kaufman County Livestock

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Demands						
Total Projected Demand	**1,570**	**1,570**	**1,570**	**1,570**	**1,570**	**1,570**
Currently Available Supplies						
Nacatoch Aquifer	100	100	100	100	100	100
Local Supplies	1,622	1,622	1,622	1,622	1,622	1,622
Total Currently Available Supplies	***1,722***	***1,722***	***1,722***	***1,722***	***1,722***	***1,722***
Need (Demand – Supply)	***0***	***0***	***0***	***0***	***0***	***0***
Water Management Strategies						
None	0	0	0	0	0	0
Total Supplies from Strategies	***0***	***0***	***0***	***0***	***0***	***0***
Reserve (Shortage)	**152**	**152**	**152**	**152**	**152**	**152**

Kaufman County Manufacturing

Manufacturing water use is defined as water used to produce manufactured goods. The water supplies for Kaufman County Manufacturing are groundwater from the Nacatoch aquifer and purchased treated water from North Texas Municipal Water District (NTMWD) through Forney, Kaufman, and Terrell. The only water management strategy for this water user group is purchasing additional water from NTMWD through the same suppliers. **Table 5E.276** shows the projected demand and current supplies for Kaufman County Manufacturing. Conservation was considered for this water user group, but it is not recommended because of the uncertainty in the ability to implement conservation measures given the multiple entities, facilities, and various manufacturing processes that make up this WUG.

Table 5E.276 Summary of Water User Group – Kaufman County Manufacturing

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Demands						
Total Projected Demand	**946**	**1,109**	**1,109**	**1,109**	**1,109**	**1,109**
Currently Available Supplies						
Nacatoch Aquifer	98	98	98	98	98	98
NTMWD through Terrell	283	282	260	235	212	195
NTMWD through Forney	650	646	598	541	487	448
NTMWD through Kaufman	9	9	8	7	7	6
Total Currently Available Supplies	***1,040***	***1,035***	***964***	***881***	***804***	***747***
Need (Demand – Supply)	***0***	***74***	***145***	***228***	***305***	***362***
Water Management Strategies						
NTMWD	4	172	243	326	403	460
Total Supplies from Strategies	***4***	***172***	***243***	***326***	***403***	***460***
Reserve (Shortage)	**98**	**98**	**98**	**98**	**98**	**98**

Kaufman County Mining

Mining water demand includes water used for oil and gas development, as well as extraction of coal and lignite, sand aggregate, and other resources. The water supplies for Kaufman County Mining are local supplies and groundwater (Nacatoch aquifer). The water management strategy for Kaufman County Mining is new well(s) in the Nacatoch aquifer. However, there is not enough MAG supply to allocate to Kaufman County mining in 2060 and 2070 to meet the projected demands. **Table 5E.277** shows the projected demand, the current supplies, and the water management strategies for Kaufman County Mining. Conservation was considered for this water user group, but it is not recommended because of the uncertainty in the ability to implement conservation measures given the multiple companies, facilities, and types of processes that make up this WUG.

Table 5E.277 Summary of Water User Group – Kaufman County Mining

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Demands						
Total Projected Demand	**296**	**386**	**491**	**646**	**783**	**951**
Currently Available Supplies						
Nacatoch Aquifer	590	589	590	590	590	590
Local Supplies	86	86	86	86	86	86
Total Currently Available Supplies	***676***	***675***	***676***	***676***	***676***	***676***
Need (Demand – Supply)	***0***	***0***	***0***	***0***	***107***	***275***
Water Management Strategies						
New Well(s) in Nacatoch Aquifer	0	0	49	49	49	49
Total Supplies from Strategies	***0***	***0***	***49***	***49***	***49***	***49***
Reserve (Shortage)	**380**	**289**	**234**	**79**	**(58)**	**(226)**

Kaufman County Municipal Utility District 11

Kaufman County MUD 11 supplies water in Kaufman County. The MUD gets its water supply from North Texas Municipal Water District (NTMWD) through Mesquite. The water management strategies include conservation and additional NTMWD supplies through Mesquite. **Table 5E.278** shows the projected population and demand, the current supplies, and the water management strategies for Kaufman County MUD 11.

Table 5E.278 Summary of Water User Group – Kaufman County MUD 11

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**3,702**	**4,540**	**5,568**	**6,828**	**8,374**	**10,269**
Projected Demands						
Municipal Demand	608	730	883	1,077	1,318	1,616
Total Projected Demand	***608***	***730***	***883***	***1,077***	***1,318***	***1,616***
Currently Available Supplies						
NTMWD through Mesquite	604	617	689	761	839	945
Total Currently Available Supplies	***604***	***617***	***689***	***761***	***839***	***945***
Need (Demand – Supply)	***4***	***113***	***194***	***316***	***479***	***671***
Water Management Strategies						
Water Conservation	30	46	53	68	88	114
NTMWD through Mesquite	0	67	141	248	391	557
Total Supplies from Strategies	***30***	***113***	***194***	***316***	***479***	***671***
Reserve (Shortage)	**26**	**0**	**0**	**0**	**0**	**0**

Kaufman County Other

Kaufman County Other includes individual domestic supplies and other water suppliers too small to be classified as water user groups. The water supplies for these entities include purchased water from North Texas Municipal Water District (NTMWD) through Kaufman and Terrell and purchased water from Tarrant Regional Water District (TRWD) through Mabank. Water management strategies for these entities include conservation, purchasing additional water from NTMWD and TRWD, and additional water from TRWD with new delivery and treatment facilities. **Table 5E.279** shows the projected population and demand, the current supplies, and the water management strategies for Kaufman County Other.

Table 5E.279 Summary of Water User Group – Kaufman County Other

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**1,559**	**2,889**	**3,241**	**3,293**	**13,587**	**31,127**
Projected Demands						
Municipal Demand	172	310	340	342	1,407	3,220
Total Projected Demand	***172***	***310***	***340***	***342***	***1,407***	***3,220***
Currently Available Supplies						
TRWD through Mabank	13	13	13	13	13	13
NTMWD through Kaufman	97	149	151	138	512	1,073
NTMWD through Terrell	64	99	101	92	341	716
Total Currently Available Supplies	***174***	***261***	***265***	***243***	***866***	***1,802***
Need (Demand – Supply)	***0***	***49***	***75***	***99***	***541***	***1,418***
Water Management Strategies						
Water Conservation	2	4	3	5	23	64
NTMWD	0	43	68	90	462	1,207
TRWD through Mabank	49	48	49	49	48	48
Water from TRWD w/ new delivery and treatment facilities (0.5 MGD)	9	16	17	17	70	161
Total Supplies from Strategies	***60***	***111***	***137***	***161***	***603***	***1,480***
Reserve (Shortage)	**62**	**62**	**62**	**62**	**62**	**62**

Kaufman County Steam Electric Power

Steam electric power demands do not include water that is used in cogeneration facilities (which is included in manufacturing projections), facilities which do not require water for production, or hydro-electric generation facilities. Kaufman County's Steam Electric Power demand is attributed to the FPLE Forney LP. The water supplies for Kaufman County SEP are direct reuse from Garland through Forney and purchased, treated water from North Texas Municipal Water District (NTMWD). Water management strategies for this water user group include purchasing treated water from Forney (originating from NTMWD). Conservation was considered for this water user group, but it is not recommended because the steam electric demand projections themselves considered items such as future efficiency programs. **Table 5E.280** shows the projected demand, the current supplies, and the water management strategies for Kaufman County SEP.

Table 5E.280 Summary of Water User Group – Kaufman County SEP

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Demands						
Total Projected Demand	**9,793**	**9,793**	**9,793**	**9,793**	**9,793**	**9,793**
Currently Available Supplies						
Reuse from Garland through Forney	8,672	8,672	8,672	8,672	8,672	8,672
NTMWD through Forney	1,115	947	875	793	714	655
Total Currently Available Supplies	***9,787***	***9,619***	***9,547***	***9,465***	***9,386***	***9,327***
Need (Demand – Supply)	***6***	***174***	***246***	***328***	***407***	***466***
Water Management Strategies						
NTMWD through Forney	6	174	246	328	407	466
Total Supplies from Strategies	***6***	***174***	***246***	***328***	***407***	***466***
Reserve (Shortage)	**0**	**0**	**0**	**0**	**0**	**0**

Kemp

Kemp is located in southern Kaufman County. The city purchases raw water from Tarrant Regional Water District (TRWD) for its water supply and treats the water at its own water treatment plant. Water management strategies for Kemp include conservation and purchasing additional raw water from TRWD. **Table 5E.281** shows the projected population and demand, the current supplies, and the water management strategies for Kemp.

Table 5E.281 Summary of Water User Group – City of Kemp

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**1,699**	**2,107**	**2,540**	**3,187**	**4,950**	**6,930**
Projected Demands						
Municipal Demand	301	364	433	540	836	1,170
Total Projected Demand	***301***	***364***	***433***	***540***	***836***	***1,170***
Currently Available Supplies						
TRWD	112	112	112	112	112	112
Total Currently Available Supplies	***112***	***112***	***112***	***112***	***112***	***112***
Need (Demand – Supply)	***189***	***252***	***321***	***428***	***724***	***1,058***
Water Management Strategies						
Water Conservation	21	41	49	63	101	144
TRWD	168	211	272	365	623	914
Total Supplies from Strategies	***189***	***252***	***321***	***428***	***724***	***1,058***
Reserve (Shortage)	**0**	**0**	**0**	**0**	**0**	**0**

Mabank

Mabank is located in southeastern Kaufman County and northern Henderson County in Region C and Van Zandt in Region D. The city supplies treated water to Kaufman County Other. The city buys and treats raw water from Tarrant Regional Water District (TRWD) for its water supply. Water management strategies for Mabank include conservation, purchasing additional water from TRWD, and water treatment plant expansions including any needed increase in delivery infrastructure from Cedar Creek Reservoir to the water treatment plant. **Table 5E.282** shows the projected population and demand, the current supplies, and the water management strategies for Mabank.

Table 5E.282 Summary of Water User Group – City of Mabank

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**10,006**	**11,085**	**12,075**	**16,092**	**22,597**	**31,486**
Projected Demands						
Municipal Demand	1,982	2,158	2,326	3,081	4,317	6,011
County Other, Kaufman	*62*	*62*	*62*	*62*	*62*	*62*
Total Projected Demand	***2,044***	***2,220***	***2,388***	***3,143***	***4,379***	***6,073***
Currently Available Supplies						
TRWD	1,289	1,289	1,289	1,289	1,289	1,289
Total Currently Available Supplies	***1,289***	***1,289***	***1,289***	***1,289***	***1,289***	***1,289***
Need (Demand – Supply)	***755***	***931***	***1,099***	***1,854***	***3,090***	***4,784***
Water Management Strategies						
Water Conservation	110	149	159	221	325	475
TRWD	645	782	940	1,633	2,765	4,309
3 MGD WTP Expansion	*645*	*782*	*940*	*1,633*	*1,682*	*1,682*
5 MGD WTP Expansion					*1,084*	*2,628*
Additional delivery infrastructure from TRWD (Cedar Creek Reservoir)		*782*	*940*	*1,633*	*2,765*	*4,309*
Total Supplies from Strategies	***755***	***931***	***1,099***	***1,854***	***3,090***	***4,784***
Reserve (Shortage)	**0**	**0**	**0**	**0**	**0**	**0**

MacBee Special Utility District

MacBee SUD supplies water to Van Zandt County, Hunt County, and a small part of northeastern Kaufman County. Most of the SUD's service area is in the North East Texas Region (Region D). MacBee SUD gets its water supply by treating raw water purchased from the Sabine River Authority (SRA) from Lake Tawakoni. The only water management strategy for Region C is conservation. Strategies for the North East Texas Region are addressed in that regional water plan. **Table 5E.283** shows the projected population and demand, the current supplies, and the water management strategies for MacBee SUD in Region C.

Table 5E.283 Summary of Water User Group – MacBee SUD (Region C Only)

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**267**	**331**	**399**	**501**	**611**	**730**
Projected Demands						
Municipal Demand	18	22	27	34	41	49
Total Projected Demand	***18***	***22***	***27***	***34***	***41***	***49***
Currently Available Supplies						
SRA through Region D	18	22	27	34	41	49
Total Currently Available Supplies	***18***	***22***	***27***	***34***	***41***	***49***
Need (Demand – Supply)	***0***	***0***	***0***	***0***	***0***	***0***
Water Management Strategies[a]						
Water Conservation	0	0	0	0	1	1
Total Supplies from Strategies	***0***	***0***	***0***	***0***	***1***	***1***
Reserve (Shortage)	**0**	**0**	**0**	**0**	**1**	**1**

[a]*Water Management Strategies for MacBee SUD are covered in Region D plan*.

Markout Water Supply Corporation

Markout WSC supplies water to Kaufman County. The WSC gets its water supply from North Texas Municipal Water District (NTMWD) through Forney. The recommended water management strategies include conservation and additional supplies from NTMWD. **Table 5E.284** shows the projected population and demand, the current supplies, and the water management strategies for Markout WSC.

Table 5E.284 Summary of Water User Group – Markout WSC

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**2,391**	**3,094**	**3,793**	**5,050**	**7,062**	**9,422**
Projected Demands						
Municipal Demand	415	526	637	843	1,177	1,569
Total Projected Demand	***415***	***526***	***637***	***843***	***1,177***	***1,569***
Currently Available Supplies						
NTMWD through Forney	308	315	320	324	326	327
Total Currently Available Supplies	***308***	***315***	***320***	***324***	***326***	***327***
Need (Demand – Supply)	***107***	***211***	***317***	***519***	***851***	***1,242***
Water Management Strategies						
Water Conservation	20	34	38	53	79	109
NTMWD	87	177	279	466	772	1,133
Total Supplies from Strategies	***107***	***211***	***317***	***519***	***851***	***1,242***
Reserve (Shortage)	**0**	**0**	**0**	**0**	**0**	**0**

Mesquite

Mesquite is located in eastern Dallas County extending into western Kaufman County. Mesquite's water supply is discussed under Dallas County in **Section 5E.3**.

North Kaufman Water Supply Corporation

North Kaufman WSC supplies water to Kaufman County. The WSC gets its water supply from North Texas Municipal Water District (NTMWD) through both Kaufman and Terrell. The water management strategies include conservation and additional water from NTMWD through Kaufman and Terrell. **Table 5E.285** shows the projected population and demand, the current supplies, and the water management strategies for North Kaufman WSC.

Table 5E.285 Summary of Water User Group – North Kaufman WSC

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**2,818**	**3,647**	**4,471**	**5,952**	**8,322**	**11,103**
Projected Demands						
Municipal Demand	192	245	300	400	559	746
Total Projected Demand	***192***	***245***	***300***	***400***	***559***	***746***
Currently Available Supplies						
NTMWD through Kaufman	29	32	35	42	53	65
NTMWD through Terrell	162	176	199	240	302	371
Total Currently Available Supplies	***191***	***208***	***234***	***282***	***355***	***436***
Need (Demand – Supply)	***1***	***37***	***66***	***118***	***204***	***310***
Water Management Strategies						
Water Conservation	2	3	3	5	9	16
NTMWD through Kaufman	0	5	10	17	30	45
NTMWD through Terrell	0	29	53	96	165	249
Total Supplies from Strategies	***2***	***37***	***66***	***118***	***204***	***310***
Reserve (Shortage)	**1**	**0**	**0**	**0**	**0**	**0**

Poetry Water Supply Corporation

Poetry WSC supplies water to Kaufman County in Region C and Hunt County in Region D. The WSC gets its water supply from North Texas Municipal Water District (NTMWD) through Terrell. The water management strategies include conservation and additional supplies from NTMWD. **Table 5E.286** shows the projected population and demand, the current supplies, and the water management strategies for Poetry WSC.

Table 5E.286 Summary of Water User Group – Poetry WSC

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**3,212**	**4,045**	**5,070**	**6,595**	**8,868**	**11,937**
Projected Demands						
Municipal Demand	353	430	528	681	913	1,228
Total Projected Demand	***353***	***430***	***528***	***681***	***913***	***1,228***
Currently Available Supplies						
NTMWD through Terrell	355	364	413	481	583	718
Total Currently Available Supplies	***355***	***364***	***413***	***481***	***583***	***718***
Need (Demand – Supply)	***0***	***66***	***115***	***200***	***330***	***510***
Water Management Strategies						
Water Conservation	1	2	1	3	4	7
NTMWD	0	64	114	197	326	503
Total Supplies from Strategies	***1***	***66***	***115***	***200***	***330***	***510***
Reserve (Shortage)	**3**	**0**	**0**	**0**	**0**	**0**

Rose Hill Special Utility District

Rose Hill SUD provides water to central and northern Kaufman County. The SUD purchases treated water from NTMWD and is expected to continue to do so. **Table 5E.287** shows the projected population and demand, current supplies, and water management strategies for Rose Hill SUD. Recommended water management strategies for Rose Hill SUD include conservation and purchasing additional water from NTWMD.

Table 5E.287 Summary of Water User Group – Rose Hill SUD

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**5,106**	**6,329**	**7,606**	**9,699**	**12,870**	**19,800**
Projected Demands						
Municipal Demand	441	523	613	773	1,022	1,569
Total Projected Demand	***441***	***523***	***613***	***773***	***1,022***	***1,569***
Currently Available Supplies						
NTMWD	439	442	479	546	652	918
Total Currently Available Supplies	***439***	***442***	***479***	***546***	***652***	***918***
Need (Demand – Supply)	***2***	***81***	***134***	***227***	***370***	***651***
Water Management Strategies						
Water Conservation	3	6	6	10	18	35
NTMWD	0	75	128	217	352	616
Total Supplies from Strategies	***3***	***81***	***134***	***227***	***370***	***651***
Reserve (Shortage)	**1**	**0**	**0**	**0**	**0**	**0**

Seagoville

Seagoville is a wholesale water provider and is discussed under Dallas County in **Section 5E.3**.

Talty Special Utility District

Talty SUD provides water to central and northern Kaufman County. The SUD purchases treated water from North Texas Municipal Water District (NTWMD) through Forney. Water management strategies for Talty SUD include conservation and purchasing additional water from NTWMD. **Table 5E.288** shows the projected population and demand, current supplies, and water management strategies for Talty SUD.

Table 5E.288 Summary of Water User Group – Talty SUD

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**10,985**	**12,710**	**14,642**	**20,600**	**28,710**	**39,600**
Projected Demands						
Municipal Demand	1,800	2,061	2,363	3,312	4,609	6,352
Total Projected Demand	***1,800***	***2,061***	***2,363***	***3,312***	***4,609***	***6,352***
Currently Available Supplies						
NTMWD through Forney	1,790	1,741	1,845	2,341	2,938	3,715
Total Currently Available Supplies	***1,790***	***1,741***	***1,845***	***2,341***	***2,938***	***3,715***
Need (Demand – Supply)	***10***	***320***	***518***	***971***	***1,671***	***2,637***
Water Management Strategies						
Water Conservation	93	132	148	217	319	461
NTMWD	0	188	370	754	1,352	2,176
Total Supplies from Strategies	***93***	***320***	***518***	***971***	***1,671***	***2,637***
Reserve (Shortage)	**83**	**0**	**0**	**0**	**0**	**0**

Terrell

The City of Terrell is located in northern Kaufman County. Terrell is a wholesale water provider (WWP) that supplies water to College Mound WSC, Kaufman County Other, Elmo WSC, High Point WSC, Kaufman County Manufacturing, North Kaufman WSC, and Poetry WSC. Terrell gets all of its water supplies from the North Texas Municipal Water District (NTMWD) and plans to continue to obtain treated water from NTMWD through the planning period. The supply currently available to Terrell is limited to their contracted amount with NTWMD (6,726 acre-feet per year). As shown in **Table 5E.289**, the recommended water management strategies for Terrell include implementing water conservation measures, purchasing treated water from NTMWD (increasing contract amounts as needed in the future), and constructing facilities to take water from NTMWD and to deliver water to Terrell's customers.

Table 5E.289 Summary of Wholesale Water Provider and Customers – City of Terrell

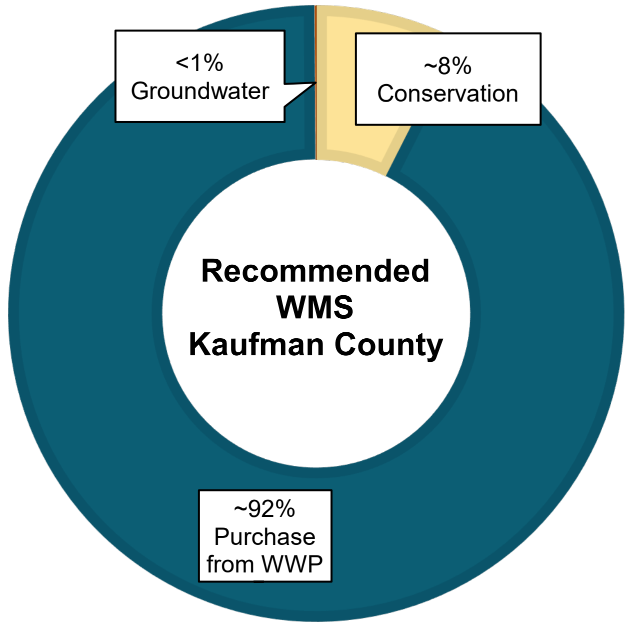
(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Demands						
Terrell	3,857	7,237	9,786	11,370	12,658	14,741
College Mound WSC	*310*	*384*	*462*	*580*	*853*	*1,080*
County Other, Kaufman	*65*	*118*	*129*	*130*	*535*	*1,224*
Elmo WSC	*216*	*268*	*320*	*421*	*586*	*782*
High Point WSC	*221*	*261*	*307*	*378*	*567*	*734*
Manufacturing, Kaufman	*284*	*333*	*333*	*333*	*333*	*333*
North Kaufman WSC	*163*	*208*	*255*	*340*	*475*	*634*
Poetry WSC	*353*	*430*	*528*	*681*	*913*	*1,228*
Total Projected Demand	***5,469***	***9,239***	***12,120***	***14,233***	***16,920***	***20,756***
Currently Available Supplies						
NTMWD	4,847	6,726	6,726	6,726	6,726	6,726
Total Currently Available Supplies	***4,847***	***6,726***	***6,726***	***6,726***	***6,726***	***6,726***
Need (Demand – Supply)	***622***	***2,513***	***5,394***	***7,507***	***10,194***	***14,030***
Water Management Strategies						
Conservation (retail)	160	355	465	578	686	848
Conservation (wholesale)	10	17	17	29	57	103
Additional NTMWD with Infrastructure as below:	452	2,141	4,912	6,900	9,451	13,079
Infrastructure Upgrades to Deliver Water to Wholesale Customers	*452*	*2,141*	*4,912*	*6,900*	*9,451*	*13,079*
Additional Connection to NTMWD	*452*	*2,141*	*4,912*	*6,900*	*9,451*	*13,079*
Total Supplies from Strategies	***622***	***2,513***	***5,394***	***7,507***	***10,194***	***14,030***
Reserve (Shortage)	**0**	**0**	**0**	**0**	**0**	**0**

West Cedar Creek Municipal Utility District

West Cedar Creek MUD supplies water to northwestern Henderson County and southwestern Kaufman County. The District is a wholesale water provider, and its plans are discussed under Henderson County in **Section 5E.9.1**.

5E.11.2 Summary of Costs for Kaufman County

Table 5E.290 summarizes the costs of the water management strategies recommended for the WUGs and WWPs who have the majority of their demand located in Kaufman County. Total quantities from **Table 5E.290** will not necessarily match total county demands. This is due mainly to water users whose sum of strategies results in a reserve as well as due to water users located in multiple counties (or wholesale water providers who develop strategies and then sell water to users in other counties). Quantities from infrastructure projects needed to deliver and/or treat water (shown in *gray italics*) are not included since the supplies are associated with other strategies. To avoid double-counting quantities of supplies, the quantities in gray italics are **not** included in the total.



The majority of the future supplies needed to meet demands within Kaufman County are projected to come through purchases from wholesale water providers. Other strategies include conservation and groundwater. Many suppliers will develop additional delivery infrastructure and/or treatment capacity.

Table 5E.291 summarizes the recommended water management strategies within Kaufman County for individual WUGs and WWPs. Alternative strategies are also included. More detailed cost estimates are located in **Appendix H.**

Table 5E.290 Summary of Recommended Water Management Strategies for Kaufman County

Type of Strategy	Quantity (Ac-Ft/Yr)	Capital Costs
Conservation[a]	3,869	$1,666,273
Purchase from WWP	47,935	$0
Additional Infrastructure	*32,687*	*$93,043,000*
Groundwater	49	$419,000
Total	**51,853**	**$95,128,273**

[a]The conservation quantities represent the sum of the individual water user groups who have the majority of their service areas located in the county, not the total conservation in the county.

Table 5E.291 Costs for Recommended Water Management Strategies for Kaufman County

WWP or WUG	Strategy	Online by:	Quantity (Ac-Ft/Yr)[b]	Capital Costs[c]	Unit Cost ($/1000 gal) With Debt Service	Unit Cost ($/1000 gal) After Debt Service	Table
WWPs							
Forney	Conservation (retail)	2020	474	$219,451	$0.51	$0.00	H.11
	Conservation (wholesale)	2020	Included with WUGs.				
	NTMWD	2020	10,720	$0	$2.78	$2.78	None
	Additional delivery infrastructure from NTWMD (pump station)	*2020*	*10,720*	*$13,054,000*	*$0.28*	*$0.11*	*H.135*
Terrell	Conservation (retail)	2020	848	$512,507	$1.16	$0.35	H.11
	Conservation (wholesale)	2020	Included with WUGs.				
	NTMWD	2020	13,079	$0	$2.78	$2.78	None
	Infrastructure Upgrades to Deliver water to Wholesale Customers	*2020*	*13,079*	*$11,472,000*	*$0.50*	*$0.05*	*H.137 & H.138*
WUGs							
Ables Springs WSC[a]	Conservation	2020	19	$14,562	$1.05	$0.11	H.11
	NTMWD	2030	488	$0	$2.78	$2.78	None
Becker Jiba WSC	Conservation	2020	28	$15,523	$1.12	$0.11	H.11
	NTMWD	2030	488	$0	$2.78	$2.78	None
College Mound WSC	Conservation	2020	61	$37,197	$1.00	$0.00	H.11
	NTMWD	2030	636	$0	$2.78	$2.78	None
	Terrell	2030	698	$0	$5.90	$5.90	None
	Additional delivery from Terrell	*2070*	*109*	*$5,078,000*	*$11.74*	*$1.68*	*H.134*
Combine WSC	Conservation	2020	16	$30,127	$2.17	$0.00	H.11
	DWU through Seagoville	2020	320	$0	$3.00	$3.00	None
Crandall	Conservation	2020	97	$33,260	$1.30	$0.80	H.11
	NTMWD	2020	684	$0	$2.78	$2.78	None
Elmo WSC	Conservation	2020	17	$3,802	$0.41	$0.06	H.11
	NTMWD through Terrell	2030	308	$0	$5.90	$5.90	None
	Conservation	2020	370	$103,609	$1.23	$0.56	H.11

WWP or WUG	Strategy	Online by:	Quantity (Ac-Ft/Yr)[b]	Capital Costs[c]	Unit Cost ($/1000 gal) With Debt Service	After Debt Service	Table
Forney Lake WSC[a]	NTMWD	2030	1,878	$0	$2.78	$2.78	None
Gastonia Scurry SUD	Conservation	2020	80	$40,309	$1.24	$0.00	H.11
	NTMWD	2030	1,387	$0	$2.78	$2.78	None
High Point WSC[a]	Conservation	2020	33	$10,172	$0.73	$0.12	H.11
	NTMWD through Forney	2030	288	$0	$5.11	$5.11	None
	NTMWD through Terrell	2030	289	$0	$5.90	$5.90	None
Kaufman	Conservation	2020	110	$70,962	$0.81	$0.11	H.11
	NTMWD	2030	1,801	$0	$2.78	$2.78	None
Kaufman County Development District 1	Conservation	2020	243	$25,007	$0.99	$0.59	H.11
	NTMWD	2030	1,153	$0	$2.78	$2.78	None
Kaufman County MUD 11	Conservation	2020	114	$81,738	$1.87	$0.89	H.11
	NTMWD	2030	557	$0	$2.78	$2.78	None
Kemp	Conservation	2020	144	$13,716	$7.01	$1.55	H.11
	TRWD	2020	914	$0	$1.26	$1.26	None
Mabank[a]	Conservation	2020	474	$134,425	$1.41	$0.75	H.11
	TRWD	2020	4,309	$0	$1.26	$1.26	None
	3 MGD WTP Expansion	*2020*	*1,682*	*$19,817,000*	*$4.63*	*$2.09*	*H.13*
	5 MGD WTP Expansion	*2060*	*2,628*	*$30,984,000*	*$4.21*	*$1.82*	*H.13*
	Additional Delivery Infrastructure from TRWD (Cedar Creek Reservoir)	*2030*	*4,309*	*$1,622,000*	*$0.13*	*$0.04*	*H.136*
MacBee SUD[a]	Conservation	2060	1	$0	$0.00	$0.00	H.11
	SRA	See Region D plan for information					
Markout WSC	Conservation	2020	109	$35,133	$1.67	$0.84	H.11
	NTMWD	2020	1,133	$0	$2.78	$2.78	None
Mesquite[a]	Conservation	See Dallas County.					
	NTMWD						
North Kaufman WSC	Conservation	2020	16	$11,783	$1.27	$0.06	H.11
	NTMWD through Kaufman	2030	45	$0	$3.00	$3.00	None
	NTMWD through Terrell	2030	249	$0	$5.90	$5.90	None

WWP or WUG	Strategy	Online by:	Quantity (Ac-Ft/Yr)[b]	Capital Costs[c]	Unit Cost ($/1000 gal) With Debt Service	After Debt Service	Table
Poetry WSC	Conservation	2020	7	$3,186	$0.69	$0.00	H.11
	NTMWD	2030	503	$0	$2.78	$2.78	None
Rose Hill SUD	Conservation	2020	35	$24,571	$1.77	$0.11	H.11
	NTMWD	2030	616	$0	$2.78	$2.78	None
Seagoville[a]	Conservation	See Dallas County.					
	DWU						
Talty SUD	Conservation	2020	461	$184,178	$1.59	$0.67	H.11
	NTMWD	2030	2,176	$0	$2.78	$2.78	None
West Cedar Creek MUD[a]	Conservation	2020	48	$58,343	$1.05	$0.00	H.11
	TRWD	2030	814	$0	$1.26	$1.26	None
County Other and Non-Municipal							
County Other, Kaufman	Conservation	2020	64	$2,712	$0.29	$0.00	H.11
	NTMWD	2030	1,207	$0	$2.78	$2.78	None
	TRWD through Mabank	2020	49	$0	$3.00	$3.00	None
	TRWD	2020	161	$0	$1.26	$1.26	None
	0.5 MGD WTP for TRWD water	*2020*	*161*	*$11,016,000*	*$23.25*	*$8.47*	*H.139*
Irrigation, Kaufman	TRWD	2030	50	$0	$1.26	$1.26	None
	DWU	2020	9	$0	$4.05	$4.05	None
Livestock, Kaufman	None	None					
Manufacturing, Kaufman	NTMWD	2020	460	$0	$0.68	$0.68	None
Mining, Kaufman	New Well(s) in Nacatoch Aquifer	2040	49	$419,000	$2.29	$0.45	H.14
Steam Electric Power, Kaufman	NTMWD through Forney	2020	466	$0	$2.78	$2.78	None

[a]Water User Groups extend into more than one county

[b]Quantities listed are for the WUG only. They do not include the WUG's customers.

[c]Purchases from wholesale water providers that require no new infrastructure have no capital costs. The unit costs shown in the table represent the cost to purchase water from the WWP.

5E.12 Navarro County

Navarro County is in the southern portion of Region C. **Figure 5E.24** shows the service areas for water user groups in Navarro County.

The population of Navarro County is projected to almost double between 2050 and 2070.

Demands for the county are predominately municipal, with the City of Corsicana providing much of the water to the county. Mining and Livestock are the second and third largest demands within the county. There is no demand from steam electric power.

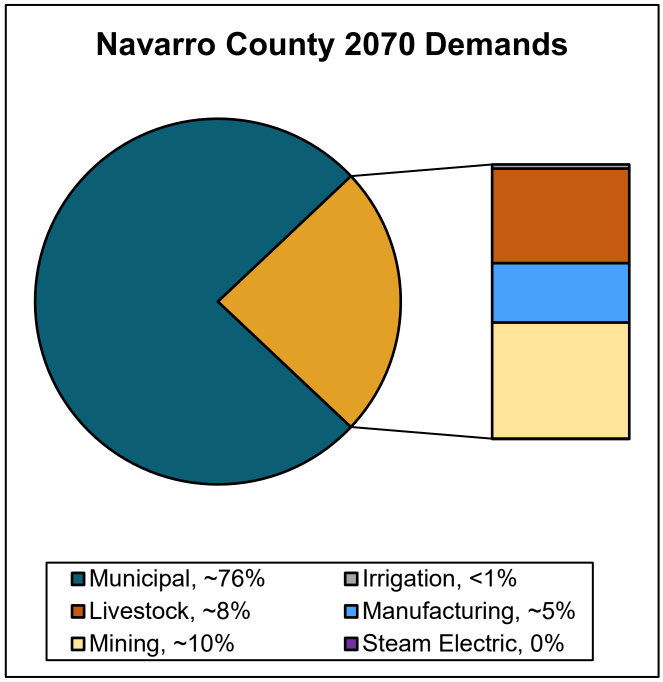


Table 5E.292 gives an overall summary of the county's projections, and water management strategies for individual WWPs and WUGs are discussed on the following pages. Strategies for Corsicana are discussed in **Chapter 5D**.

Navarro County Quick Facts

2010 Population: 47,735

Projected 2070 Population: 99,056

Projected 2070 Demand: 18 MGD

County Seat: Corsicana

Economy: Manufacturing; agribusinesses; oil-field operations, distribution

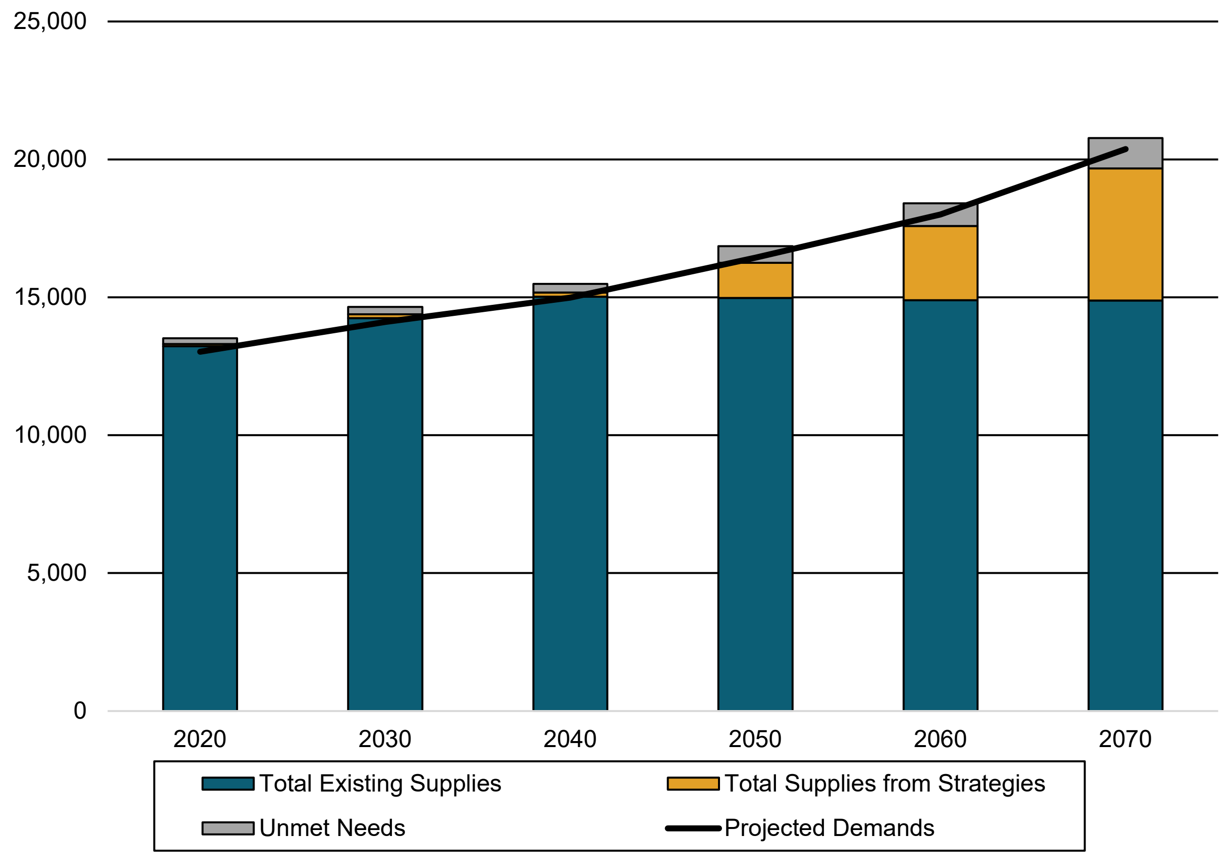
River Basins: Trinity (100%)

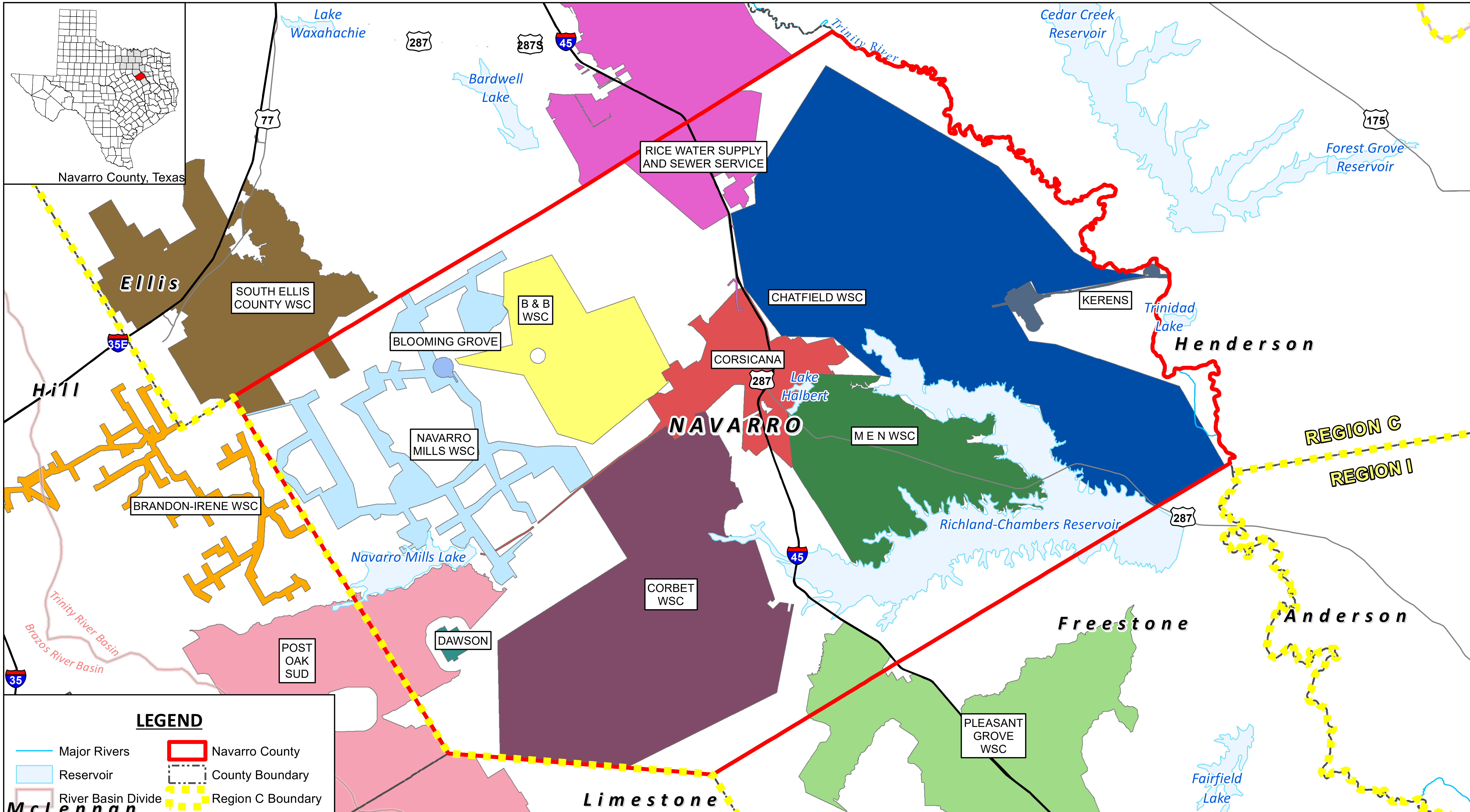
Table 5E.292 Summary of Navarro County

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**52,505**	**59,556**	**65,958**	**74,213**	**83,221**	**99,056**
Projected Demands	**13,027**	**14,103**	**14,987**	**16,436**	**18,002**	**20,374**
Municipal	9,174	10,037	10,877	12,036	13,368	15,470
Irrigation	75	75	75	75	75	75
Livestock	1,691	1,691	1,691	1,691	1,691	1,691
Manufacturing	894	1,062	1,062	1,062	1,062	1,062
Mining	1,193	1,238	1,282	1,572	1,806	2,076
Steam Electric	0	0	0	0	0	0
Total Existing Supplies	**13,220**	**14,246**	**15,022**	**14,972**	**14,900**	**14,879**
Need (Demand - Supply)	**0**	**0**	**0**	**1,464**	**3,102**	**5,495**
Total Supplies from Strategies	**84**	**140**	**155**	**1,285**	**2,683**	**4,793**
Reserve (Shortage)	**277**	**283**	**190**	**(179)**	**(419)**	**(702)**
Unmet Needs	**217**	**262**	**306**	**596**	**830**	**1,100**

[a]Unmet needs are for Navarro County Mining

Figure 5E.23 Summary of Navarro County





REGION C
Water Planning for North Texas

2021 Region C Water Plan
NAVARRO COUNTY, TEXAS
FIGURE 5E.24

1 in = 5 miles
0 1 2 4 6
Miles

Data Source(s): ESRI, USGS, TNRIS

TR116409: H:\WR_PLANNING\1 - Working\5E_County WMS\Navarro.mxd

5E.12.1 Wholesale Water Providers and Water User Groups

Water management strategies for Navarro County wholesale water providers (WWPs) and water user groups (WUGs) are discussed below (in alphabetical order). The costs and a summary for Navarro County are presented in **Section 5E.12.2.**

B and B Water Supply Corporation

B and B WSC supplies water to Navarro County. The WSC gets its water supply from Corsicana, and the recommended water management strategies include conservation and additional supplies from Corsicana. **Table 5E.293** shows the projected population and demand, the current supplies, and the water management strategies for B and B WSC.

Table 5E.293 Summary of Water User Group – B and B WSC

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**1,752**	**1,809**	**1,954**	**2,265**	**2,755**	**3,416**
Projected Demands						
Municipal Demand	242	242	255	293	355	440
Total Projected Demand	***242***	***242***	***255***	***293***	***355***	***440***
Currently Available Supplies						
Corsicana	242	242	254	265	291	315
Total Currently Available Supplies	***242***	***242***	***254***	***265***	***291***	***315***
Need (Demand – Supply)	***0***	***0***	***1***	***28***	***64***	***125***
Water Management Strategies						
Water Conservation	2	3	3	4	6	9
Corsicana	0	0	0	24	58	116
Total Supplies from Strategies	***2***	***3***	***3***	***28***	***64***	***125***
Reserve (Shortage)	**2**	**3**	**2**	**0**	**0**	**0**

Blooming Grove

Blooming Grove is located in northwestern Navarro County. The city buys treated water from Corsicana for its current supply. Water management strategies for Blooming Grove include conservation and purchasing additional water from Corsicana. **Table 5E.294** shows the projected population and demand, the current supplies, and the water management strategies for Blooming Grove.

Table 5E.294 Summary of Water User Group – City of Blooming Grove

(Values in Acre-feet per year)	2020	2030	2040	2050	2060	2070
Projected Population	**973**	**1,073**	**1,175**	**1,293**	**1,416**	**1,547**
Projected Demands						
Municipal Demand	163	175	187	204	223	243
Total Projected Demand	***163***	***175***	***187***	***204***	***223***	***243***
Currently Available Supplies						
Corsicana	163	175	186	185	183	174
Total Currently Available Supplies	***163***	***175***	***186***	***185***	***183***	***174***
Need (Demand – Supply)	***0***	***0***	***1***	***19***	***40***	***69***
Water Management Strategies						
Water Conservation	2	2	2	12	15	17
Corsicana	0	0	0	7	25	52
Total Supplies from Strategies	***2***	***2***	***2***	***19***	***40***	***69***
Reserve (Shortage)	***2***	***2***	***1***	***0***	***0***	***0***

Brandon Irene Water Supply Corporation

Brandon Irene WSC serves part of Ellis, Hill and Navarro Counties. The majority of the WSC's service area is in Hill County in the Brazos G region, so the water supply plans are covered in more detail in the Brazos G Regional Water Plan. The current supply is water from the Trinity aquifer and Aquilla Water Supply District, which purchases and treats water from the Brazos River Authority (Lake Aquilla). That supply is adequate to meet projected demands, and the only water management strategy for Brandon Irene WSC in Region C is conservation. **Table 5E.295** shows the projected population and demand, the current supplies, and the water management strategies for Brandon Irene WSC in Region C.

Table 5E.295 Summary of Water User Group – Brandon Irene WSC (Region C Only)

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**2,013**	**2,166**	**2,286**	**2,420**	**2,538**	**2,648**
Projected Demands						
Municipal Demand	265	275	282	295	309	322
Total Projected Demand	***265***	***275***	***282***	***295***	***309***	***322***
Currently Available Supplies						
Trinity Aquifer	233	256	255	254	253	239
Lake Aquila through Aquilla WSC	235	234	235	234	235	234
Total Currently Available Supplies	***468***	***490***	***490***	***488***	***488***	***473***
Need (Demand – Supply)	***0***	***0***	***0***	***0***	***0***	***0***
Water Management Strategies						
Water Conservation	0	0	0	1	1	1
Total Supplies from Strategies	***0***	***0***	***0***	***1***	***1***	***1***
Reserve (Shortage)	**203**	**215**	**208**	**194**	**180**	**152**

Chatfield Water Supply Corporation

Chatfield WSC serves eastern Navarro County. The WSC gets its water supply by purchasing treated water from Corsicana. The water management strategies for Chatfield WSC include conservation and additional water from Corsicana. **Table 5E.296** shows the projected population and demand, the current supplies, and the water management strategies for Chatfield WSC.

Table 5E.296 Summary of Water User Group – Chatfield WSC

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**3,933**	**4,414**	**4,894**	**5,374**	**5,854**	**6,334**
Projected Demands						
Municipal Demand	428	465	503	544	591	639
Total Projected Demand	***428***	***465***	***503***	***544***	***591***	***639***
Currently Available Supplies						
Corsicana	428	465	501	493	484	457
Total Currently Available Supplies	***428***	***465***	***501***	***493***	***484***	***457***
Need (Demand – Supply)	***0***	***0***	***2***	***51***	***107***	***182***
Water Management Strategies						
Water Conservation	3	5	5	7	10	13
Corsicana	0	0	0	44	97	169
Total Supplies from Strategies	***3***	***5***	***5***	***51***	***107***	***182***
Reserve (Shortage)	**3**	**5**	**3**	**0**	**0**	**0**

Corbet Water Supply Corporation

Corbet WSC is located in southern Navarro County. The WSC buys treated water from Corsicana for its current supply. Water management strategies for Corbet WSC include conservation and purchasing additional water from Corsicana. **Table 5E.297** shows the projected population and demand, the current supplies, and the water management strategies for Corbet WSC.

Table 5E.297 Summary of Water User Group – Corbet WSC

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**2,785**	**3,071**	**3,366**	**3,702**	**4,054**	**4,429**
Projected Demands						
Municipal Demand	250	264	280	303	331	361
Total Projected Demand	***250***	***264***	***280***	***303***	***331***	***361***
Currently Available Supplies						
Corsicana	250	264	279	274	271	258
Total Currently Available Supplies	***250***	***264***	***279***	***274***	***271***	***258***
Need (Demand – Supply)	***0***	***0***	***1***	***29***	***60***	***103***
Water Management Strategies						
Water Conservation	2	3	3	4	6	7
Corsicana	0	0	0	25	54	96
Total Supplies from Strategies	***2***	***3***	***3***	***29***	***60***	***103***
Reserve (Shortage)	**2**	**3**	**2**	**0**	**0**	**0**

Corsicana

Corsicana is a regional wholesale water provider located in Navarro County. Corsicana's water supply plans are discussed in **Chapter 5D**.

Dawson

Dawson is located in southwestern Navarro County. The city buys treated water from Corsicana for its current supply. Water management strategies for Dawson include conservation and purchasing additional water from Corsicana. **Table 5E.298** shows the projected population and demand, the current supplies, and the water management strategies for Dawson.

Table 5E.298 Summary of Water User Group – City of Dawson

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**893**	**934**	**975**	**1,016**	**1,057**	**1,100**
Projected Demands						
Municipal Demand	149	151	155	159	165	172
Total Projected Demand	***149***	***151***	***155***	***159***	***165***	***172***
Currently Available Supplies						
Corsicana	149	151	154	144	135	123
Total Currently Available Supplies	***149***	***151***	***154***	***144***	***135***	***123***
Need (Demand – Supply)	***0***	***0***	***1***	***15***	***30***	***49***
Water Management Strategies						
Water Conservation	1	2	2	2	3	3
Corsicana	0	0	0	13	27	46
Total Supplies from Strategies	***1***	***2***	***2***	***15***	***30***	***49***
Reserve (Shortage)	**1**	**2**	**1**	**0**	**0**	**0**

Kerens

Kerens is located in eastern Navarro County. The city gets its current water supply by purchasing treated water from Corsicana. Water management strategies for Kerens include conservation and additional water from Corsicana. **Table 5E.299** shows the projected population and demand, the current supplies, and the water management strategies for Kerens.

Table 5E.299 Summary of Water User Group – City of Kerens

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**1,824**	**2,011**	**2,204**	**2,424**	**2,655**	**2,900**
Projected Demands						
Municipal Demand	216	227	241	263	288	314
Total Projected Demand	***216***	***227***	***241***	***263***	***288***	***314***
Currently Available Supplies						
Corsicana	216	227	240	238	236	225
Total Currently Available Supplies	***216***	***227***	***240***	***238***	***236***	***225***
Need (Demand – Supply)	***0***	***0***	***1***	***25***	***52***	***89***
Water Management Strategies						
Water Conservation	2	3	2	4	5	6
Corsicana	0	0	0	21	47	83
Total Supplies from Strategies	***2***	***3***	***2***	***25***	***52***	***89***
Reserve (Shortage)	**2**	**3**	**1**	**0**	**0**	**0**

M E N Water Supply Corporation

MEN WSC serves central and southern Navarro County. The WSC purchases treated water from Corsicana. The water management strategies for MEN WSC include conservation and purchasing additional water from Corsicana, which includes increasing the delivery infrastructure from Corsicana. Alternative water management strategies include raw surface water from an additional source and RO of brackish groundwater. **Table 5E.300** shows the projected population and demand, the current supplies, and the water management strategies for MEN WSC.

Table 5E.300 Summary of Water User Group – MEN WSC

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**3,451**	**3,805**	**4,171**	**4,588**	**5,023**	**5,488**
Projected Demands						
Municipal Demand	487	523	564	615	672	734
Total Projected Demand	***487***	***523***	***564***	***615***	***672***	***734***
Currently Available Supplies						
Corsicana	487	523	562	557	550	525
Total Currently Available Supplies	***487***	***523***	***562***	***557***	***550***	***525***
Need (Demand – Supply)	***0***	***0***	***2***	***58***	***122***	***209***
Water Management Strategies						
Water Conservation	4	6	6	8	11	15
Corsicana	0	0	0	50	111	194
Additional Delivery Infrastructure from Corsicana (Upsize Lake Halbert connection)	*0*	*0*	*0*	*50*	*111*	*194*
Total Supplies from Strategies	***4***	***6***	***6***	***58***	***122***	***209***
Reserve (Shortage)	**4**	**6**	**4**	**0**	**0**	**0**
Alternative Water Management Strategy						
Raw Surface Water from Additional Source	***250***	***250***	***250***	***250***	***250***	***250***
RO of Brackish Groundwater	***250***	***250***	***250***	***250***	***250***	***250***

Navarro County Irrigation

Irrigation demand projections include the water necessary for irrigation activities, including field crops, orchards, pasture, turf grass, vineyards, golf courses irrigated by raw water, and limited aquaculture operations. The current irrigation supply in Navarro County is local surface water (Trinity run-of-river). Current supplies are sufficient to meet the need, and there are no recommended water management strategies. **Table 5E.301** shows the projected demand, the current supplies, and the water management strategies for Navarro County Irrigation.

Table 5E.301 Summary of Water User Group – Navarro County Irrigation

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Demands						
Total Projected Demand	**75**	**75**	**75**	**75**	**75**	**75**
Currently Available Supplies						
Local Supplies	226	226	226	226	226	226
Total Currently Available Supplies	***226***	***226***	***226***	***226***	***226***	***226***
Need (Demand – Supply)	***0***	***0***	***0***	***0***	***0***	***0***
Water Management Strategies						
None	0	0	0	0	0	0
Total Supplies from Strategies	***0***	***0***	***0***	***0***	***0***	***0***
Reserve (Shortage)	**151**	**151**	**151**	**151**	**151**	**151**

Navarro County Livestock

Livestock water use is defined as water used in the production of livestock, both for consumption and for cleaning and environmental purposes. The current supplies in Navarro County are local surface water supplies and groundwater (Carrizo-Wilcox, Nacatoch, and Other aquifers). These sources are sufficient to meet projected demands, and there are no water management strategies for this water user group. **Table 5E.302** shows the projected demand, current supplies, and water management strategies for Navarro County Livestock.

Table 5E.302 Summary of Water User Group – Navarro County Livestock

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Demands						
Total Projected Demand	**1,691**	**1,691**	**1,691**	**1,691**	**1,691**	**1,691**
Currently Available Supplies						
Carrizo-Wilcox Aquifer	9	9	9	9	9	9
Local Supplies	1,603	1,603	1,603	1,603	1,603	1,603
Nacatoch Aquifer	10	10	10	10	10	10
Other Aquifer	69	69	69	69	69	69
Total Currently Available Supplies	***1,691***	***1,691***	***1,691***	***1,691***	***1,691***	***1,691***
Need (Demand – Supply)	***0***	***0***	***0***	***0***	***0***	***0***
Water Management Strategies						
None	0	0	0	0	0	0
Total Supplies from Strategies	***0***	***0***	***0***	***0***	***0***	***0***
Reserve (Shortage)	**0**	**0**	**0**	**0**	**0**	**0**

Navarro County Manufacturing

Manufacturing water use is defined as water used to produce manufactured goods. Current supplies are treated water from Corsicana and water through the Winkler WSC from Tarrant Regional Water District (TRWD). Winkler WSC is not large enough to be considered by TWDB as a water user group, so it is included in Navarro County Other. The water management strategy for Navarro County Manufacturing is additional water from Corsicana. **Table 5E.303** shows the projected demand, current supplies, and water management strategies for Navarro County Manufacturing. Conservation was considered for this water user group, but not recommended because of the uncertainty in the ability to implement conservation measures given the multiple entities, facilities, and various manufacturing processes that make up this WUG.

Table 5E.303 Summary of Water User Group – Navarro County Manufacturing

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Demands						
Total Projected Demand	**894**	**1,062**	**1,062**	**1,062**	**1,062**	**1,062**
Currently Available Supplies						
Corsicana	889	1,057	1,052	957	865	756
TRWD through Winkler WSC	5	5	3	4	4	3
Total Currently Available Supplies	***894***	***1,062***	***1,055***	***961***	***869***	***759***
Need (Demand – Supply)	***0***	***0***	***7***	***101***	***193***	***303***
Water Management Strategies						
Corsicana	0	0	5	100	192	301
TRWD through Winkler WSC	0	0	2	1	1	2
Total Supplies from Strategies	***0***	***0***	***7***	***101***	***193***	***303***
Reserve (Shortage)	**0**	**0**	**0**	**0**	**0**	**0**

Navarro County Mining

Mining water demand includes water used for oil and gas development, as well as extraction of coal and lignite, sand aggregate, and other resources. Navarro County Mining is supplied from the Carrizo-Wilcox and Nacatoch aquifers. There are no water management strategies for Navarro County Mining, but the anticipated future use is groundwater. However, there is no MAG supply to allocate to Navarro County mining as a water management strategy. **Table 5E.304** shows the projected demand and the current supplies for Navarro County Mining.

Table 5E.304 Summary of Water User Group – Navarro County Mining

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Demands						
Total Projected Demand	**1,193**	**1,238**	**1,282**	**1,572**	**1,806**	**2,076**
Currently Available Supplies						
Carrizo-Wilcox Aquifer	6	6	6	6	6	6
Nacatoch Aquifer	970	970	970	970	970	970
Total Currently Available Supplies	***976***	***976***	***976***	***976***	***976***	***976***
Need (Demand – Supply)	***217***	***262***	***306***	***596***	***830***	***1,100***
Water Management Strategies						
None	0	0	0	0	0	0
Total Supplies from Strategies	***0***	***0***	***0***	***0***	***0***	***0***
Reserve (Shortage)	**(217)**	**(262)**	**(306)**	**(596)**	**(830)**	**(1,100)**

Navarro County Other

Navarro County Other includes individual domestic supplies and water suppliers too small to be classified as water user groups. The entities included under Navarro County Other receive their water supply from the groundwater (Other aquifer), Corsicana, and Tarrant Regional Water District (TRWD). Water management strategies for these entities include conservation, additional water from Corsicana, and additional water from TRWD. **Table 5E.305** shows the projected population and demand, the current supplies, and the water management strategies for Navarro County Other.

Table 5E.305 Summary of Water User Group – Navarro County Other

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**2,298**	**3,838**	**4,379**	**5,919**	**7,460**	**15,000**
Projected Demands						
Municipal Demand	261	424	474	628	787	1,579
Manufacturing, Navarro	5	5	5	5	5	5
Total Projected Demand	***266***	***429***	***479***	***633***	***792***	***1,584***
Currently Available Supplies						
Other Aquifer	200	200	200	200	200	200
Corsicana	222	360	401	484	548	960
TRWD	44	61	59	71	80	145
Total Currently Available Supplies	***466***	***621***	***660***	***755***	***828***	***1,305***
Need (Demand – Supply)	***0***	***0***	***0***	***0***	***0***	***279***
Water Management Strategies						
Water Conservation	2	5	5	8	13	32
Corsicana	0	0	0	43	110	355
TRWD	0	7	16	27	41	92
Total Supplies from Strategies	***2***	***12***	***21***	***78***	***164***	***479***
Reserve (Shortage)	**202**	**204**	**202**	**200**	**200**	**200**

Navarro County Steam Electric Power

There is no demand in Navarro County for Steam Electric Power.

Navarro Mills Water Supply Corporation

Navarro Mills WSC provides water for northwestern Navarro County. The WSC gets its water supply from groundwater (Woodbine aquifer) and by purchasing treated water from Corsicana. The water management strategies for Navarro Mills WSC include conservation, purchasing additional water from Corsicana, and new well(s) in the Woodbine aquifer. **Table 5E.306** shows the projected population and demand, the current supplies, and the water management strategies for Navarro Mills WSC.

Table 5E.306 Summary of Water User Group – Navarro Mills WSC

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**3,128**	**3,450**	**3,782**	**4,159**	**4,554**	**4,975**
Projected Demands						
Municipal Demand	333	352	376	407	444	485
Total Projected Demand	***333***	***352***	***376***	***407***	***444***	***485***
Currently Available Supplies						
Corsicana	333	352	371	369	364	347
Woodbine Aquifer	20	20	20	20	20	20
Total Currently Available Supplies	***353***	***372***	***391***	***389***	***384***	***367***
Need (Demand – Supply)	***0***	***0***	***0***	***18***	***60***	***118***
Water Management Strategies						
Water Conservation	3	4	4	5	7	10
Corsicana	0	0	1	33	73	128
New Well(s) in Woodbine Aquifer	0	0	0	8	8	8
Total Supplies from Strategies	***3***	***4***	***5***	***46***	***88***	***146***
Reserve (Shortage)	**23**	**24**	**20**	**28**	**28**	**28**

Pleasant Grove Water Supply Corporation

Pleasant Grove WSC provides water to Freestone and Navarro Counties. Water management strategies for Pleasant Grove WSC are discussed under Freestone County in **Section 5E.7**.

Post Oak Special Utility District

Post Oak SUD supplies water to Navarro County in Region C and Hill and Limestone Counties in Region G. The SUD gets its water supply from Corsicana, and the recommended water management strategies are conservation and additional water from Corsicana. **Table 5E.307** shows the projected population and demand, the current supplies, and the water management strategies for Post Oak SUD.

Table 5E.307 Summary of Water User Group – Post Oak SUD

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**1,756**	**1,883**	**1,994**	**2,171**	**2,411**	**2,681**
Projected Demands						
Municipal Demand	129	131	155	169	187	208
Birome (Region D)	147	147	147	147	147	147
Coolidge (Region D)	167	183	205	201	193	174
Hubbard (Region D)	147	149	162	152	140	120
Total Projected Demand	***590***	***610***	***669***	***669***	***667***	***649***
Currently Available Supplies						
Corsicana	590	610	665	606	546	465
Total Currently Available Supplies	***590***	***610***	***665***	***606***	***546***	***465***
Need (Demand – Supply)	***0***	***0***	***4***	***63***	***121***	***184***
Water Management Strategies						
Water Conservation	0	0	1	1	1	1
Corsicana	0	0	3	62	120	183
Total Supplies from Strategies	***0***	***0***	***4***	***63***	***121***	***184***
Reserve (Shortage)	**0**	**0**	**0**	**0**	**0**	**0**

Rice Water Supply and Sewer Service

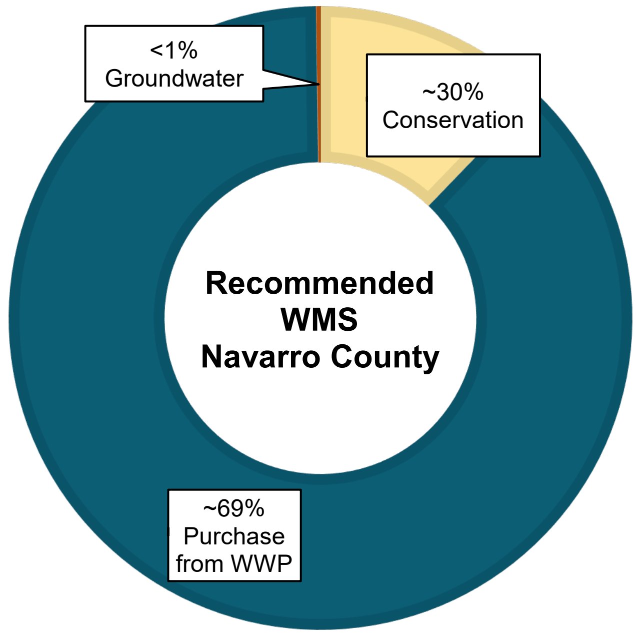
Rice Water Supply and Sewer Service provides retail water service to northern Navarro County and southeastern Ellis County. The WSC's water supply plans are discussed under Ellis County in **Section 5E.5**.

South Ellis County Water Supply Corporation

South Ellis County WSC serves Ellis and Navarro Counties. The water supplies for South Ellis County WSC are discussed under Ellis County in **Section 5E.5**.

5E.12.2 Summary of Costs for Navarro County

Table 5E.308 summarizes the costs of the water management strategies recommended for the WUGs and WWPs who have the majority of their demand located in Navarro County. Total quantities from **Table 5E.308** will not necessarily match total county demands. This is due mainly to water users whose sum of strategies results in a reserve as well as due to water users located in multiple counties (or wholesale water providers who develop strategies and then sell water to users in other counties). Quantities from infrastructure projects needed to deliver and/or treat water (shown in *gray italics*) are not included since the supplies are associated with other strategies. To avoid double-counting quantities of supplies, the quantities in gray italics are **not** included in the total.



The majority of the future supplies needed to meet demands within Navarro County are projected to come through purchases from wholesale water providers. Other strategies include conservation and groundwater.

Table 5E.309 summarizes the recommended water management strategies within Navarro County for individual WUGs and WWPs. Alternative strategies are also included. More detailed cost estimates are located in **Appendix H.**

Table 5E.308 Summary of Recommended Water Management Strategies for Navarro County

Type of Strategy	Quantity (Ac-Ft/Yr)	Capital Costs
Conservation[a]	785	$712,733
Purchase from WWP	1,815	$0
Additional Infrastructure	*194*	*$4,088,000*
Groundwater	8	$1,247,000
Total	**2,608**	**$6,047,733**

[a]The conservation quantities represent the sum of the individual water user groups who have the majority of their service areas located in the county, not the total conservation in the county.

Table 5E.309 Costs for Recommended Water Management Strategies for Navarro County

WWP or WUG	Strategy	Online by:	Quantity (Ac-Ft/Yr)[b]	Capital Costs[c]	Unit Cost ($/1000 gal) With Debt Service	Unit Cost ($/1000 gal) After Debt Service	Table
WWPs							
Corsicana is a regional wholesale water provider and discussed in **Chapter 5D**.							
WUGs							
B and B WSC	Conservation	2020	9	$5,528	$0.60	$0.00	H.11
	Corsicana	2050	116	$0	$4.15	$4.15	None
Blooming Grove	Conservation	2020	17	$12,881	$1.39	$0.93	H.11
	Corsicana	2050	52	$0	$4.15	$4.15	None
Brandon Irene WSC[a] (Region C only)	Conservation	2050	1	$0	$0.00	$0.00	H.11
Chatfield WSC	Conservation	2020	13	$12,274	$0.88	$0.00	H.11
	Corsicana	2050	169	$0	$4.15	$4.15	None
Corbet WSC	Conservation	2020	7	$4,543	$0.49	$0.00	H.11
	Corsicana	2050	96	$0	$4.15	$4.15	None
Corsicana	Conservation	2020	671	$620,621	$2.27	$0.49	H.11
	Other WMSs	See Corsicana in **Chapter 5D.**					
Dawson	Conservation	2020	3	$9,479	$2.05	$0.00	H.11
	Corsicana	2050	46	$0	$4.15	$4.15	None
Kerens	Conservation	2020	6	$6,764	$0.73	$0.00	H.11
	Corsicana	2050	83	$0	$4.15	$4.15	None
M E N WSC	Conservation	2020	15	$24,737	$1.34	$0.00	H.11
	Corsicana	2050	194	$0	$4.15	$4.15	None
	Additional delivery infrastructure from Corsicana (Upsize Lake Halbert Connection)	*2050*	*194*	*$4,088,000*	*$5.25*	*$0.67*	*H.141*
	ALTERNATIVE Raw Surface Water from Additional Source	*2020*	*250*	*$10,631,000*	*$14.32*	*$6.12*	*H.142*
	ALTERNATIVE RO of Brackish Groundwater	*2020*	*250*	*$7,370,000*	*$13.30*	*$6.94*	*H.14*
	Conservation	2020	10	$10,610	$0.76	$0.00	H.11

WWP or WUG	Strategy	Online by:	Quantity (Ac-Ft/Yr)[b]	Capital Costs[c]	Unit Cost ($/1000 gal) With Debt Service	Unit Cost ($/1000 gal) After Debt Service	Table
Navarro Mills WSC	Corsicana	2050	128	$0	$4.15	$4.15	None
	New Well(s) in Woodbine	2050	8	$1,247,000	$38.94	$5.29	H.14
Pleasant Grove WSC	Conservation	See Freestone County.					
	New Well(s) in Carrizo-Wilcox Aquifer						
Post Oak SUD	Conservation	2050	1	$0	$0.00	$0.00	H.11
	Corsicana	2050	183	$0	$4.15	$4.15	None
Rice Water Supply and Sewer Service[a]	Conservation	See Ellis County.					
	Ennis						
	Corsicana						
	Additional Delivery Infrastructure from Corsicana						
South Ellis County WSC	Conservation	See Ellis County.					
	TRWD through Waxahachie						
County Other and Non-Municipal							
County Other, Navarro	Conservation	2020	32	$5,296	$0.57	$0.00	H.11
	Corsicana	2030	355	$0	$4.15	$4.15	None
	TRWD	2040	90	$0	$1.26	$1.26	None
Irrigation, Navarro	None	None					
Livestock, Navarro	None	None					
Manufactur-ing Navarro	Corsicana	2050	301	$0	$4.15	$4.15	None
	TRWD through Winkler WSC	2040	2	$0	$3.00	$3.00	None
Mining, Navarro	None	None					
Steam Electric Power, Navarro	None	None					

[a]Water User Groups extend into more than one county

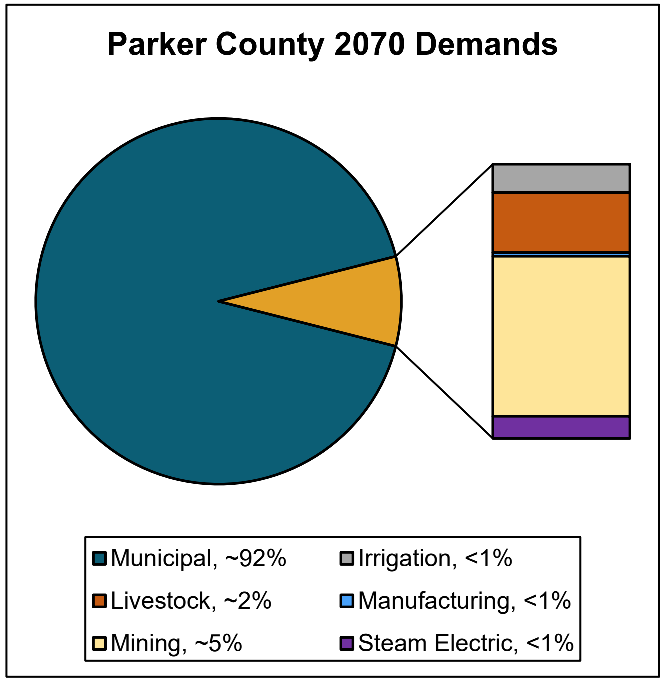
[b]Quantities listed are for the WUG only. They do not include the WUG's customers.

[c]Purchases from wholesale water providers that require no new infrastructure have no capital costs. The unit costs shown in the table represent the cost to purchase water from the WWP.

5E.13 Parker County

Parker County is located immediately west of Tarrant County in Region C. **Figure 5E.26** shows the service areas for water user groups in Parker County.

The population of Parker County is projected to almost triple between 2020 and 2070. Weatherford is the largest city in Parker County. Walnut Creek SUD and Weatherford are wholesale water providers in the county. Groundwater in Parker County is limited. The county is expected to use surface water and other sources to meet their needs generated by the expected growth.



Demands in the county are predominately municipal. Mining and livestock are the second and third largest demands. Irrigation, manufacturing, and steam electric power demands are all less than 1% of the total county demand.

An overall summary of the county's projections are shown in **Table 5E.310,** and water management strategies for individual WWPs and WUGs are discussed on the following pages.

Parker County Quick Facts

2010 Population: 116,927

Projected 2070 Population: 593,000

Projected 2070 Demand: 84 MGD

County Seat: Weatherford

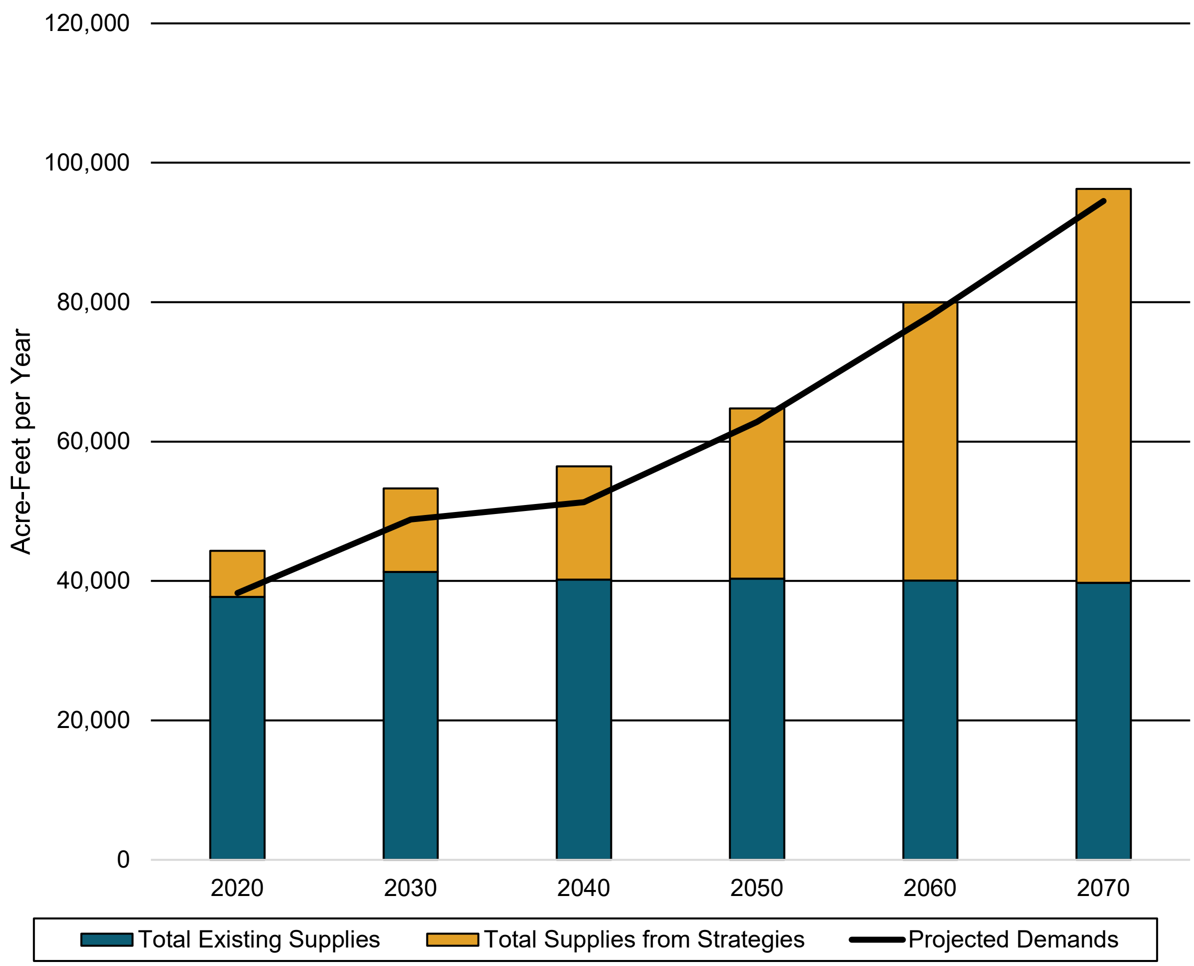
Economy: Agribusiness; manufacturing; government/services

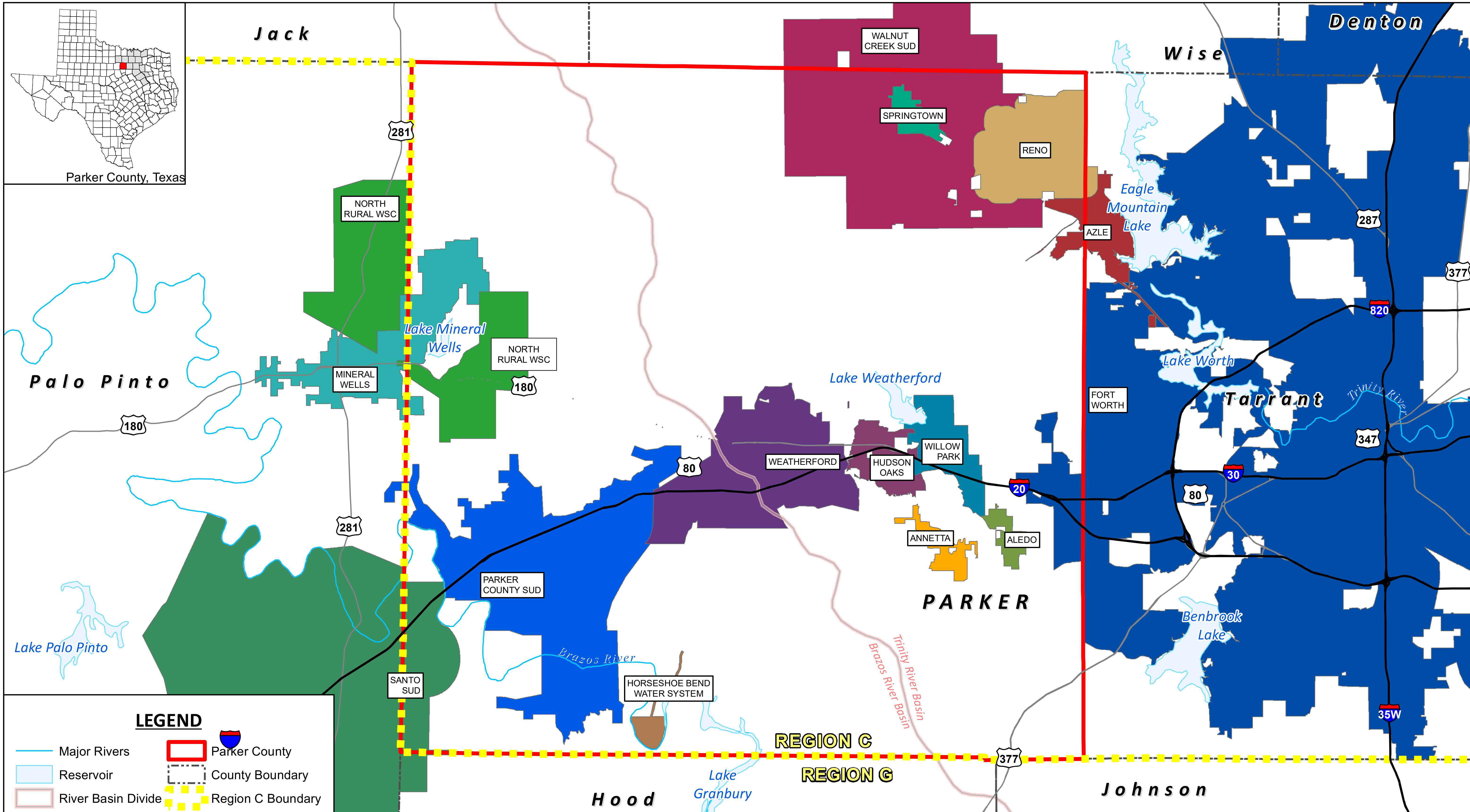
River Basins: Trinity (53%), Brazos (47%)

Table 5E.310 Summary of Parker County

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**201,491**	**260,194**	**276,979**	**360,125**	**472,097**	**593,000**
Projected Demands	**38,281**	**48,850**	**51,306**	**62,835**	**78,038**	**94,520**
Municipal	32,001	41,707	44,186	55,648	70,800	87,042
Irrigation	773	773	773	773	773	773
Livestock	1,634	1,634	1,634	1,634	1,634	1,634
Manufacturing	87	103	103	103	103	103
Mining	3,182	4,029	4,006	4,073	4,124	4,364
Steam Electric	604	604	604	604	604	604
Total Existing Supplies	**37,701**	**41,324**	**40,204**	**40,336**	**40,085**	**39,762**
Need (Demand - Supply)	**580**	**7,526**	**11,102**	**22,499**	**37,953**	**54,758**
Total Supplies from Strategies	**6,638**	**11,982**	**16,265**	**24,411**	**39,861**	**56,515**
Reserve (Shortage)	**6,058**	**4,456**	**5,163**	**1,912**	**1,908**	**1,757**

Figure 5E.25 Summary of Parker County





REGION C
Water Planning for North Texas

2021 Region C Water Plan
PARKER COUNTY, TEXAS
FIGURE 5E.26

1 in = 4 miles
0 1 2 4 6
Miles

N
W E
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Data Source(s): ESRI, USGS, TNRIS

TR116409: H:\WR_PLANNING\1 - Working\5E_County WMS\Parker1.mxd

5E.13.1 Wholesale Water Providers and Water User Groups

Water management strategies for Parker County wholesale water providers (WWPs) and water user groups (WUGs) are discussed below (in alphabetical order). The costs and a summary for Parker County are presented in **Section 5E.13.2.**

Aledo

Aledo is located in eastern Parker County. The city gets part of its current water supply from wells in the Trinity aquifer, and the city also purchases treated water from Fort Worth. Water management strategies for Aledo include conservation and purchasing additional treated water from Fort Worth, including adding delivery infrastructure (pipeline and pump station). **Table 5E.311** shows the projected population and demand, the current supplies, and the water management strategies for Aledo.

Table 5E.311 Summary of Water User Group – City of Aledo

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**5,579**	**8,724**	**10,000**	**11,500**	**12,000**	**13,500**
Projected Demands						
Municipal Demand	862	1,322	1,505	1,727	1,802	2,026
Total Projected Demand	***862***	***1,322***	***1,505***	***1,727***	***1,802***	***2,026***
Currently Available Supplies						
Trinity Aquifer	207	207	207	207	207	207
TRWD through Fort Worth	690	1,012	1,042	1,088	1,119	1,158
Total Currently Available Supplies	***897***	***1,219***	***1,249***	***1,295***	***1,326***	***1,365***
Need (Demand – Supply)	***0***	***103***	***256***	***432***	***476***	***661***
Water Management Strategies						
Water Conservation	7	16	17	27	35	46
TRWD through Fort Worth	0	139	306	486	648	822
Additional infrastructure from TRWD	*0*	*139*	*306*	*486*	*648*	*822*
Total Supplies from Strategies	***7***	***155***	***323***	***513***	***683***	***868***
Reserve (Shortage)	**42**	**52**	**67**	**81**	**207**	**207**

Annetta

Annetta is located in eastern Parker County. The current water supply for residents comes from wells in the Trinity aquifer. Water management strategies for Annetta include conservation and purchasing treated water from an area surface water provider. **Table 5E.312** shows the projected population and demand, the current supplies, and the water management strategies for Annetta.

Table 5E.312 Summary of Water User Group – Town of Annetta

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**3,720**	**4,422**	**5,123**	**5,825**	**6,526**	**7,228**
Projected Demands						
Municipal Demand	431	496	565	637	712	787
Total Projected Demand	***431***	***496***	***565***	***637***	***712***	***787***
Currently Available Supplies						
Trinity Aquifer	787	787	787	787	787	787
Total Currently Available Supplies	***787***	***787***	***787***	***787***	***787***	***787***
Need (Demand – Supply)	***0***	***0***	***0***	***0***	***0***	***0***
Water Management Strategies						
Water Conservation	3	5	6	8	12	16
Connect to Surface Water	0	195	194	192	188	184
Total Supplies from Strategies	***3***	***200***	***200***	***200***	***200***	***200***
Reserve (Shortage)	**359**	**491**	**422**	**350**	**275**	**200**

Azle

Azle is located in northwestern Tarrant County and northeastern Parker County. The water management strategies for Azle are discussed under Tarrant County in **Section 5E.15.1**.

Horseshoe Bend Water System

Horseshoe Bend Water System supplies water to Parker County and gets its water supply from the Trinity aquifer. The only recommended water management strategy is conservation. **Table 5E.313** shows the projected population and demand, the current supplies, and the water management strategies for Horseshoe Bend Water System.

Table 5E.313 Summary of Water User Group – Horseshoe Bend Water System

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**1,655**	**2,112**	**2,409**	**3,035**	**3,978**	**5,210**
Projected Demands						
Municipal Demand	157	192	213	265	346	453
Total Projected Demand	***157***	***192***	***213***	***265***	***346***	***453***
Currently Available Supplies						
Trinity Aquifer	453	453	453	453	453	453
Total Currently Available Supplies	***453***	***453***	***453***	***453***	***453***	***453***
Need (Demand – Supply)	***0***	***0***	***0***	***0***	***0***	***0***
Water Management Strategies						
Water Conservation	2	2	2	4	6	9
Total Supplies from Strategies	***2***	***2***	***2***	***4***	***6***	***9***
Reserve (Shortage)	**298**	**263**	**242**	**192**	**113**	**9**

Hudson Oaks

Hudson Oaks is located in central and eastern Parker County. The city gets its current water supply from wells in the Trinity aquifer and treated water purchased from Weatherford. Water management strategies for Hudson Oaks include conservation, purchasing additional treated water from Weatherford, and direct connection to Fort Worth. **Table 5E.314** shows the projected population and demand, the current supplies, and the water management strategies for Hudson Oaks.

Table 5E.314 Summary of Water User Group – City of Hudson Oaks

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**4,000**	**5,513**	**5,679**	**5,679**	**5,679**	**5,679**
Projected Demands						
Municipal Demand	1,375	1,875	1,922	1,919	1,918	1,918
Total Projected Demand	***1,375***	***1,875***	***1,922***	***1,919***	***1,918***	***1,918***
Currently Available Supplies						
Trinity Aquifer	400	400	400	400	400	400
TRWD through Weatherford	650	866	794	714	657	608
Total Currently Available Supplies	***1,050***	***1,266***	***1,194***	***1,114***	***1,057***	***1,008***
Need (Demand – Supply)	***325***	***609***	***728***	***805***	***861***	***910***
Water Management Strategies						
Water Conservation	77	127	126	133	139	145
Weatherford	0	32	137	210	262	307
Direct Connection to Fort Worth	299	450	465	462	460	458
Total Supplies from Strategies	***376***	***609***	***728***	***805***	***861***	***910***
Reserve (Shortage)	**51**	**0**	**0**	**0**	**0**	**0**

Mineral Wells

Mineral Wells is located in eastern Palo Pinto County (in the Brazos G Region) and western Parker County. The city gets its water supply from Palo Pinto County Water Control and Improvement District Number 1 (which diverts and treats water from Lake Palo Pinto in the Brazos G region). Conservation is the only water management strategy recommended for Mineral Wells in Region C. **Table 5E.315** shows the projected population and demand, the current supplies, and the water management strategies for Mineral Wells in Region C. Brazos G Region strategies for Mineral Wells are discussed in the Brazos G Regional Water Plan.

Table 5E.315 Summary of Water User Group – City of Mineral Wells (Region C Only)

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**2,107**	**2,078**	**2,044**	**2,004**	**1,958**	**1,905**
Projected Demands						
Municipal Demand	343	330	318	308	300	292
Total Projected Demand	***343***	***330***	***318***	***308***	***300***	***292***
Currently Available Supplies						
Lake Palo Pinto through Palo Pinto County WCID # 1	93	81	70	61	52	44
Total Currently Available Supplies	***93***	***81***	***70***	***61***	***52***	***44***
Need (Demand – Supply)	***250***	***249***	***248***	***247***	***248***	***248***
Water Management Strategies						
Water Conservation	17	21	3	4	5	6
Lake Palo Pinto through Palo Pinto County WCID # 1	233	228	245	243	243	242
Total Supplies from Strategies	***250***	***249***	***248***	***247***	***248***	***248***
Reserve (Shortage)	**0**	**0**	**0**	**0**	**0**	**0**

North Rural Water Supply Corporation

North Rural WSC supplies water to Parker County in Region C and Palo Pinto County in Region G. The WSC gets its water supply from Mineral Wells, and the only recommended water management strategy is conservation. **Table 5E.316** shows the projected population and demand, the current supplies, and the water management strategies for North Rural WSC in Region C. Brazoz G Region strategies for North Rural WSC are discussed in the Brazos G Regional Water Plan.

Table 5E.316 Summary of Water User Group – North Rural WSC (Region C Only)

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**770**	**826**	**864**	**899**	**926**	**947**
Projected Demands						
Municipal Demand	75	77	78	79	82	83
Total Projected Demand	***75***	***77***	***78***	***79***	***82***	***83***
Currently Available Supplies						
Mineral Wells	104	104	104	104	104	103
Total Currently Available Supplies	***104***	***104***	***104***	***104***	***104***	***103***
Need (Demand – Supply)	***0***	***0***	***0***	***0***	***0***	***0***
Water Management Strategies						
Water Conservation	0	1	1	1	1	2
Total Supplies from Strategies	***0***	***1***	***1***	***1***	***1***	***2***
Reserve (Shortage)	**29**	**28**	**27**	**26**	**23**	**22**

Parker County Irrigation

Irrigation demand projections include the water necessary for irrigation activities, including field crops, orchards, pasture, turf grass, vineyards, golf courses irrigated by raw water, and limited aquaculture operations. The current supplies are local surface water supplies (Trinity run-of-river), direct reuse through Annetta, Millsap and Weatherford, and groundwater (Trinity aquifer). These sources are sufficient to meet projected demands in Parker County, and there are no recommended water management strategies. **Table 5E.317** shows the projected demand, the current supplies, and the water management strategies for Parker County Irrigation.

Table 5E.317 Summary of Water User Group – Parker County Irrigation

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Demands						
Total Projected Demand	**773**	**773**	**773**	**773**	**773**	**773**
Currently Available Supplies						
Direct Reuse from Annetta	126	145	167	183	202	222
Direct Reuse from Millsap	2	2	2	2	2	2
Direct Reuse from Weatherford	269	316	334	456	456	456
Local Supplies	239	239	239	239	239	239
Trinity Aquifer	185	185	185	185	185	185
Total Currently Available Supplies	***821***	***887***	***927***	***1,065***	***1,084***	***1,104***
Need (Demand – Supply)	***0***	***0***	***0***	***0***	***0***	***0***
Water Management Strategies						
None	0	0	0	0	0	0
Total Supplies from Strategies	***0***	***0***	***0***	***0***	***0***	***0***
Reserve (Shortage)	**48**	**114**	**154**	**292**	**311**	**331**

Parker County Livestock

Livestock water use is defined as water used in the production of livestock, both for consumption and for cleaning and environmental purposes. The current supplies are local surface water supplies and groundwater from the Trinity aquifer. These sources are sufficient to meet projected demands, and there are no recommended water management strategies. **Table 5E.318** shows the projected demand, current supplies, and water management strategies for Parker County Livestock.

Table 5E.318 Summary of Water User Group – Parker County Livestock

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Demands						
Total Projected Demand	**1,634**	**1,634**	**1,634**	**1,634**	**1,634**	**1,634**
Currently Available Supplies						
Trinity Aquifer	229	229	229	229	229	229
Local Supplies	1,922	1,922	1,922	1,922	1,922	1,922
Total Currently Available Supplies	***2,151***	***2,151***	***2,151***	***2,151***	***2,151***	***2,151***
Need (Demand – Supply)	***0***	***0***	***0***	***0***	***0***	***0***
Water Management Strategies						
None	0	0	0	0	0	0
Total Supplies from Strategies	***0***	***0***	***0***	***0***	***0***	***0***
Reserve (Shortage)	**517**	**517**	**517**	**517**	**517**	**517**

Parker County Manufacturing

Manufacturing water use is defined as water used to produce manufactured goods. **Table 5E.319** shows the projected demand and current supplies for Parker County Manufacturing. Current supplies are groundwater (Trinity aquifer), treated water from Parker County SUD through Mineral Wells from Lake Palo Pinto, treated water from Weatherford (part from Lake Weatherford and part from Tarrant Regional Water District(TRWD)), and treated water from Walnut Creek SUD (from TRWD sources). The water management strategies for this water user group include additional water from Weatherford and additional water from Walnut Creek SUD. Conservation was considered for this water user group, but it is not recommended because of the uncertainty in the ability to implement conservation measures given the multiple entities, facilities, and various manufacturing processes that make up this WUG.

Table 5E.319 Summary of Water User Group – Parker County Manufacturing

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Demands						
Total Projected Demand	**87**	**103**	**103**	**103**	**103**	**103**
Currently Available Supplies						
Trinity Aquifer	43	43	43	43	43	43
Lake Palo Pinto through Parker County SUD	25	25	25	25	25	25
TRWD through Weatherford	20	17	15	14	14	12
TRWD through Walnut Creek SUD	10	10	9	6	5	3
Total Currently Available Supplies	***98***	***95***	***92***	***88***	***87***	***83***
Need (Demand – Supply)	***0***	***8***	***11***	***15***	***16***	***20***
Water Management Strategies						
TRWD through Weatherford	0	3	5	6	6	8
TRWD through Walnut Creek SUD	3	5	6	9	10	12
Total Supplies from Strategies	***3***	***8***	***11***	***15***	***16***	***20***
Reserve (Shortage)	**14**	**0**	**0**	**0**	**0**	**0**

Parker County Mining

Mining water demand includes water used for oil and gas development, as well as extraction of coal and lignite, sand aggregate, and other resources. Parker County Mining is supplied from local supplies, purchased supplies from Brazos River Authority (BRA) and groundwater from the Trinity aquifer. The only recommended water management strategy is new well(s) in the Trinity aquifer. **Table 5E.320** shows the projected demand, the current supplies, and the water management strategies for Parker County Mining.

Table 5E.320 Summary of Water User Group – Parker County Mining

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Demands						
Total Projected Demand	**3,182**	**4,029**	**4,006**	**4,073**	**4,124**	**4,364**
Currently Available Supplies						
Local Supplies	6	6	6	6	6	6
Brazos Local Supplies	14	14	14	14	14	14
Brazos River Supply (Purchased from BRA)	1,000	1,000	1,000	1,000	1,000	1,000
Trinity Aquifer	2,720	2,720	2,720	2,720	2,720	2,720
Total Currently Available Supplies	***3,740***	***3,740***	***3,740***	***3,740***	***3,740***	***3,740***
Need (Demand – Supply)	***0***	***289***	***266***	***333***	***384***	***624***
Water Management Strategies						
New Well(s) in Trinity Aquifer	0	289	266	333	384	624
Total Supplies from Strategies	***0***	***289***	***266***	***333***	***384***	***624***
Reserve (Shortage)	**558**	**0**	**0**	**0**	**0**	**0**

Parker County Other

Parker County Other includes individual domestic supplies and water suppliers too small to be classified as water user groups. The population projections are shown to decline slightly over the first two decades as some of the rural county population is incorporated by local cities and/or water providers. By 2070, the County Other population is projected to be nearly three times the 2020 population. Sources of supply for Parker County Other include Mineral Wells (from Lake Palo Pinto) and groundwater (Trinity and Cross Timbers aquifers). Water management strategies for Parker County Other include conservation, water from Weatherford, new well(s) in the Trinity aquifer, and supplies from Tarrant Regional Water District (TRWD) including a new water treatment plant. **Table 5E.321** shows the projected population and demand, the current supplies, and the water management strategies for Parker County Other.

Table 5E.321 Summary of Water User Group – Parker County Other

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**50,936**	**49,541**	**40,513**	**64,100**	**100,000**	**146,554**
Projected Demands						
Municipal Demand	6,614	6,272	5,027	7,828	12,150	17,770
Total Projected Demand	***6,614***	***6,272***	***5,027***	***7,828***	***12,150***	***17,770***
Currently Available Supplies						
Trinity Aquifer	4,983	4,983	4,983	4,983	4,983	4,983
Cross Timbers Aquifer	50	50	50	50	50	50
Lake Palo Pinto through Mineral Wells	663	663	663	663	663	663
Total Currently Available Supplies	***5,696***	***5,696***	***5,696***	***5,696***	***5,696***	***5,696***
Need (Demand – Supply)	***918***	***576***	***0***	***2,132***	***6,454***	***12,074***
Water Management Strategies						
Water Conservation	55	73	50	104	203	355
New Well(s) in Trinity Aquifer	235	235	235	235	235	235
Weatherford	0	0	0	1,200	2,500	4,000
TRWD with 12.5 MGD WTP	628	268	0	593	3,516	7,484
Total Supplies from Strategies	***918***	***576***	***285***	***2,132***	***6,454***	***12,074***
Reserve (Shortage)	**0**	**0**	**954**	**0**	**0**	**0**

Parker County Special Utility District

Parker County SUD is located in rural western Parker County and receives its water supply from Mineral Wells, the Brazos River Authority (in Region G), and groundwater (Trinity aquifer). Water management strategies for Parker County SUD include conservation and expansion of the desalination water treatment plant to treat Brazos River water purchased from the Brazos River Authority (BRA). **Table 5E.322** shows the projected population and demand, the current supplies, and the water management strategies for Parker County SUD.

Table 5E.322 Summary of Water User Group – Parker County SUD

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**6,822**	**10,812**	**14,804**	**18,800**	**22,800**	**26,805**
Projected Demands						
Municipal Demand	724	1,114	1,505	1,899	2,298	2,698
Manufacturing, Parker	*25*	*25*	*25*	*25*	*25*	*25*
Total Projected Demand	***749***	***1,139***	***1,530***	***1,924***	***2,323***	***2,723***
Currently Available Supplies						
Mineral Wells	473	473	473	473	473	473
Brazos River Authority	392	392	392	392	392	392
Trinity Aquifer	36	36	36	36	36	36
Total Currently Available Supplies	***901***	***901***	***901***	***901***	***901***	***901***
Need (Demand – Supply)	***0***	***238***	***629***	***1,023***	***1,422***	***1,822***
Water Management Strategies						
Water Conservation	6	14	19	30	44	61
3.5 MGD WTP Expansion – BRA	0	224	610	993	1,378	1,761
Total Supplies from Strategies	***6***	***238***	***629***	***1,023***	***1,422***	***1,822***
Reserve (Shortage)	**158**	**0**	**0**	**0**	**0**	**0**

Parker County Steam Electric Power

Steam electric power demands do not include water that is used in cogeneration facilities (which is included in manufacturing projections), facilities which do not require water for production, or hydro-electric generation facilities. Parker County's Steam Electric Power demand is attributed to the Brazos Electric Power Coop Inc. Parker County SEP is supplied by Weatherford (from Lake Weatherford). This source is sufficient to meet projected demands, and there are no water management strategies. **Table 5E.323** shows the projected demand, the current supplies, and the water management strategies for Parker County SEP.

Table 5E.323 Summary of Water User Group – Parker County SEP

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Demands						
Total Projected Demand	**604**	**604**	**604**	**604**	**604**	**604**
Currently Available Supplies						
Lake Weatherford through Weatherford	604	604	604	604	604	604
Total Currently Available Supplies	***604***	***604***	***604***	***604***	***604***	***604***
Need (Demand – Supply)	***0***	***0***	***0***	***0***	***0***	***0***
Water Management Strategies						
None	0	0	0	0	0	0
Total Supplies from Strategies	***0***	***0***	***0***	***0***	***0***	***0***
Reserve (Shortage)	**0**	**0**	**0**	**0**	**0**	**0**

Reno

Reno is located in northeastern Parker County and northwest Tarrant County. The city gets its current water supply from wells in the Trinity aquifer and treated water purchased from Walnut Creek SUD (from Tarrant Regional Water District (TRWD) raw water). Water management strategies for Reno include conservation and purchasing additional treated water from Walnut Creek SUD. **Table 5E.324** shows the projected population and demand, the current supplies, and the water management strategies for Reno.

Table 5E.324 Summary of Water User Group – City of Reno

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**2,537**	**2,588**	**2,642**	**2,706**	**2,778**	**2,858**
Projected Demands						
Municipal Demand	171	173	178	181	187	192
Total Projected Demand	***171***	***173***	***178***	***181***	***187***	***192***
Currently Available Supplies						
Trinity Aquifer	142	142	142	142	142	142
TRWD through Walnut Creek SUD	39	33	29	21	15	11
Total Currently Available Supplies	***181***	***175***	***171***	***163***	***157***	***153***
Need (Demand – Supply)	***0***	***0***	***7***	***18***	***30***	***39***
Water Management Strategies						
Water Conservation	2	2	2	2	3	4
TRWD through Walnut Creek SUD	9	15	19	27	32	35
Total Supplies from Strategies	***11***	***17***	***21***	***29***	***35***	***39***
Reserve (Shortage)	**21**	**19**	**14**	**11**	**5**	**0**

Santo Special Utility District

Santo SUD supplies water to Parker County in Region C, and Hood and Palo Pinto Counties in Region G. The SUD gets its water from Lake Palo Pinto through Mineral Wells, and the only recommended water management strategy is additional supplies from this source. **Table 5E.325** shows the projected population and demand, the current supplies, and the water management strategies for Santo SUD.

Table 5E.325 Summary of Water User Group – Santo SUD

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**2,177**	**2,370**	**2,501**	**2,651**	**2,805**	**2,971**
Projected Demands						
Municipal Demand	273	286	295	309	326	346
Total Projected Demand	***273***	***286***	***295***	***309***	***326***	***346***
Currently Available Supplies						
Lake Palo Pinto through Mineral Wells	331	331	331	331	331	331
Total Currently Available Supplies	***331***	***331***	***331***	***331***	***331***	***331***
Need (Demand – Supply)	***0***	***0***	***0***	***0***	***0***	***15***
Water Management Strategies						
Lake Palo Pinto through Mineral Wells	0	0	0	0	0	15
Total Supplies from Strategies	***0***	***0***	***0***	***0***	***0***	***15***
Reserve (Shortage)	**58**	**45**	**36**	**22**	**5**	**0**

Springtown

Springtown is located in northern Parker County. The city gets its current water supply from wells in the Trinity aquifer and purchased from Tarrant Regional Water District (TRWD). Surface water supplies are limited to 340 acre-feet per year due to infrastructure limitations during drought. Water management strategies for Springtown include conservation and additional raw water from TRWD with infrastructure improvements. **Table 5E.326** shows the projected population and demand, the current supplies, and the water management strategies for Springtown.

Table 5E.326 Summary of Water User Group – City of Springtown

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**4,068**	**5,484**	**5,484**	**5,484**	**5,484**	**5,484**
Projected Demands						
Municipal Demand	903	1,196	1,189	1,184	1,183	1,183
Total Projected Demand	***903***	***1,196***	***1,189***	***1,184***	***1,183***	***1,183***
Currently Available Supplies						
Trinity Aquifer	95	95	95	95	95	95
TRWD (Eagle Mountain Lake)	340	340	340	340	340	340
Total Currently Available Supplies	***435***	***435***	***435***	***435***	***435***	***435***
Need (Demand – Supply)	***468***	***761***	***754***	***749***	***748***	***748***
Water Management Strategies						
Water Conservation	115	301	298	301	304	308
TRWD	448	555	551	543	539	535
Surface Water Treatment Plant & Supply Project	*448*	*555*	*551*	*543*	*539*	*535*
Total Supplies from Strategies	***563***	***856***	***849***	***844***	***843***	***843***
Reserve (Shortage)	**95**	**95**	**95**	**95**	**95**	**95**

Walnut Creek Special Utility District

Walnut Creek SUD is a wholesale water provider (WWP) that purchases raw water from Tarrant Regional Water District (TRWD) and provides treated water to its own retail customers and to suppliers in Parker and Wise Counties. Its current wholesale customers include Boyd, Reno, Rhome, West Wise SUD, and Parker County Manufacturing. Walnut Creek SUD also provides wholesale service to portions of Wise County Other. The recommended water management strategies for Walnut Creek SUD include implementing water conservation measures, purchasing additional water from TRWD, expanding their current water treatment facilities, constructing new treatment facilities, and other infrastructure to deliver water to customers. **Table 5E.327** shows the recommended plan for Walnut Creek SUD.

Table 5E.327 Summary of Water User Group – Walnut Creek SUD

(Values in Ac-Ft/Yr)	*2020*	*2030*	*2040*	*2050*	*2060*	*2070*
Projected Demands						
Walnut Creek SUD	1,596	1,860	2,006	2,772	4,089	5,338
Boyd	*64*	*76*	*163*	*238*	*394*	*440*
Reno	*50*	*50*	*50*	*50*	*50*	*50*
Rhome	*228*	*383*	*543*	*966*	*1,354*	*1,774*
West Wise SUD	*24*	*24*	*24*	*25*	*25*	*26*
County Other, Wise	*728*	*734*	*723*	*755*	*777*	*1,202*
Manufacturing, Parker	*13*	*15*	*15*	*15*	*15*	*15*
Potential Customers						
Newark	*69*	*123*	*219*	*337*	*518*	*732*
County Other, Jack (Perrin)	*55*	*56*	*57*	*57*	*57*	*58*
Total Projected Demand	***2,827***	***3,321***	***3,800***	***5,215***	***7,279***	***9,635***
Currently Available Supplies						
TRWD (limited by WTP capacity)	2,200	2,200	2,200	2,200	2,200	2,200
Total Currently Available Supplies	***2,200***	***2,200***	***2,200***	***2,200***	***2,200***	***2,200***
Need (Demand – Supply)	***627***	***1,121***	***1,600***	***3,015***	***5,079***	***7,435***
Water Management Strategies						
Conservation (retail)	15	26	25	44	78	120
Conservation (wholesale)	112	202	252	282	405	555
TRWD	500	893	1,323	2,689	4,596	6,760
6 MGD WTP New	*500*	*893*	*1,323*	*2,689*	*3,363*	*3,363*
New 7 MGD Eagle Mountain WTP					*1,233*	*3,397*
Infrastructure to deliver to customers	*500*	*893*	*1,323*	*2,689*	*4,596*	*6,760*
Total Supplies from Strategies	***627***	***1,121***	***1,600***	***3,015***	***5,079***	***7,435***
Reserve (Shortage)	**0**	**0**	**0**	**0**	**0**	**0**

Weatherford

Weatherford is located in central Parker County. The City of Weatherford is a wholesale water provider (WWP) that provides municipal, manufacturing, and irrigation water to users in Parker County. Weatherford currently provides water to the City of Hudson Oaks and may serve the City of Annetta and much of Parker County Other in the future. Weatherford also provides a small amount of water from Lake Weatherford for steam electric power (Brazos Electric Co-Op).

Weatherford's water supply consists of water from Lake Weatherford (city water right) and Benbrook Lake (city water right through its Sunshine Lake permit and purchase from Tarrant Regional Water District), and reuse (of effluent from Weatherford's water treatment plant lagoons for irrigation at Oeste Ranch golf course). The currently available supplies for Weatherford are 7,860 acre-feet per year, which reflects existing treatment plant capacity and raw water use for irrigation demand. To fully utilize its existing water rights and contracts, Weatherford will need to expand its water treatment plant capacity and expand the pumping capacity of the pipeline from Benbrook Lake. The recommended water management strategies for Weatherford include implementing water conservation measures, developing indirect reuse, purchasing additional water from the TRWD, increasing treatment capacity (new plant and expansions), and increasing transmission capacity from Benbrook Lake. **Table 5E.328** shows the recommended water management strategies for Weatherford.

Table 5E.328 Summary of Wholesale Water Provider and Customers – City of Weatherford

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Demands						
Weatherford	5,306	6,213	6,586	10,928	17,870	24,614
Hudson Oaks	*650*	*983*	*1,015*	*1,013*	*1,012*	*1,012*
Manufacturing, Parker	*20*	*20*	*20*	*20*	*20*	*20*
Irrigation, Parker	*269*	*316*	*334*	*456*	*456*	*456*
Steam Electric, Parker	*604*	*604*	*604*	*604*	*604*	*604*
Potential Customers						
Annetta	*0*	*200*	*200*	*200*	*200*	*200*
County Other, Parker	*0*	*0*	*0*	*1,200*	*2,500*	*4,000*
Total Projected Demand	***6,849***	***8,336***	***8,759***	***14,421***	***22,662***	***30,906***
Currently Available Supplies						
Lake Weatherford	2,923	2,880	2,837	2,793	2,750	2,707
Reuse	269	316	334	456	456	456
TRWD	3,440	3,653	3,579	3,498	3,441	3,390
Total Currently Available Supplies – Limited by Plant Capacity (14 MGD)	***6,632***	***6,849***	***6,750***	***6,747***	***6,647***	***6,553***
Need (Demand – Supply)	***217***	***1,487***	***2,009***	***7,674***	***16,015***	***24,353***
Water Management Strategies						
Conservation (retail)	220	432	543	939	1,602	2,292
Conservation (wholesale)	54	90	90	97	105	113
Indirect Reuse - Lake Weatherford	2,242	2,803	3,363	3,363	3,363	3,363
TRWD	0	0	0	3,275	10,945	18,585
Treatment Plant & Infrastructure to treat and deliver TRWD and reuse						
8 MGD WTP Expansion	*2,242*	*2,803*	*3,363*	*4,484*	*4,484*	*4,484*
14 MGD WTP Expansion				*2,154*	*7,847*	*7,847*
18 MGD WTP Expansion					*1,977*	*9,617*
Expand Lake Benbrook PS	*448*	*448*	*448*	*448*	*448*	*448*
Total Supplies from Strategies	***2,516***	***3,325***	***3,996***	***7,674***	***16,015***	***24,353***
Reserve (Shortage)	**2,299**	**1,838**	**1,987**	**0**	**0**	**0**

Willow Park

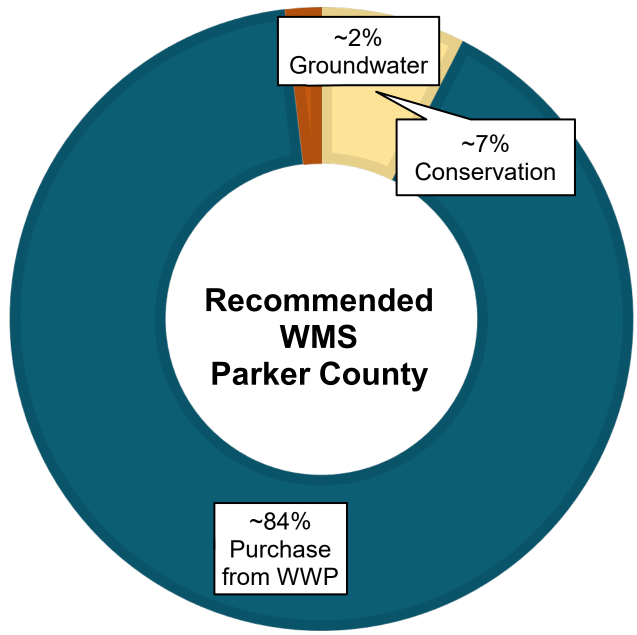
Willow Park is located in eastern Parker County. Willow Park gets its water supply from groundwater (Trinity aquifer). Water management strategies for Willow Park include conservation and purchasing treated water from Fort Worth (with the raw water supplied to Fort Worth by Tarrant Regional Water District (TRWD)). **Table 5E.329** shows the projected population and demand, the current supplies, and the water management strategies for Willow Park.

Table 5E.329 Summary of Water User Group – City of Willow Park

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**5,500**	**8,200**	**10,100**	**12,500**	**16,000**	**18,000**
Projected Demands						
Municipal Demand	856	1,243	1,509	1,853	2,367	2,661
Total Projected Demand	***856***	***1,243***	***1,509***	***1,853***	***2,367***	***2,661***
Currently Available Supplies						
Trinity Aquifer	690	690	690	690	690	690
Total Currently Available Supplies	***690***	***690***	***690***	***690***	***690***	***690***
Need (Demand – Supply)	***166***	***553***	***819***	***1,163***	***1,677***	***1,971***
Water Management Strategies						
Water Conservation	11	20	17	30	45	60
Connect to and Purchase Water from Fort Worth (TRWD)	155	533	802	1,133	1,632	1,911
Total Supplies from Strategies	***166***	***553***	***819***	***1,163***	***1,677***	***1,971***
Reserve (Shortage)	**0**	**0**	**0**	**0**	**0**	**0**

5E.13.2 Summary of Costs for Parker County

Table 5E.330 summarizes the costs of the water management strategies recommended for the WUGs and WWPs who have the majority of their demand located in Parker County. Total quantities from **Table 5E.330** will not necessarily match total county demands. This is due mainly to water users whose sum of strategies results in a reserve as well as due to water users located in multiple counties (or wholesale water providers who develop strategies and then sell water to users in other counties). Quantities from infrastructure projects needed to deliver and/or treat water (shown in *gray italics*) are not included since the supplies are associated with other strategies. To avoid double-counting quantities of supplies, the quantities in gray italics are **not** included in the total.



The majority of the future supplies to meet demands for WUGs located within Parker County are projected to come through purchases from wholesale water providers. Other strategies include conservation, Weatherford indirect reuse and groundwater.

Table 5E.331 summarizes the recommended water management strategies within Parker County for individual WUGs and WWPs. Alternative strategies are also included. More detailed cost estimates are located in **Appendix H.**

Table 5E.330 Summary of Recommended Water Management Strategies for Parker County

Type of Strategy	Quantity (Ac-Ft/Yr)	Capital Costs
Conservation[a]	3,424	$5,152,517
Purchase from WWP	41,399	$0
Additional Infrastructure	*41,826*	*$480,234,000*
Indirect Reuse	3,363	$15,326,000
Groundwater	859	$4,611,000
Total	**49,045**	**$505,323,517**

[a]The conservation quantities represent the sum of the individual water user groups who have the majority of their service areas located in the county, not the total conservation in the county.

Table 5E.331 Costs for Recommended Water Management Strategies for Parker County

WWP or WUG	Strategy	Online by:	Quantity (Ac-Ft/Yr)[b]	Capital Costs[c]	Unit Cost ($/1000 gal) With Debt Service	Unit Cost ($/1000 gal) After Debt Service	Table
WWPs							
Walnut Creek SUD	Conservation (retail)	2020	120	$76,702	$1.10	$0.00	H.11
	Conservation (wholesale)	2020	Included with WUGs.				
	TRWD	2020	6,760	$0	$1.26	$1.26	None
	6 MGD WTP Expansion	*2020*	*3,363*	*$36,582,000*	*$4.11*	*$1.76*	*H.13*
	New 7 MGD WTP-Eagle Mountain	*2060*	*3,397*	*$42,167,000*	*$4.03*	*$1.71*	*H.13*
Weatherford	Conservation (retail)	2020	2,292	$3,853,135	$3.78	$1.40	H.11
	Conservation (wholesale)	2020	Included with WUGs.				
	Additional Indirect Reuse Phase I	2020	2,242	$14,840,000	$1.69	$0.26	H.147
	Additional Indirect Reuse Phase II	2030	1,121	$486,000	$0.19	$0.09	H.148
	TRWD	2030	18,585	$0	$1.26	$1.26	None
	8 MGD WTP Expansion	*2020*	*4,484*	*$47,753,000*	*$3.97*	*$1.68*	*H.13*
	14 MGD WTP Expansion	*2050*	*7,847*	*$77,267,000*	*$3.65*	*$1.52*	*H.13*
	18 MGD WTP Expansion	*2060*	*9,617*	*$95,609,000*	*$3.51*	*$1.47*	*H.13*
	Expand Lake Benbrook PS	*2020*	*448*	*$2,299,000*	*$2.09*	*$0.99*	*H.149*
WUGs							
Aledo	Conservation	2020	46	$27,245	$0.84	$0.11	H.11
	TRWD through Fort Worth	2030	822	$0	$1.63	$1.63	None
	Parallel pipeline and pump station from Fort Worth	*2060*	*299*	*$9,382,000*	*$7.72*	*$0.94*	*H.144*

WWP or WUG	Strategy	Online by:	Quantity (Ac-Ft/Yr)[b]	Capital Costs[c]	Unit Cost ($/1000 gal) With Debt Service	Unit Cost ($/1000 gal) After Debt Service	Table
Annetta	Conservation	2020	16	$11,234	$0.81	$0.00	H.11
	Weatherford	2030	195	$0	$7.45	$7.45	None
	Connect to Weatherford	*2030*	*195*	*$3,985,000*	*$5.30*	*$0.90*	*H.143*
Azle[a]	Conservation	See Tarrant County.					
	TRWD						
	WTP expansion						
Fort Worth[a]	Conservation	See Fort Worth in **Chapter 5D**.					
	Other WMSs						
Horseshoe Bend Water System	Conservation	2020	9	$12,104	$1.31	$0.00	H.11
Hudson Oaks	Conservation	2020	145	$170,437	$1.11	$0.44	H.11
	Weatherford	2030	307	$0	$7.45	$7.45	None
	Fort Worth	2020	465	$0	$1.63	$1.63	None
	Direct Connection to Fort Worth	*2020*	*465*	*$5,500,000*	*$2.97*	*$0.42*	*H.145*
Mineral Wells[a]	Conservation	2020	6	$7,493	$1.45	$0.00	H.11
	Lake Palo Pinto through Palo Pinto County WCID #1	2020	245	See Region G Plan.			
North Rural WSC	Conservation	2020	2	$0	$0.00	$0.00	H.11
Parker County SUD[a]	Conservation	2020	61	$48,090	$1.73	$0.11	H.11
	BRA with Treatment Plant Expansion	2030	1,761	$32,308,000	$7.53	$3.98	H.13
Reno	Conservation	2020	4	$8,218	$0.89	$0.00	H.11
	Walnut Creek SUD	2020	35	$0	$6.11	$6.11	None
Santo SUD	Conservation	2020	0	$0	$0.00	$0.00	H.11
	Lake Palo Pinto through Mineral Wells	2070	15	$0	$5.54	$5.54	None
Springtown	Conservation	2020	308	$35,894	$1.64	$0.65	H.11
	TRWD	2020	555	$0	$1.26	$1.26	None
	Infrastructure improvements - Surface Water Treatment	*2020*	*555*	*$4,163,000*	*$2.44*	*$0.82*	*H.146*

WWP or WUG	Strategy	Online by:	Quantity (Ac-Ft/Yr)[b]	Capital Costs[c]	Unit Cost ($/1000 gal) With Debt Service	Unit Cost ($/1000 gal) After Debt Service	Table
	Plant & Supply Project						
Willow Park	Conservation	2020	60	$63,875	$1.25	$0.12	H.11
	Fort Worth	2020	1,911	$0	$1.63	$1.63	None
	Connect to Fort Worth (TRWD)	*2020*	*1,911*	*$4,017,000*	*$0.54*	*$0.08*	*H.150*
County Other and Non-Municipal							
County Other, Parker	Conservation	2020	355	$838,090	$3.29	$0.00	H.11
	Weatherford	2050	4,000	$0	$7.45	$7.45	None
	New Well(s) in Trinity Aquifer	2020	235	$2,157,000	$3.39	$1.40	H.14
	TRWD	2060	7,484	$0	$1.26	$1.26	None
	WTP and Transmission Facilities	*2020*	*7,484*	*$119,202,000*	*$5.75*	*$2.00*	*H.151*
Irrigation, Parker	None	None.					
Livestock, Parker	None	None.					
Manufacturing, Parker	Weatherford	2030	8	$0	$7.45	$7.45	None
	Walnut Creek SUD	2020	12	$0	$6.11	$6.11	None
Mining, Parker	New Well(s) in Trinity Aquifer	2030	624	$2,454,000	$1.04	$0.19	H.14
Steam Electric Power, Parker	None	None.					

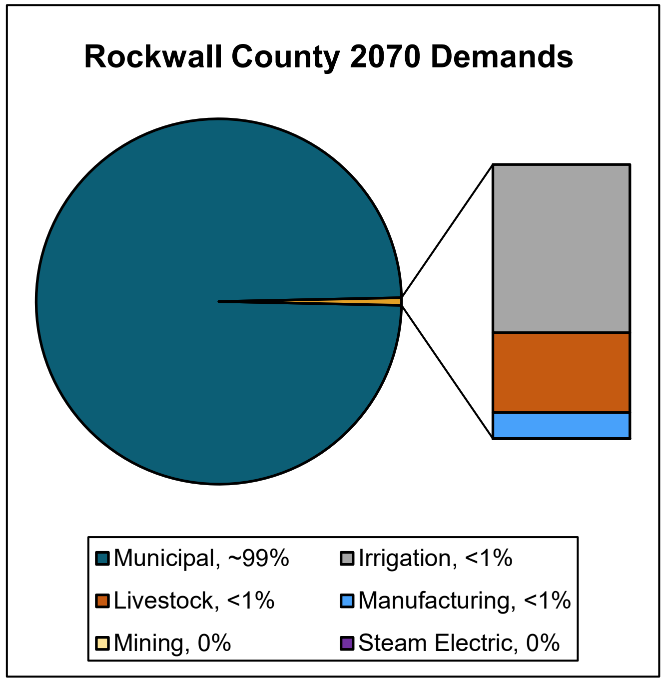
[a]Water User Groups extend into more than one county

[b]Quantities listed are for the WUG only. They do not include the WUG's customers.

[c]Purchases from wholesale water providers that require no new infrastructure have no capital costs. The unit costs shown in the table represent the cost to purchase water from the WWP.

5E.14 Rockwall County

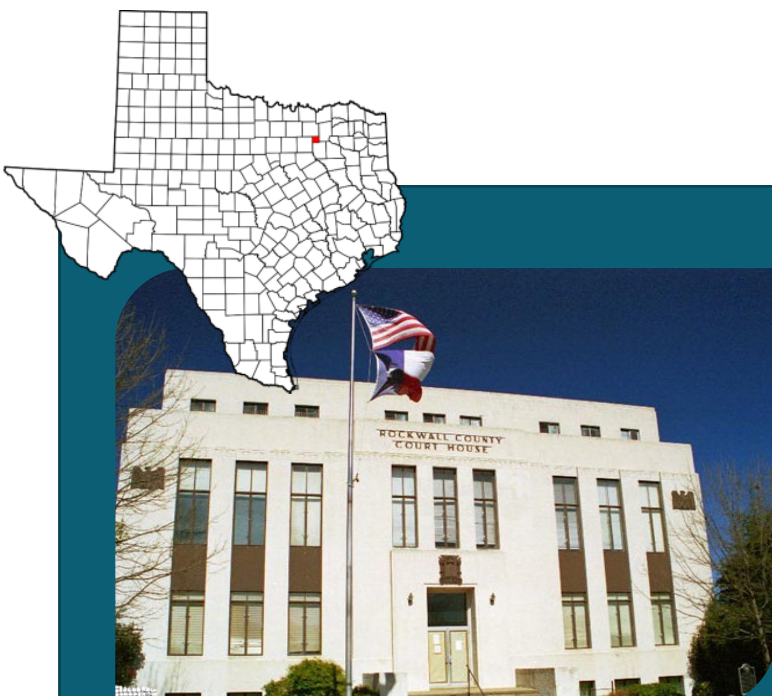
Rockwall is a small county located east of Dallas and south of Collin County. **Figure 5E.28** shows the service area for the water user groups in Rockwall County.



The population of Rockwall County is expected to almost triple between 2020 and 2070.

Demands for the county are predominately municipal. There is no mining or steam electric power demand on the county, and all other non-municipal demand accounts for less than 1% of the total county demand.

North Texas Municipal Water District (NTMWD) is a major water provider that provides most of the water to Rockwall County. An overall summary of the county's projections are shown in **Table 5E.332**, and water management strategies for individual WWPs and WUGs are discussed on the following pages.



Rockwall County Quick Facts

2010 Population: 78,337

Projected 2070 Population: 325,052

Projected 2070 Demand: 51 MGD

County Seat: Rockwall

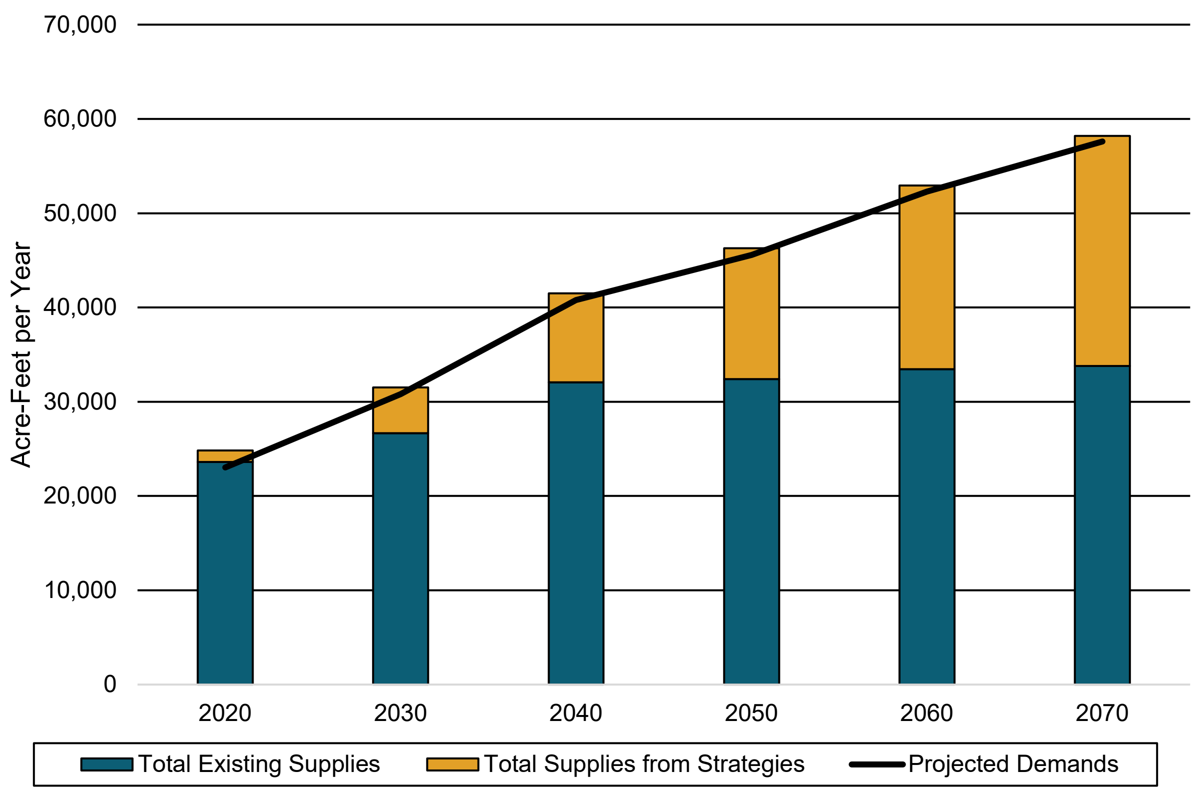
Economy: Industry

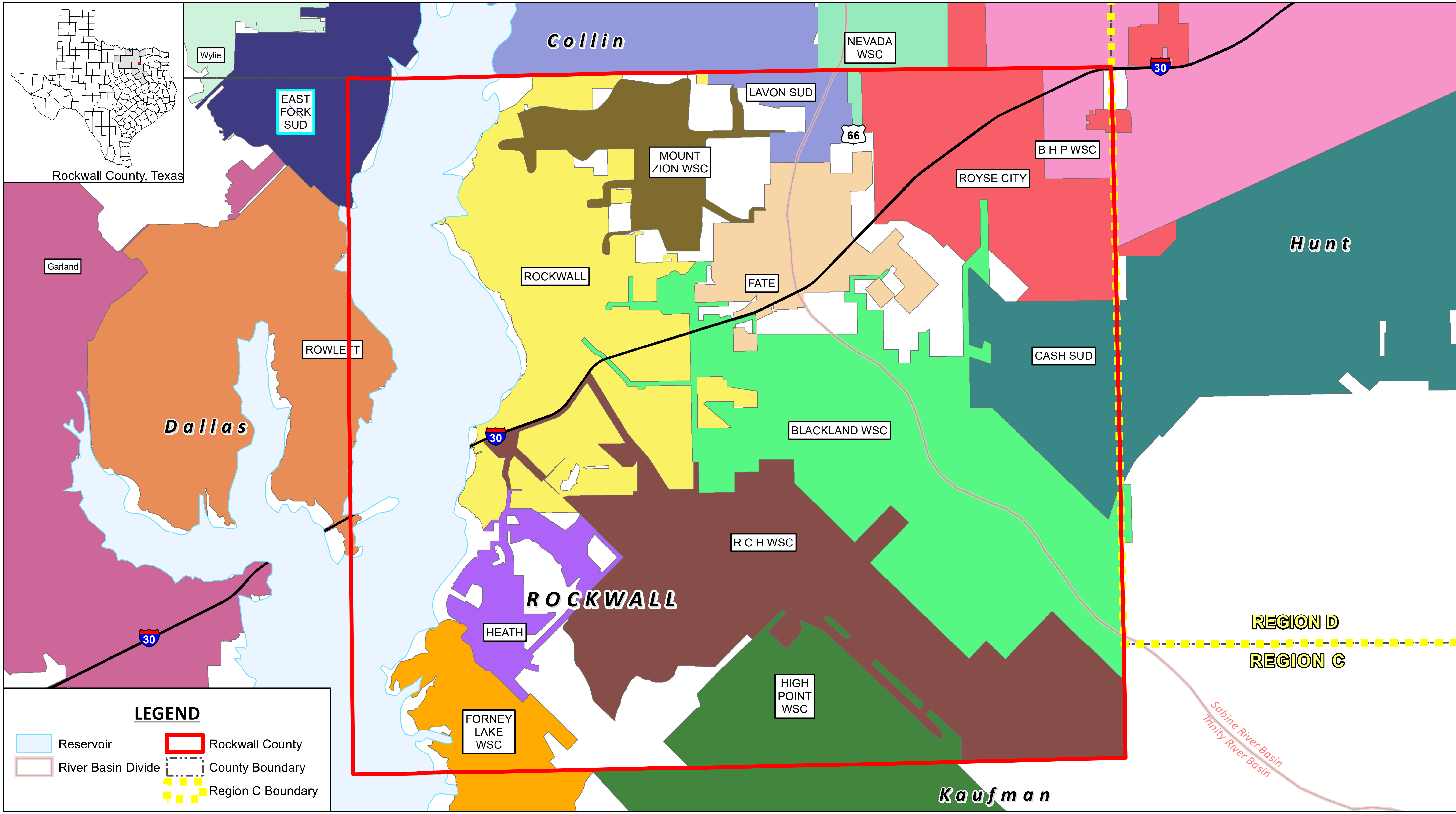
River Basins: Trinity (76%), Sabine (24%)

Table 5E.332 Summary of Rockwall County

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**119,410**	**160,315**	**213,619**	**246,938**	**291,850**	**325,052**
Projected Demands	**23,030**	**30,792**	**40,797**	**45,577**	**52,291**	**57,606**
Municipal	22,654	30,411	40,416	45,196	51,910	57,225
Irrigation	234	234	234	234	234	234
Livestock	111	111	111	111	111	111
Manufacturing	31	36	36	36	36	36
Mining	0	0	0	0	0	0
Steam Electric	0	0	0	0	0	0
Total Existing Supplies	**23,628**	**26,655**	**32,056**	**32,386**	**33,454**	**33,788**
Need (Demand - Supply)	**0**	**4,137**	**8,741**	**13,191**	**18,837**	**23,818**
Total Supplies from Strategies	**1,219**	**4,875**	**9,460**	**13,890**	**19,487**	**24,428**
Reserve (Shortage)	**1,817**	**738**	**719**	**699**	**650**	**610**

Figure 5E.27 Rockwall County Summary





REGION C
Water Planning for North Texas

2021 Region C Water Plan

ROCKWALL COUNTY, TEXAS

FIGURE 5E.28

1 in = 1 mile
0 1 2 3
Miles

N W E S

Data Source(s): ESRI, USGS, TNRIS

TR116409: H:\WR_PLANNING\1 - Working\5E_County WMS\Rockwall1.mxd

5E.14.1 Wholesale Water Providers and Water User Groups

Water management strategies for Rockwall County wholesale water providers (WWPs) and water user groups (WUGs) are discussed below (in alphabetical order). The costs and a summary for Rockwall County are presented in **Section 5E.14.2.**

B H P Water Supply Corporation

B H P WSC is located in Hunt County in Region D and Collin and Rockwall Counties in Region C. Water management strategies for B H P WSC are discussed under Collin County in **Section 5E.1**.

Bear Creek Water Supply Corporation

Bear Creek WSC is located in Collin and Rockwall Counties. Water management strategies for Bear Creek WSC are discussed under Collin County in **Section 5E.1**.

Blackland Water Supply Corporation

Blackland WSC is located in eastern Rockwall County, with a small area in Hunt County. The WSC gets its water supply from the North Texas Municipal Water District (NTMWD) through Rockwall. Water management strategies for Blackland WSC include conservation and additional supplies through NTMWD (either by establishing a direct connection or through Rockwall). **Table 5E.333** shows the projected population and demand, the current supplies, and the water management strategies for Blackland WSC.

Table 5E.333 Summary of Water User Group – Blackland WSC (Regions C & D)

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**4,280**	**4,847**	**5,206**	**5,355**	**6,029**	**6,491**
Projected Demands						
Municipal Demand	865	961	1,017	1,038	1,167	1,256
Total Projected Demand	***865***	***961***	***1,017***	***1,038***	***1,167***	***1,256***
Currently Available Supplies						
NTMWD through Rockwall	860	811	794	734	744	734
Total Currently Available Supplies	***860***	***811***	***794***	***734***	***744***	***734***
Need (Demand – Supply)	***5***	***150***	***223***	***304***	***423***	***522***
Water Management Strategies						
Water Conservation	43	59	60	66	77	87
NTMWD (either direct or through Rockwall)	0	91	163	238	346	435
Total Supplies from Strategies	***43***	***150***	***223***	***304***	***423***	***522***
Reserve (Shortage)	**38**	**0**	**0**	**0**	**0**	**0**

Cash Special Utility District

Cash SUD provides water supply in eastern Rockwall County in Region C and in Hopkins, Hunt and Rains Counties in the North East Texas Region (Region D). Most of the SUD's customers are in the North East Texas Region. Cash SUD's current water supplies are from North Texas Municipal Water District (NTMWD) in Region C and from Sabine River Authority (SRA) in the North East Texas Region.

Cash SUD has a contract with NTMWD for 2.2 MGD (2,466 acre-feet per year). Additional supply comes from the SRA in the North East Texas Region (either as currently available supply or as part of a future strategy; see the North East Texas Regional Plan for details on supply and strategies from SRA). Cash SUD operates its own water treatment plant in the North East Texas Region to treat the supply from SRA. The water management strategies for Cash SUD include conservation and additional supplies from NTMWD, including additional delivery infrastructure. **Table 5E.334** shows the projected total population and demand for the WSC, the current supplies, and the water management strategies for the Region C portion of Cash SUD.

Table 5E.334 Summary of Water User Group – Cash SUD (Region C & D)

(Values in Ac-Ft/Yr)	*2020*	*2030*	*2040*	*2050*	*2060*	*2070*
Projected Population	**20,491**	**24,592**	**29,451**	**35,192**	**42,044**	**50,195**
Projected Demands						
Municipal Demand	2,353	2,736	3,215	3,808	4,537	5,411
Total Projected Demand	***2,353***	***2,736***	***3,215***	***3,808***	***4,537***	***5,411***
Currently Available Supplies						
NTMWD	1,120	1,120	1,120	1,120	1,120	1,120
SRA (current and future)	896	943	1,086	1,342	2,071	2,945
Total Currently Available Supplies	***2,016***	***2,063***	***2,206***	***2,462***	***3,191***	***4,065***
Need (Demand – Supply)	***337***	***673***	***1,009***	***1,346***	***1,346***	***1,346***
Water Management Strategies in Region C						
Water Conservation	5	7	9	11	14	18
NTMWD	332	666	1,000	1,335	1,332	1,328
Additional delivery infrastructure from NTWMD	*332*	*666*	*1,000*	*1,335*	*1,332*	*1,328*
Total Supplies from Strategies	***337***	***673***	***1,009***	***1,346***	***1,346***	***1,346***
Reserve (Shortage)	**0**	**0**	**0**	**0**	**0**	**0**

East Fork Special Utility District

East Fork SUD is located in southern Collin County and extends into Dallas and Rockwall Counties. The water management strategies for East Fork SUD are described under Collin County in **Section 5E.1**.

Fate

Fate is located in northern Rockwall County. The city gets its water supply from the North Texas Municipal Water District (NTMWD), and water management strategies include conservation and additional water from NTMWD with additional delivery infrastructure. **Table 5E.335** shows the projected population and demand, the current supplies, and the water management strategies for Fate.

Table 5E.335 Summary of Water User Group – City of Fate

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**15,994**	**20,789**	**28,000**	**37,000**	**45,000**	**50,000**
Projected Demands						
Municipal Demand	2,818	3,626	4,869	6,422	7,803	8,663
Total Projected Demand	***2,818***	***3,626***	***4,869***	***6,422***	***7,803***	***8,663***
Currently Available Supplies						
NTMWD	2,803	3,063	3,803	4,540	4,973	5,066
Total Currently Available Supplies	***2,803***	***3,063***	***3,803***	***4,540***	***4,973***	***5,066***
Need (Demand – Supply)	***15***	***563***	***1,066***	***1,882***	***2,830***	***3,597***
Water Management Strategies						
Water Conservation	139	209	273	382	490	573
NTMWD	0	354	793	1,500	2,340	3,024
Additional Delivery Infrastructure from NTMWD	*0*	*0*	*0*	*974*	*2,247*	*3,024*
Total Supplies from Strategies	***139***	***563***	***1,066***	***1,882***	***2,830***	***3,597***
Reserve (Shortage)	**124**	**0**	**0**	**0**	**0**	**0**

Forney Lake Water Supply Corporation

Forney Lake WSC supplies water to northwestern Kaufman County and southwestern Rockwall County. Water management strategies for Forney Lake WSC are discussed under Kaufman County in **Section 5E.11**.

Garland

Garland is located in northeastern Dallas, Collin, and Rockwall Counties. Garland is a wholesale water provider and is discussed under Dallas County in **Section 5E.3**.

Heath

Heath is located in southwestern Rockwall County. The city gets its water supply from North Texas Municipal Water District (NTMWD) through the City of Rockwall. The water management strategies for Heath are conservation and additional water from NTMWD through Rockwall. **Table 5E.336** shows the projected population and demand, the current supplies, and the water management strategies for Heath.

Table 5E.336 Summary of Water User Group – City of Heath

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**12,109**	**17,246**	**21,713**	**22,000**	**23,000**	**24,000**
Projected Demands						
Municipal Demand	3,946	5,563	6,992	7,078	7,397	7,718
Total Projected Demand	***3,946***	***5,563***	***6,992***	***7,078***	***7,397***	***7,718***
Currently Available Supplies						
NTMWD through Rockwall	3,925	4,699	5,461	5,004	4,714	4,513
Total Currently Available Supplies	***3,925***	***4,699***	***5,461***	***5,004***	***4,714***	***4,513***
Need (Demand – Supply)	***21***	***864***	***1,531***	***2,074***	***2,683***	***3,205***
Water Management Strategies						
Water Conservation	213	372	457	486	532	581
NTMWD through Rockwall	0	492	1,074	1,588	2,151	2,624
Total Supplies from Strategies	***213***	***864***	***1,531***	***2,074***	***2,683***	***3,205***
Reserve (Shortage)	**192**	**0**	**0**	**0**	**0**	**0**

High Point Water Supply Corporation

High Point WSC supplies water to northwestern Kaufman County and southern Rockwall County. Water management strategies for High Point WSC are discussed under Kaufman County in **Section 5E.11**.

Mount Zion Water Supply Corporation

Mount Zion WSC serves northern Rockwall County. The WSC gets its water supply from North Texas Municipal Water District (NTMWD). Water management strategies for Mount Zion WSC include conservation and additional water from NTMWD. **Table 5E.337** shows the projected population and demand, the current supplies, and the water management strategies for Mount Zion WSC.

Table 5E.337 Summary of Water User Group – Mount Zion WSC

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**2,521**	**3,171**	**3,869**	**4,660**	**5,590**	**6,542**
Projected Demands						
Municipal Demand	501	615	740	886	1,061	1,241
Total Projected Demand	***501***	***615***	***740***	***886***	***1,061***	***1,241***
Currently Available Supplies						
NTMWD	498	519	578	626	676	726
Total Currently Available Supplies	***498***	***519***	***578***	***626***	***676***	***726***
Need (Demand – Supply)	***3***	***96***	***162***	***260***	***385***	***515***
Water Management Strategies						
Water Conservation	22	29	34	44	56	69
NTMWD	0	67	128	216	329	446
Total Supplies from Strategies	***22***	***96***	***162***	***260***	***385***	***515***
Reserve (Shortage)	**19**	**0**	**0**	**0**	**0**	**0**

Nevada Special Utility District

Nevada SUD supplies water to Collin and Rockwall Counties. The SUD's water supply is discussed under Collin County in **Section 5E.1**.

R C H Water Supply Corporation

R C H WSC supplies water to Rockwall County. The WSC gets its water supply from North Texas Municipal Water District (NTMWD) through Rockwall. The water management strategies include conservation and additional supplies from NTMWD. **Table 5E.338** shows the projected population and demand, the current supplies, and the water management strategies for R C H WSC.

Table 5E.338 Summary of Water User Group – R C H WSC

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**4,266**	**5,946**	**6,969**	**8,487**	**10,994**	**13,407**
Projected Demands						
Municipal Demand	900	1,234	1,432	1,736	2,246	2,737
Total Projected Demand	***900***	***1,234***	***1,432***	***1,736***	***2,246***	***2,737***
Currently Available Supplies						
NTMWD through Rockwall	895	1,043	1,118	1,227	1,432	1,601
Total Currently Available Supplies	***895***	***1,043***	***1,118***	***1,227***	***1,432***	***1,601***
Need (Demand – Supply)	***5***	***191***	***314***	***509***	***814***	***1,136***
Water Management Strategies						
Water Conservation	47	77	88	112	154	202
NTMWD	0	114	226	397	660	934
Total Supplies from Strategies	***47***	***191***	***314***	***509***	***814***	***1,136***
Reserve (Shortage)	**42**	**0**	**0**	**0**	**0**	**0**

Rockwall County Irrigation

Irrigation demand projections include the water necessary for irrigation activities, including field crops, orchards, pasture, turf grass, vineyards, golf courses irrigated by raw water, and limited aquaculture operations. In Rockwall County, the irrigation demand is for golf courses. The current supplies are reuse from North Texas Municipal Water District (NTMWD) and water from Dallas Water Utilities (DWU). The recommended water management strategy is additional water from DWU to meet the existing demand of the golf course. **Table 5E.339** shows the projected demand, the current supplies, and the water management strategies for Rockwall County Irrigation.

Table 5E.339 Summary of Water User Group – Rockwall County Irrigation

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Demands						
Total Projected Demand	**234**	**234**	**234**	**234**	**234**	**234**
Currently Available Supplies						
Direct Reuse from NTMWD	672	672	672	672	672	672
DWU	333	317	287	265	252	242
Total Currently Available Supplies	***1,005***	***989***	***959***	***937***	***924***	***914***
Need (Demand – Supply)	***0***	***0***	***0***	***0***	***0***	***0***
Water Management Strategies						
DWU	14	30	60	82	95	105
Total Supplies from Strategies	***14***	***30***	***60***	***82***	***95***	***105***
Reserve (Shortage)	**785**	**785**	**785**	**785**	**785**	**785**

Rockwall County Livestock

Livestock water use is defined as water used in the production of livestock, both for consumption and for cleaning and environmental purposes. The current supply is local surface water supplies. This source is sufficient to meet projected demands, and there is no recommended water management strategy for this water user group. **Table 5E.340** shows the projected demand, current supplies, and water management strategies for Rockwall County Livestock.

Table 5E.340 Summary of Water User Group – Rockwall County Livestock

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Demands						
Total Projected Demand	**111**	**111**	**111**	**111**	**111**	**111**
Currently Available Supplies						
Local Supplies	117	117	117	117	117	117
Total Currently Available Supplies	***117***	***117***	***117***	***117***	***117***	***117***
Need (Demand – Supply)	***0***	***0***	***0***	***0***	***0***	***0***
Water Management Strategies						
None	0	0	0	0	0	0
Total Supplies from Strategies	***0***	***0***	***0***	***0***	***0***	***0***
Reserve (Shortage)	**6**	**6**	**6**	**6**	**6**	**6**

Rockwall County Manufacturing

Manufacturing water use is defined as water used to produce manufactured goods. Current supplies are from Rockwall, which is supplied by North Texas Municipal Water District (NTMWD). The only water management strategy for this water user group is water from NTMWD. **Table 5E.341** shows the projected demand and current supplies for Rockwall County Manufacturing. Conservation was considered for this water user group, but not recommended because of the uncertainty in the ability to implement conservation measures given the multiple entities, facilities, and various manufacturing processes that make up this WUG.

Table 5E.341 Summary of Water User Group – Rockwall County Manufacturing

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Demands						
Total Projected Demand	**31**	**36**	**36**	**36**	**36**	**36**
Currently Available Supplies						
NTMWD through Rockwall	31	31	28	25	23	21
Total Currently Available Supplies	***31***	***31***	***28***	***25***	***23***	***21***
Need (Demand – Supply)	***0***	***5***	***8***	***11***	***13***	***15***
Water Management Strategies						
NTMWD through Rockwall	0	5	8	11	13	15
Total Supplies from Strategies	***0***	***5***	***8***	***11***	***13***	***15***
Reserve (Shortage)	**0**	**0**	**0**	**0**	**0**	**0**

Rockwall County Mining

Mining water demand includes water used for oil and gas development, as well as extraction of coal and lignite, sand aggregate, and other resources. There is no mining demand in Rockwall County.

Rockwall County Other

Rockwall County Other includes individual domestic supplies and water suppliers too small to be classified as water user groups. Rockwall County Other gets its water supply from North Texas Municipal Water District (NTMWD) through Rockwall. Water management strategies for Rockwall County Other include conservation and additional water from NTMWD. **Table 5E.342** shows the projected population and demand, the current supplies, and the water management strategies for Rockwall County Other.

Table 5E.342 Summary of Water User Group – Rockwall County Other

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**2,491**	**3,516**	**3,602**	**3,367**	**3,768**	**5,843**
Projected Demands						
Municipal Demand	401	562	573	534	592	917
Total Projected Demand	***401***	***562***	***573***	***534***	***592***	***917***
Currently Available Supplies						
NTMWD through Rockwall	399	474	447	377	377	536
Total Currently Available Supplies	***399***	***474***	***447***	***377***	***377***	***536***
Need (Demand – Supply)	***2***	***88***	***126***	***157***	***215***	***381***
Water Management Strategies						
Water Conservation	14	24	23	23	28	46
NTMWD	0	64	103	134	187	335
Total Supplies from Strategies	***14***	***88***	***126***	***157***	***215***	***381***
Reserve (Shortage)	**12**	**0**	**0**	**0**	**0**	**0**

Rockwall County Steam Electric Power

Steam electric power demands do not include water that is used in cogeneration facilities (which is included in manufacturing projections), facilities which do not require water for production, or hydro-electric generation facilities. There is no demand from steam electric power in Rockwall County.

Rockwall

Rockwall is located in central Rockwall County. Rockwall's current water supply is water purchased from North Texas Municipal Water District (NTMWD). Rockwall is a wholesale water provider (WWP) that sells water to Heath, Blackland WSC, R C H WSC, Rockwall County Other, and Rockwall County Manufacturing. **Table 5E.343** shows the projected demand, the current supplies, and the water management strategies for the City of Rockwall.

Table 5E.343 Summary of Wholesale Water Provider and Customers – Rockwall

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Demands						
Rockwall	9,902	14,346	21,079	22,002	23,798	25,611
Heath	*3,946*	*5,563*	*6,992*	*7,078*	*7,397*	*7,718*
Blackland WSC	*865*	*961*	*1,017*	*1,038*	*1,167*	*1,256*
R C H WSC	*900*	*1,234*	*1,432*	*1,736*	*2,246*	*2,737*
County Other, Rockwall	*401*	*562*	*573*	*534*	*592*	*917*
Manufacturing, Rockwall	*31*	*36*	*36*	*36*	*36*	*36*
Total Projected Demand	***16,045***	***22,702***	***31,129***	***32,424***	***35,236***	***38,275***
Currently Available Supplies						
NTMWD	15,956	19,055	23,758	22,338	21,851	21,766
Total Currently Available Supplies	***15,956***	***19,055***	***23,758***	***22,338***	***21,851***	***21,766***
Need (Demand – Supply)	***89***	***3,647***	***7,371***	***10,086***	***13,385***	***16,509***
Water Management Strategies						
Conservation (retail)	620	927	1,271	1,440	1,666	1,911
Conservation (wholesale)	317	532	628	687	791	916
NTMWD	0	2,188	5,472	7,959	10,928	13,682
Additional delivery infrastructure from NTWMD	*0*	*2,188*	*5,472*	*7,959*	*10,928*	*13,682*
Total Supplies from Strategies	***937***	***3,647***	***7,371***	***10,086***	***13,385***	***16,509***
Reserve (Shortage)	**848**	**0**	**0**	**0**	**0**	**0**

Rowlett

Rowlett is located in northeastern Dallas County and Rockwall County. Water management strategies for Rowlett are discussed under Dallas County in **Section 5E.3**.

Royse City

Royse City is located in northeast Rockwall County and southeast Collin County. The city is expected to grow considerably over the planning period, with the 2070 population projected to be nearly 100,000 people. The city gets its water supply from North Texas Municipal Water District (NTMWD). The water management strategies for Royse City include conservation and additional water from NTMWD. **Table 5E.344** shows the projected population and demand, the current supplies, and the water management strategies for Royse City.

Table 5E.344 Summary of Water User Group – Royse City

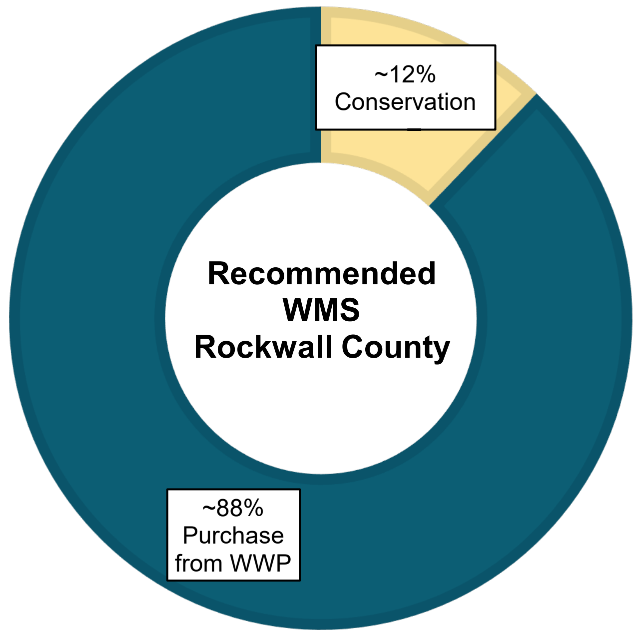
(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**11,651**	**20,772**	**29,766**	**54,816**	**81,859**	**99,349**
Projected Demands						
Municipal Demand	1,350	2,345	3,316	6,068	9,045	10,976
Total Projected Demand	***1,350***	***2,345***	***3,316***	***6,068***	***9,045***	***10,976***
Currently Available Supplies						
NTMWD	1,342	1,981	2,590	4,290	5,764	6,419
Total Currently Available Supplies	***1,342***	***1,981***	***2,590***	***4,290***	***5,764***	***6,419***
Need (Demand – Supply)	***8***	***364***	***726***	***1,778***	***3,281***	***4,557***
Water Management Strategies						
Water Conservation	13	32	41	95	171	244
NTMWD	0	332	685	1,683	3,110	4,313
Total Supplies from Strategies	***13***	***364***	***726***	***1,778***	***3,281***	***4,557***
Reserve (Shortage)	**5**	**0**	**0**	**0**	**0**	**0**

Wylie

Wylie is located in southern Collin County with small areas in Dallas and Rockwall Counties. Wylie's water supply plans are discussed under Collin County in **Section 5E.1**.

5E.14.2 Summary of Costs for Rockwall County

Table 5E.345 summarizes the costs of the water management strategies recommended for the WUGs and WWPs who have the majority of their demand located in Rockwall County. Total quantities from **Table 5E.345** will not necessarily match total county demands. This is due mainly to water users whose sum of strategies results in a reserve as well as due to water users located in multiple counties (or wholesale water providers who develop strategies and then sell water to users in other counties). Quantities from infrastructure projects needed to deliver and/or treat water (shown in *gray italics*) are not included since the supplies are associated with other strategies. To avoid double-counting quantities of supplies, the quantities in gray italics are **not** included in the total.



The majority of the future supplies needed to meet demands for WUGs located within Rockwall County are projected to come through purchases from wholesale water providers. Other strategies include conservation.

Table 5E.346 summarizes the recommended water management strategies within Rockwall County for individual WUGs and WWPs. Alternative strategies are also included. More detailed cost estimates are located in **Appendix H.**

Table 5E.345 Summary of Recommended Water Management Strategies for Rockwall County

Type of Strategy	Quantity (Ac-Ft/Yr)	Capital Costs
Conservation[a]	3,731	$3,248,142
Purchase from WWP	27,248	$0
Additional Infrastructure	*18,476*	*$45,443,000*
Total	**30,979**	**$48,691,142**

[a]The conservation quantities represent the sum of the individual water user groups who have the majority of their service areas located in the county, not the total conservation in the county.

Table 5E.346 Costs for Recommended Water Management Strategies for Rockwall County

WWP or WUG	Strategy	Online by:	Quantity (Ac-Ft/Yr)[b]	Capital Costs[c]	Unit Cost ($/1000 gal) With Debt Service	Unit Cost ($/1000 gal) After Debt Service	Table
WWPs							
Rockwall	Conservation (retail)	2020	1,911	$1,600,987	$0.68	$0.10	H.11
	Conservation (wholesale)	2020	Included with WUGs.				
	NTMWD	2030	13,682	$0	$2.78	$2.78	None
	Increase Delivery Infrastructure to Purchase Additional Water from NTMWD	*2030*	*13,682*	*$28,750,000*	*$0.55*	*$0.10*	*H.155*
WUGs							
Bear Creek SUD	Conservation	See Collin County.					
	NTMWD						
B H P WSC	Conservation	See Collin County.					
	NTMWD						
Blackland WSC[a]	Conservation	2020	87	$292,347	$2.48	$0.73	H.11
	NTMWD	2030	435	$0	$2.78	$2.78	None
	Direct Connection to NTMWD	*2030*	*435*	*$6,804,000*	*$3.88*	*$0.50*	*H.152*
Cash SUD[a]	Conservation	2020	18	$2,304	$0.10	$0.00	H.11
	SRA	See Region D plan for costs.					
	NTMWD	2020	1,335	$0	$2.78	$2.78	None
	Additional Delivery Infrastructure from NTWMD	*2020*	*1,335*	*$7,888,000*	*$1.88*	*$0.18*	*H.153*
	WTP Expansion	See Region D plan for costs.					
Dallas[a]	Conservation	See DWU in **Chapter 5D**.					
	Other WMS						
East Fork SUD[a]	Conservation	See Collin County.					
	NTMWD						
Fate	Conservation	2020	573	$404,091	$1.19	$0.36	H.11
	NTMWD	2030	3,024	$0	$2.78	$2.78	None
	Additional Delivery	*2050*	*3,024*	*$2,001,000*	*$0.20*	*$0.06*	*H.154*

WWP or WUG	Strategy	Online by:	Quantity (Ac-Ft/Yr)[b]	Capital Costs[c]	Unit Cost ($/1000 gal) With Debt Service	Unit Cost ($/1000 gal) After Debt Service	Table
	Infrastructure from NTMWD						
Forney Lake WSC[a]	Conservation	See Kaufman County.					
	NTMWD						
Garland[a]	Conservation	See Dallas County.					
	NTMWD						
Heath	Conservation	2020	581	$662,052	$1.31	$0.43	H.11
	NTMWD	2030	2,624	$0	$2.78	$2.78	None
Mount Zion WSC	Conservation	2020	69	$61,736	$1.32	$0.45	H.11
	NTMWD	2030	446	$0	$2.78	$2.78	None
Nevada SUD	Conservation	See Collin County.					
	NTMWD						
R C H WSC	Conservation	2020	202	$75,116	$1.44	$0.75	H.11
	NTMWD	2030	934	$0	$2.78	$2.78	None
Rowlett[a]	Conservation	See Dallas County.					
	NTMWD						
Royse City[a]	Conservation	2020	244	$139,057	$2.31	$0.00	H.11
	NTMWD	2030	4,313	$0	$2.78	$2.78	None
Wylie[a]	Conservation	See Collin County.					
	NTMWD						
County Other and Non-Municipal							
County Other, Rockwall	Conservation	2020	46	$10,452	$0.53	$0.17	H.11
	NTMWD	2030	335	$0	$2.78	$2.78	None
Irrigation, Rockwall	DWU	2020	105	$0	$4.05	$4.05	None
Livestock, Rockwall	None	None.					
Manufactur-ing, Rockwall	NTMWD	2030	15	$0	$2.78	$2.78	None
Mining, Rockwall	None	None.					
Steam Electric Power, Rockwall	None	None.					

[a]Water User Groups extend into more than one county

[b]Quantities listed are for the WUG only. They do not include the WUG's customers.
[c]Purchases from wholesale water providers that require no new infrastructure have no capital costs. The unit costs shown in the table represent the cost to purchase water from the WWP.

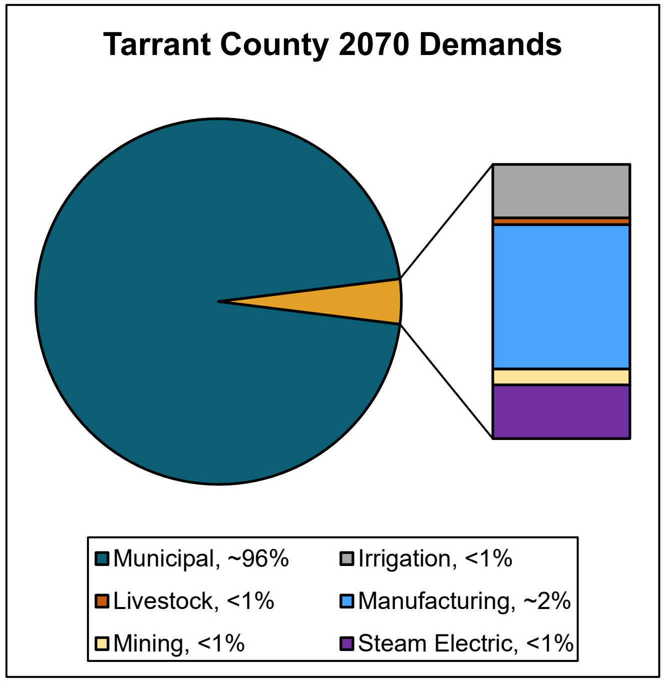
5E.15 Tarrant County

Tarrant County is located in the central portion of Region C and is home to Fort Worth. **Figure 5E.30** shows the service areas for water user groups in Tarrant County.

Tarrant County's population is projected to increase by over a million between 2020 and 2070.

Demands for the county are predominately municipal. Much of the water for Tarrant County is supplied by the Tarrant Regional Water District. Additional water from TRWD will also be a major part of Tarrant County water management strategies.

An overall summary of the county's projections is shown in **Table 5E.347**, and water management strategies for individual WWPs and WUGs are discussed on the following pages.



Tarrant County Quick Facts

2010 Population: 1,809,034

Projected 2070 Population: 3,167,377

Projected 2070 Demand: 569 MGD

County Seat: Fort Worth

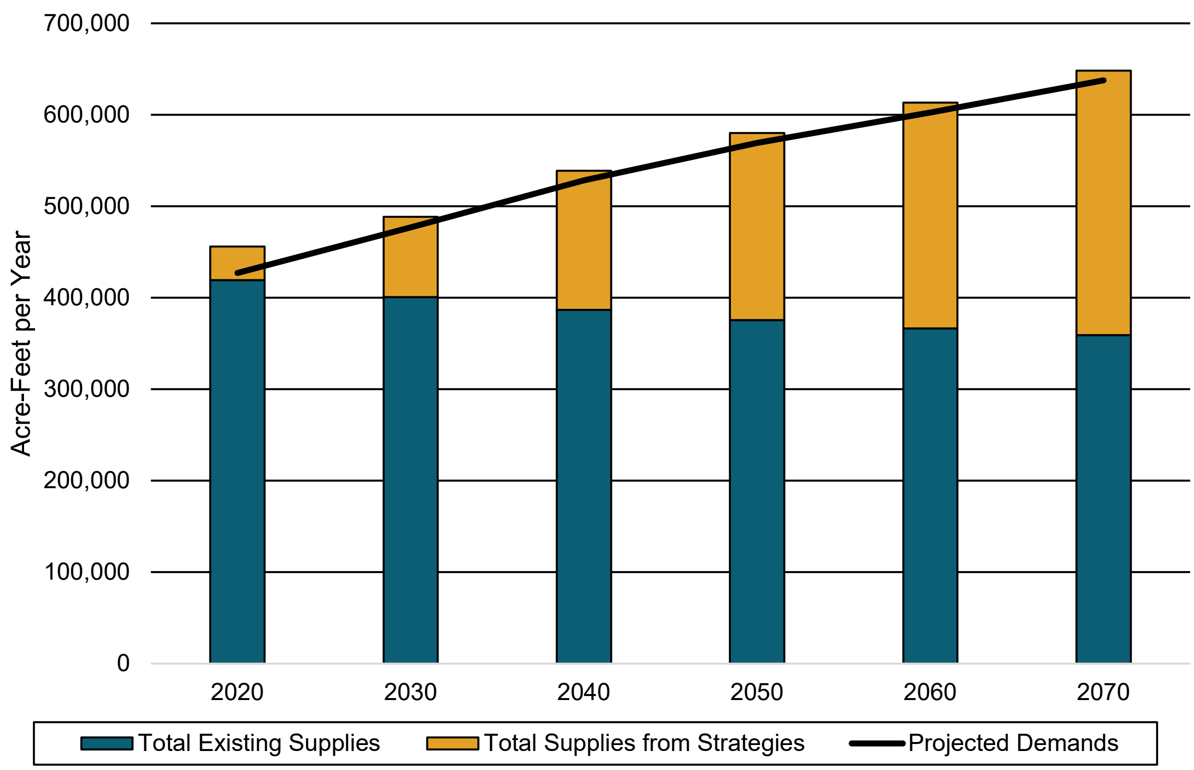
Economy: Tourism; manufacturing

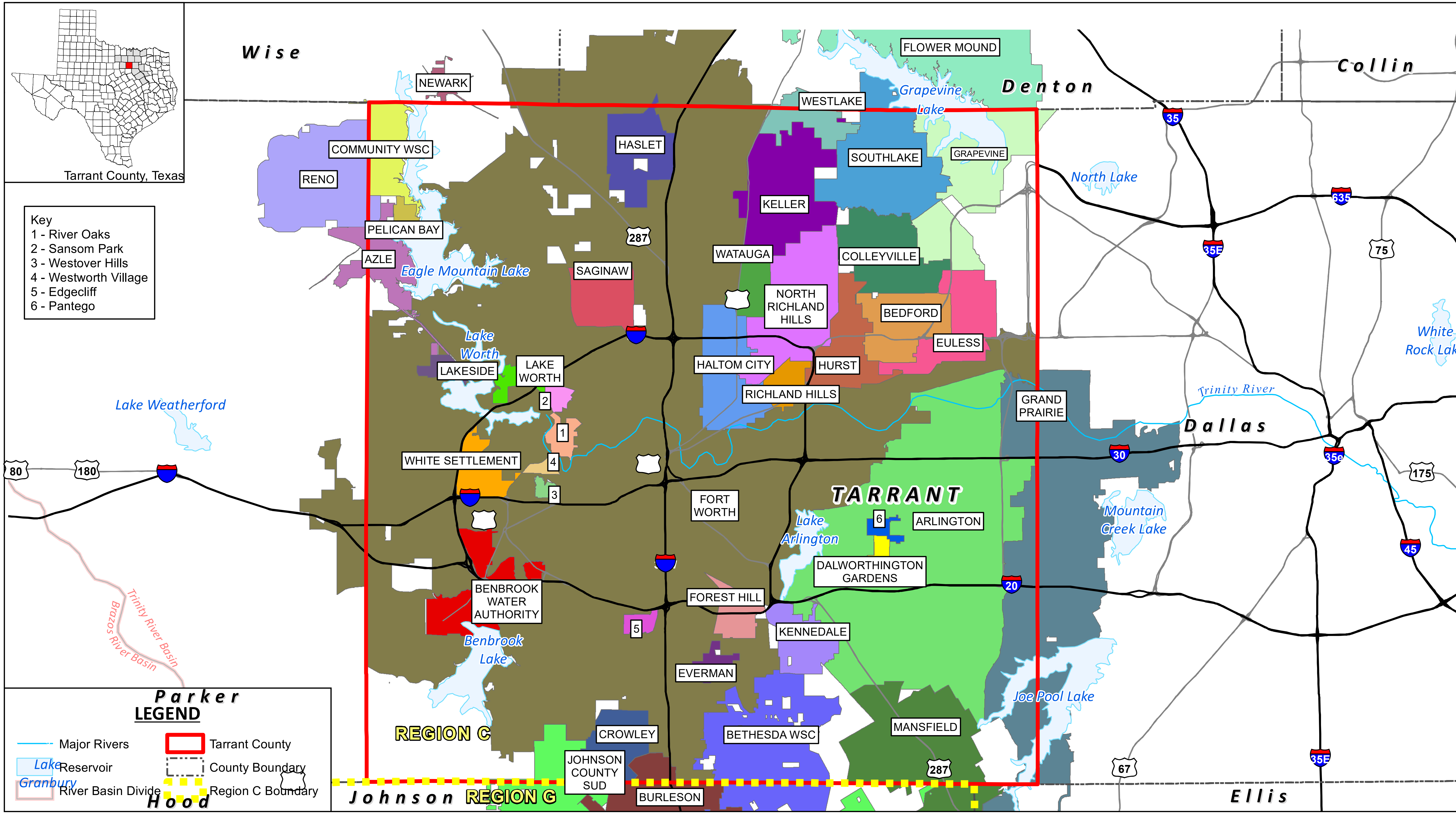
River Basins: Trinity (100%)

Table 5E.347 Summary of Tarrant County

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**2,004,609**	**2,279,113**	**2,580,325**	**2,799,127**	**2,978,034**	**3,167,377**
Projected Demands	**427,050**	**476,807**	**528,442**	**569,340**	**602,456**	**637,649**
Municipal	396,608	446,443	503,051	544,001	577,157	612,383
Irrigation	4,926	4,926	4,926	4,926	4,926	4,926
Livestock	627	627	627	627	627	627
Manufacturing	12,197	13,301	13,301	13,301	13,301	13,301
Mining	11,535	6,562	1,589	1,537	1,497	1,464
Steam Electric	1,157	4,948	4,948	4,948	4,948	4,948
Total Existing Supplies	**419,296**	**400,543**	**386,610**	**375,597**	**366,329**	**359,201**
Need (Demand - Supply)	**7,754**	**76,264**	**141,832**	**193,743**	**236,127**	**278,448**
Total Supplies from Strategies	**36,707**	**87,793**	**152,256**	**204,525**	**246,863**	**289,006**
Reserve (Shortage)	**28,953**	**11,529**	**10,424**	**10,782**	**10,736**	**10,558**

Figure 5E.29 Summary of Tarrant County





REGION C
Water Planning for North Texas

2021 Region C Water Plan

TARRANT COUNTY, TEXAS

FIGURE 5E.30

1 in = 4 miles
0 1 2 4 6
Miles

Data Source(s): ESRI, USGS, TNRIS

TR16409: H:\WR_PLANNING\1 - Working\5E_County WMS\Tarrant1.mxd

5E.15.1 Wholesale Water Providers and Water User Groups

Water management strategies for Tarrant County wholesale water providers (WWPs) and water user groups (WUGs) are discussed below (in alphabetical order). The costs and a summary for Tarrant County are presented in **Section 5E.15.2.**

Arlington

Arlington is located in eastern Tarrant County. Arlington is a wholesale water provider (WWP) that purchases raw water from Tarrant Regional Water District (TRWD) and direct reuse from Fort Worth. Its current customers are Bethesda WSC, Dalworthington Gardens, Tarrant County Irrigation, Manufacturing, and Mining.

Potential future customers for Arlington include Cleburne, Grand Prairie, Kennedale, and Pantego. The city is under no obligation to provide services to these entities just because they are listed in this plan as potential future customers.

Table 5E.348 shows the projected demand, the current supplies, and the water management strategies for Arlington.

Table 5E.348 Summary of Wholesale Water Provider and Customers – Arlington

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Demands						
Arlington	66,810	68,113	68,511	69,419	69,282	69,277
Bethesda WSC	1,234	1,473	1,724	2,003	2,312	2,637
Dalworthington Gardens	363	367	372	377	385	392
Irrigation, Tarrant	281	281	281	281	281	281
Manufacturing, Tarrant	2,000	2,181	2,181	2,181	2,181	2,181
Mining, Tarrant	105	105	105	105	105	105
Potential Future Customers						
Grand Prairie	*0*	*2,242*	*2,074*	*2,074*	*2,074*	*2,074*
Kennedale	*0*	*34*	*33*	*33*	*33*	*33*
Pantego	*0*	*280*	*280*	*280*	*280*	*280*
Total Projected Demand	***70,793***	***75,076***	***75,561***	***76,753***	***76,933***	***77,260***
Currently Available Supplies						
Fort Worth Direct Reuse	178	178	178	178	178	178
TRWD	70,615	63,746	57,049	52,314	48,284	44,872
Existing Treatment Capacity	96,686	96,686	96,686	96,686	96,686	96,686
Total Currently Available Supplies	70,793	63,924	57,227	52,492	48,462	45,050
Need (Demand – Supply)	***0***	***11,152***	***18,334***	***24,261***	***28,471***	***32,210***
Water Management Strategies						
Conservation (retail)	2,674	5,198	5,152	5,377	5,606	5,837
Conservation (wholesale)	31	44	46	54	64	75
TRWD	0	5,910	18,737	30,032	34,003	37,500
Total Supplies from Strategies	***2,705***	***11,152***	***23,935***	***35,463***	***39,673***	***43,412***
Reserve (Shortage)	**2,705**	**0**	**5,601**	**11,202**	**11,202**	**11,202**

Azle

Azle is located in northwestern Tarrant and northeastern Parker Counties. Azle purchases and treats raw water from Tarrant Regional Water District (TRWD). Water management strategies for the city include conservation, water treatment plant expansions, and water from TRWD. **Table 5E.349** shows the projected population and demand, the current supplies, and the water management strategies for Azle.

Table 5E.349 Summary of Water User Group – City of Azle

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**12,339**	**13,377**	**14,432**	**15,503**	**18,731**	**24,029**
Projected Demands						
Municipal Demand	1,932	2,036	2,151	2,286	2,754	3,527
Total Projected Demand	***1,932***	***2,036***	***2,151***	***2,286***	***2,754***	***3,527***
Currently Available Supplies						
TRWD	1,680	1,680	1,680	1,612	1,680	1,680
Total Currently Available Supplies	***1,680***	***1,680***	***1,680***	***1,612***	***1,680***	***1,680***
Need (Demand – Supply)	***252***	***356***	***471***	***674***	***1,074***	***1,847***
Water Management Strategies						
Water Conservation	28	39	27	36	53	80
TRWD with Treatment	224	317	444	638	1,021	1,767
4 MGD WTP Expansion		*317*	*444*	*638*	*1,021*	*1,767*
Total Supplies from Strategies	***252***	***356***	***471***	***674***	***1,074***	***1,847***
Reserve (Shortage)	**0**	**0**	**0**	**0**	**0**	**0**

Bedford

Bedford is located in northeastern Tarrant County. The city's water supply is groundwater (Trinity aquifer) and treated water from the Trinity River Authority (TRA), which gets raw water from Tarrant Regional Water District (TRWD). Water management strategies include conservation and additional water from TRA. Water savings associated with conservation in the early decades are savings realized from leak detection and pipeline replacement. These savings diminish over time. **Table 5E.350** shows the projected population and demand, the current supplies, and the water management strategies for Bedford.

Table 5E.350 Summary of Water User Group – City of Bedford

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**48,435**	**52,345**	**56,255**	**60,166**	**60,166**	**60,166**
Projected Demands						
Municipal Demand	9,202	9,679	10,191	10,785	10,768	10,768
Total Projected Demand	***9,202***	***9,679***	***10,191***	***10,785***	***10,768***	***10,768***
Currently Available Supplies						
Trinity Aquifer	8,757	8,137	7,617	7,292	6,702	6,201
TRWD through TRA	445	445	445	445	445	445
Total Currently Available Supplies	***9,202***	***8,582***	***8,062***	***7,737***	***7,147***	***6,646***
Need (Demand – Supply)	***0***	***1,097***	***2,129***	***3,048***	***3,621***	***4,122***
Water Management Strategies						
Water Conservation	997	1,390	459	522	556	592
TRWD through TRA	0	0	1,670	2,526	3,065	3,530
Total Supplies from Strategies	***997***	***1,390***	***2,129***	***3,048***	***3,621***	***4,122***
Reserve (Shortage)	**997**	**293**	**0**	**0**	**0**	**0**

Benbrook

Benbrook is located in southwestern Tarrant County. The city's water supply is raw water from Tarrant Regional Water District (TRWD) which is treated at Benbrook's own water treatment plant and groundwater (Trinity aquifer). Water management strategies include conservation and additional water from TRWD, including water treatment plant expansions. **Table 5E.351** shows the projected population and demand, the current supplies, and the water management strategies for Benbrook.

Table 5E.351 Summary of Water User Group – City of Benbrook

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**22,323**	**24,803**	**27,284**	**30,749**	**34,213**	**34,213**
Projected Demands						
Municipal Demand	5,164	5,614	6,081	6,797	7,544	7,544
Total Projected Demand	***5,164***	***5,614***	***6,081***	***6,797***	***7,544***	***7,544***
Currently Available Supplies						
Trinity Aquifer	199	199	199	199	199	199
TRWD	3,380	3,380	3,380	3,380	3,380	3,380
Total Currently Available Supplies	***3,579***	***3,579***	***3,579***	***3,579***	***3,579***	***3,579***
Need (Demand – Supply)	***1,585***	***2,035***	***2,502***	***3,218***	***3,965***	***3,965***
Water Management Strategies						
Water Conservation	293	395	421	497	578	603
TRWD	1,292	1,640	2,081	2,721	3,387	3,362
3 MGD WTP Expansion	*0*	*1,682*	*1,682*	*1,682*	*1,682*	*1,682*
Total Supplies from Strategies	***1,585***	***2,035***	***2,502***	***3,218***	***3,965***	***3,965***
Reserve (Shortage)	**0**	**0**	**0**	**0**	**0**	**0**

Bethesda Water Supply Corporation

Bethesda WSC serves southern Tarrant County and northern Johnson County (which is in the Brazos G water planning region). Most of the WSC's service area is located in Region G, and the Brazos G regional water plan will have additional details on strategies for this WUG. Bethesda WSC's water supplies are groundwater (Trinity aquifer) and supplies from Tarrant Regional Water District (TRWD) through both Arlington and Fort Worth. Water management strategies for Bethesda WSC include conservation, and additional water from Arlington and Fort Worth. **Table 5E.352** shows the projected population and demand, the current supplies, and the water management strategies for Bethesda WSC.

Table 5E.352 Summary of Water User Group – Bethesda WSC (Regions C and G)

(Values in Ac-Ft/Yr	2020	2030	2040	2050	2060	2070
Projected Population	**28,794**	**32,909**	**37,099**	**41,531**	**46,215**	**51,113**
Projected Demands						
Municipal Demand	6,036	6,752	7,504	8,342	9,268	10,245
Total Projected Demand	***6,036***	***6,752***	***7,504***	***8,342***	***9,268***	***10,245***
Currently Available Supplies						
Trinity Aquifer	2,333	2,333	2,333	2,333	2,333	2,333
TRWD through Arlington	1,231	1,295	1,344	1,409	1,497	1,580
TRWD through Fort Worth	2,469	2,596	2,694	2,825	2,975	2,975
Total Currently Available Supplies	***6,033***	***6,224***	***6,371***	***6,567***	***6,805***	***6,888***
Need (Demand – Supply)	***3***	***528***	***1,133***	***1,775***	***2,463***	***3,357***
Water Management Strategies						
Water Conservation	92	119	127	148	172	196
TRWD through Arlington	0	138	338	545	757	989
TRWD through Fort Worth	0	271	668	1,082	1,534	2,172
Total Supplies from Strategies	***92***	***528***	***1,133***	***1,775***	***2,463***	***3,357***
Reserve (Shortage)	**89**	**0**	**0**	**0**	**0**	**0**

Burleson

Burleson is located in southern Tarrant County and northern Johnson County (which is in the Brazos G water planning region). Most of Burleson's service area is located in Region G, and the Brazos G regional water plan will also have additional details on strategies for this WUG. The city provides water to a small portion of Johnson County Manufacturing. The city's water supply is treated water from Fort Worth, which gets its raw water from Tarrant Regional Water District (TRWD). Water management strategies for Burleson include conservation, additional water from Fort Worth, and an additional connection to Fort Worth to increase delivery capacity. **Table 5E.353** shows the projected population and demand, the current supplies, and the water management strategies for Burleson.

Table 5E.353 Summary of Water User Group – City of Burleson (Regions C and G)

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**42,785**	**50,642**	**58,630**	**67,043**	**75,909**	**85,147**
Projected Demands						
Municipal Demand	6,466	7,484	8,553	9,718	10,980	12,309
Manufacturing, Johnson	2	2	2	2	2	2
Total Projected Demand	***6,468***	***7,486***	***8,555***	***9,720***	***10,982***	***12,311***
Currently Available Supplies						
TRWD through Fort Worth	6,465	6,441	6,518	6,654	6,870	7,107
Total Currently Available Supplies	***6,465***	***6,441***	***6,518***	***6,654***	***6,870***	***7,107***
Need (Demand – Supply)	***3***	***1,045***	***2,037***	***3,066***	***4,112***	***5,204***
Water Management Strategies						
Water Conservation	48	54	57	87	118	141
TRWD through Fort Worth	0	991	1,980	2,979	3,994	5,063
Additional delivery capacity from Fort Worth	*0*	*0*	*0*	*104*	*1,335*	*2,641*
Total Supplies from Strategies	***48***	***1,045***	***2,037***	***3,066***	***4,112***	***5,204***
Reserve (Shortage)	**45**	**0**	**0**	**0**	**0**	**0**

Colleyville

Colleyville is located in northeastern Tarrant County. The city's water supply is treated water from the Trinity River Authority (TRA), which gets raw water from Tarrant Regional Water District (TRWD). Colleyville's water management strategies include conservation and additional water from TRA. **Table 5E.354** shows the projected population and demand, the current supplies, and the water management strategies for Colleyville.

Table 5E.354 Summary of Water User Group – City of Colleyville

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**23,719**	**25,201**	**27,000**	**28,000**	**28,000**	**28,000**
Projected Demands						
Municipal Demand	9,211	9,693	10,313	10,656	10,648	10,648
Total Projected Demand	***9,211***	***9,693***	***10,313***	***10,656***	***10,648***	***10,648***
Currently Available Supplies						
TRWD through TRA	9,211	8,542	8,059	7,514	6,913	6,396
Total Currently Available Supplies	***9,211***	***8,542***	***8,059***	***7,514***	***6,913***	***6,396***
Need (Demand – Supply)	***0***	***1,151***	***2,254***	***3,142***	***3,735***	***4,252***
Water Management Strategies						
Water Conservation	187	641	705	765	799	835
TRWD through TRA	0	510	1,549	2,377	2,936	3,417
Total Supplies from Strategies	***187***	***1,151***	***2,254***	***3,142***	***3,735***	***4,252***
Reserve (Shortage)	**187**	**0**	**0**	**0**	**0**	**0**

Community Water Supply Corporation

Community WSC serves northwestern Tarrant County. The WSC gets raw water from Tarrant Regional Water District (TRWD) and operates its own water treatment plant. Water management strategies for Community WSC include conservation and additional water from TRWD. **Table 5E.355** shows the projected population and demand, the current supplies, and the water management strategies for Community WSC.

Table 5E.355 Summary of Water User Group – Community WSC

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**3,419**	**3,845**	**4,265**	**4,673**	**5,083**	**5,484**
Projected Demands						
Municipal Demand	338	360	384	419	455	490
Total Projected Demand	***338***	***360***	***384***	***419***	***455***	***490***
Currently Available Supplies						
TRWD	338	317	300	295	295	294
Total Currently Available Supplies	***338***	***317***	***300***	***295***	***295***	***294***
Need (Demand – Supply)	***0***	***43***	***84***	***124***	***160***	***196***
Water Management Strategies						
Water Conservation	3	4	4	6	8	10
TRWD	0	39	80	118	152	186
Total Supplies from Strategies	***3***	***43***	***84***	***124***	***160***	***196***
Reserve (Shortage)	**3**	**0**	**0**	**0**	**0**	**0**

Crowley

Crowley is located in southern Tarrant County. The city's water supply is treated water from Fort Worth (which gets its raw water from Tarrant Regional Water District (TRWD)) and groundwater from the Trinity aquifer. Water management strategies for Crowley are conservation, additional water from Fort Worth, and an additional connection to Fort Worth (increase delivery infrastructure). **Table 5E.356** shows the projected population and demand, the current supplies, and the water management strategies for Crowley.

Table 5E.356 Summary of Water User Group – City of Crowley

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**16,311**	**19,082**	**22,811**	**27,438**	**35,102**	**40,131**
Projected Demands						
Municipal Demand	2,418	2,767	3,263	3,898	4,975	5,683
Total Projected Demand	***2,418***	***2,767***	***3,263***	***3,898***	***4,975***	***5,683***
Currently Available Supplies						
Trinity Aquifer	170	170	170	170	170	170
TRWD through Fort Worth	2,242	2,242	2,242	2,242	2,242	2,242
Total Currently Available Supplies	***2,412***	***2,412***	***2,412***	***2,412***	***2,412***	***2,412***
Need (Demand – Supply)	***6***	***355***	***851***	***1,486***	***2,563***	***3,271***
Water Management Strategies						
Water Conservation	95	122	137	178	242	296
TRWD through Fort Worth	0	233	714	1,308	2,321	2,975
Additional delivery infrastructure from Ft Worth	*0*	*233*	*714*	*1,308*	*2,321*	*2,975*
Total Supplies from Strategies	***95***	***355***	***851***	***1,486***	***2,563***	***3,271***
Reserve (Shortage)	**89**	**0**	**0**	**0**	**0**	**0**

Dalworthington Gardens

Dalworthington Gardens is located in eastern Tarrant County. The city's water supply is treated water from Fort Worth and Arlington (both get raw water from Tarrant Regional Water District (TRWD)). Water management strategies for Dalworthington Gardens include conservation and additional water from Fort Worth and Arlington. **Table 5E.357** shows the projected population and demand, the current supplies, and the water management strategies for Dalworthington Gardens.

Table 5E.357 Summary of Water User Group – City of Dalworthington Gardens

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**2,298**	**2,350**	**2,401**	**2,451**	**2,501**	**2,549**
Projected Demands						
Municipal Demand	908	918	929	943	962	980
Total Projected Demand	***908***	***918***	***929***	***943***	***962***	***980***
Currently Available Supplies						
TRWD through Fort Worth	545	486	435	399	375	354
TRWD through Arlington	362	323	290	265	249	235
Total Currently Available Supplies	***907***	***809***	***725***	***664***	***624***	***589***
Need (Demand – Supply)	***1***	***109***	***204***	***279***	***338***	***391***
Water Management Strategies						
Water Conservation	8	44	46	50	54	58
TRWD through Arlington	1	44	82	112	136	157
TRWD through Fort Worth	0	21	76	117	148	176
Total Supplies from Strategies	***9***	***109***	***204***	***279***	***338***	***391***
Reserve (Shortage)	**8**	**0**	**0**	**0**	**0**	**0**

Edgecliff

Edgecliff (or Edgecliff Village) is located in southern Tarrant County. The city's water supply is treated water from Fort Worth, which gets raw water from Tarrant Regional Water District (TRWD). Water management strategies for Edgecliff include conservation and additional water from Fort Worth. **Table 5E.358** shows the projected population and demand, the current supplies, and the water management strategies for Edgecliff.

Table 5E.358 Summary of Water User Group – City of Edgecliff

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**2,924**	**2,924**	**2,924**	**2,924**	**2,924**	**2,924**
Projected Demands						
Municipal Demand	503	490	480	474	473	473
Total Projected Demand	***503***	***490***	***480***	***474***	***473***	***473***
Currently Available Supplies						
TRWD through Fort Worth	503	432	375	334	307	284
Total Currently Available Supplies	***503***	***432***	***375***	***334***	***307***	***284***
Need (Demand – Supply)	***0***	***58***	***105***	***140***	***166***	***189***
Water Management Strategies						
Water Conservation	5	22	23	24	26	27
TRWD through Fort Worth	0	36	82	116	140	162
Total Supplies from Strategies	***5***	***58***	***105***	***140***	***166***	***189***
Reserve (Shortage)	**5**	**0**	**0**	**0**	**0**	**0**

Euless

Euless is located in northeastern Tarrant County. The city's water supply is groundwater (Trinity aquifer), Fort Worth direct reuse, and treated water from the Trinity River Authority (TRA) which gets raw water from Tarrant Regional Water District (TRWD). Euless' water management strategies include conservation and additional water from TRA. An alternative strategy for Euless is to further increase treated water purchased from TRA. **Table 5E.359** shows the projected population and demand, the current supplies, and the water management strategies for Euless.

Table 5E.359 Summary of Water User Group – City of Euless

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**54,725**	**57,689**	**57,689**	**57,689**	**57,689**	**57,689**
Projected Demands						
Municipal Demand	9,062	9,298	9,116	9,016	8,997	8,996
Total Projected Demand	***9,062***	***9,298***	***9,116***	***9,016***	***8,997***	***8,996***
Currently Available Supplies						
Direct Reuse through Fort Worth	368	368	368	368	368	368
Trinity Aquifer	2,106	2,106	2,106	2,106	2,106	2,106
TRWD through TRA	6,588	6,013	5,191	4,614	4,235	3,919
Total Currently Available Supplies	***9,062***	***8,487***	***7,665***	***7,088***	***6,709***	***6,393***
Need (Demand – Supply)	***0***	***811***	***1,451***	***1,928***	***2,288***	***2,603***
Water Management Strategies						
Water Conservation	443	817	769	445	474	504
TRWD through TRA	0	0	682	1,483	1,814	2,099
Total Supplies from Strategies	***443***	***817***	***1,451***	***1,928***	***2,288***	***2,603***
Reserve (Shortage)	**443**	**6**	**0**	**0**	**0**	**0**
Alternative Strategy						
Purchase water from TRA	*2,106*	*2,106*	*2,106*	*2,106*	*2,106*	*2,106*

Everman

Everman is located in southern Tarrant County. The city's water supply is groundwater from the Trinity aquifer. The only recommended water management strategy for Everman is conservation. **Table 5E.360** shows the projected population and demand, the current supplies, and the water management strategies for Everman.

Table 5E.360 Summary of Water User Group – City of Everman

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**6,153**	**6,477**	**6,600**	**6,600**	**6,600**	**6,600**
Projected Demands						
Municipal Demand	529	527	513	501	499	499
Total Projected Demand	***529***	***527***	***513***	***501***	***499***	***499***
Currently Available Supplies						
Trinity Aquifer	529	529	529	529	529	529
Total Currently Available Supplies	***529***	***529***	***529***	***529***	***529***	***529***
Need (Demand – Supply)	***0***	***0***	***0***	***0***	***0***	***0***
Water Management Strategies						
Water Conservation	21	23	20	22	23	25
Total Supplies from Strategies	***21***	***23***	***20***	***22***	***23***	***25***
Reserve (Shortage)	**21**	**25**	**36**	**50**	**53**	**55**

Flower Mound

Flower Mound is located in southern Denton County with a small area in Tarrant County. The water supply for Flower Mound is discussed under Denton County in **Section 5E.4.1**.

Forest Hill

Forest Hill is located in southern Tarrant County. The city's water supply is treated water from Fort Worth, which gets its raw water from Tarrant Regional Water District (TRWD). Water management strategies for Forest Hill include conservation and water from Fort Worth. **Table 5E.361** shows the projected population and demand, the current supplies, and the water management strategies for Forest Hill.

Table 5E.361 Summary of Water User Group – City of Forest Hill

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**12,975**	**13,761**	**14,971**	**17,965**	**22,955**	**29,942**
Projected Demands						
Municipal Demand	1,359	1,377	1,445	1,699	2,159	2,811
Total Projected Demand	***1,359***	***1,377***	***1,445***	***1,699***	***2,159***	***2,811***
Currently Available Supplies						
TRWD through Fort Worth	1,357	1,214	1,129	1,199	1,381	1,565
Total Currently Available Supplies	***1,357***	***1,214***	***1,129***	***1,199***	***1,381***	***1,565***
Need (Demand – Supply)	***2***	***163***	***316***	***500***	***778***	***1,246***
Water Management Strategies						
Water Conservation	14	19	18	27	41	63
TRWD through Fort Worth	0	144	298	473	737	1,183
Total Supplies from Strategies	***14***	***163***	***316***	***500***	***778***	***1,246***
Reserve (Shortage)	**12**	**0**	**0**	**0**	**0**	**0**

Fort Worth

Fort Worth is located primarily in Tarrant County, with some population in Denton, Parker, and Wise Counties in Region C and in Johnson County in Region G. Fort Worth is a major wholesale water provider and is discussed in **Chapter 5D**.

Grand Prairie

Grand Prairie is a wholesale water provider in Dallas, Ellis and Tarrant Counties in Region C. Grand Prairie is discussed under Dallas County in **Section 5.3.1**.

Grapevine

Grapevine is located in northeastern Tarrant County and is expected to reach buildout by 2030. The city gets its water supply from multiple sources – Dallas Water Utility (DWU), indirect reuse from Lake Grapevine purchased from Dallas County Park Cities MUD (DCPCMUD), treated water from Trinity River Authority (TRA), and raw water from Lake Grapevine (based on the city's portion of the firm yield). Water management strategies for Grapevine include conservation, water from TRA, and water from DWU. An alternative water management strategy for Grapevine would be to purchase a portion of Dallas County Park Cities MUD's unused supply from Lake Grapevine yield. Grapevine does not require any additional infrastructure to take delivery or to treat their supplies in the future (beyond maintenance of existing facilities). **Table 5E.362** shows the projected population and demand, the current supplies, and the water management strategies for Grapevine.

Table 5E.362 Summary of Water User Group – City of Grapevine

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**52,243**	**54,037**	**54,037**	**54,037**	**54,037**	**54,037**
Projected Demands						
Municipal Demand	18,406	18,806	18,665	18,589	18,574	18,573
Irrigation, Tarrant	*1,121*	*1,121*	*1,121*	*1,121*	*1,121*	*1,121*
Total Projected Demand	***19,527***	***19,927***	***19,786***	***19,710***	***19,695***	***19,694***
Currently Available Supplies						
DWU	2,666	2,601	2,235	2,042	1,960	1,907
Indirect Reuse (Lake Grapevine) from DCPCMUD	3,295	3,659	3,698	3,683	3,680	3,679
TRWD through TRA	10,584	9,156	8,222	7,560	7,138	6,905
Lake Grapevine[a]	1,919	1,886	1,852	1,818	1,784	1,750
Total Currently Available Supplies	***18,464***	***17,302***	***16,007***	***15,103***	***14,562***	***14,241***
Need (Demand – Supply)	***1,063***	***2,625***	***3,779***	***4,607***	***5,133***	***5,453***
Water Management Strategies						
Water Conservation	1,054	1,182	1,129	1,181	1,242	1,303
TRWD through TRA	102	1,431	2,398	3,016	3,390	3,576
DWU	0	12	252	410	501	574
Total Supplies from Strategies	***1,156***	***2,625***	***3,779***	***4,607***	***5,133***	***5,453***
Reserve (Shortage)	**93**	**0**	**0**	**0**	**0**	**0**
Alternative Strategy						
Purchase water from Dallas County Park Cities MUD	*5,000*	*5,000*	*5,000*	*5,000*	*5,000*	*4,852*

[a]Lake Grapevine supply is based on Grapevine's portion of the firm yield as calculated by TCEQ WAM. It is significantly less then Grapevine's water right amount.

Haltom City

Haltom City is located in central Tarrant County. The city purchases treated water from Fort Worth, which gets raw water from Tarrant Regional Water District (TRWD). Haltom City's water management strategies include conservation and water from Fort Worth. **Table 5E.363** shows the projected population and demand, the current supplies, and the water management strategies for Haltom City.

Table 5E.363 Summary of Water User Group – Haltom City

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**43,611**	**44,602**	**46,585**	**50,550**	**54,514**	**59,470**
Projected Demands						
Municipal Demand	5,238	5,179	5,260	5,619	6,039	6,581
Total Projected Demand	***5,238***	***5,179***	***5,260***	***5,619***	***6,039***	***6,581***
Currently Available Supplies						
TRWD through Fort Worth	5,238	4,564	4,111	3,962	3,921	3,953
Total Currently Available Supplies	***5,238***	***4,564***	***4,111***	***3,962***	***3,921***	***3,953***
Need (Demand – Supply)	***0***	***615***	***1,149***	***1,657***	***2,118***	***2,628***
Water Management Strategies						
Water Conservation	296	318	313	353	401	459
TRWD through Fort Worth	0	297	836	1,304	1,717	2,169
Total Supplies from Strategies	***296***	***615***	***1,149***	***1,657***	***2,118***	***2,628***
Reserve (Shortage)	**296**	**0**	**0**	**0**	**0**	**0**

Haslet

Haslet is located in northern Tarrant County. The city's water supply is treated water from Fort Worth, which gets its raw water from Tarrant Regional Water District (TRWD), and groundwater from the Trinity aquifer. Water management strategies for Haslet include conservation and water from Fort Worth. **Table 5E.364** shows the projected population and demand, the current supplies, and the water management strategies for Haslet.

Table 5E.364 Summary of Water User Group – City of Haslet

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**1,750**	**5,380**	**7,870**	**14,000**	**14,000**	**14,000**
Projected Demands						
Municipal Demand	570	1,730	2,513	4,447	4,443	4,443
Total Projected Demand	***570***	***1,730***	***2,513***	***4,447***	***4,443***	***4,443***
Currently Available Supplies						
TRWD through Fort Worth	507	1,469	1,869	3,136	2,885	2,669
Trinity Aquifer	63	63	63	63	63	63
Total Currently Available Supplies	***570***	***1,532***	***1,932***	***3,199***	***2,948***	***2,732***
Need (Demand – Supply)	***0***	***198***	***581***	***1,248***	***1,495***	***1,711***
Water Management Strategies						
Water Conservation	5	102	155	296	316	331
TRWD through Fort Worth	0	200	529	1,015	1,242	1,443
Total Supplies from Strategies	***5***	***302***	***684***	***1,311***	***1,558***	***1,774***
Reserve (Shortage)	**5**	**104**	**103**	**63**	**63**	**63**

Hurst

Hurst is located in northeast Tarrant County. The city gets its water supply from Fort Worth, which gets raw water from Tarrant Regional Water District (TRWD), and groundwater from the Trinity aquifer. Hurst's water management strategies include conservation and additional water from Fort Worth. **Table 5E.365** shows the projected population and demand, the current supplies, and the water management strategies for Hurst.

Table 5E.365 Summary of Water User Group – City of Hurst

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**39,229**	**40,209**	**40,209**	**40,209**	**40,209**	**40,209**
Projected Demands						
Municipal Demand	6,696	6,687	6,551	6,476	6,463	6,462
Total Projected Demand	***6,696***	***6,687***	***6,551***	***6,476***	***6,463***	***6,462***
Currently Available Supplies						
Trinity Aquifer	378	378	378	378	378	378
TRWD through Fort Worth	6,318	5,559	4,824	4,300	3,951	3,655
Total Currently Available Supplies	***6,696***	***5,937***	***5,202***	***4,678***	***4,329***	***4,033***
Need (Demand – Supply)	***0***	***750***	***1,349***	***1,798***	***2,134***	***2,429***
Water Management Strategies						
Water Conservation	326	391	320	328	350	371
TRWD through Fort Worth	0	359	1,029	1,470	1,784	2,058
Total Supplies from Strategies	***326***	***750***	***1,349***	***1,798***	***2,134***	***2,429***
Reserve (Shortage)	**326**	**0**	**0**	**0**	**0**	**0**

Johnson County Special Utility District

Johnson County SUD has a large service area in Johnson and Hill Counties in the Brazos G region and Tarrant County in Region C. The majority of the population served by the SUD is located in Johnson County. The Johnson County SUD gets its water from Tarrant Regional Water District (TRWD) through Mansfield and the Brazos River Authority (BRA) (Lake Granbury). Water management strategies for the SUD include conservation and additional supply from Mansfield. **Table 5E.366** shows the projected demand, the current supplies, and the water management strategies for Johnson County SUD.

Table 5E.366 Summary of Water User Group – Johnson County SUD (Region C & G)

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**44,817**	**49,018**	**54,698**	**60,378**	**66,058**	**71,738**
Projected Demands						
Municipal Demand	5,771	6,120	6,696	7,320	7,986	8,665
Total Projected Demand	***5,771***	***6,120***	***6,696***	***7,320***	***7,986***	***8,665***
Currently Available Supplies						
TRWD through Mansfield	3,728	5,135	5,420	4,641	4,173	3,789
Lake Granbury through BRA	3,160	3,160	3,160	3,160	3,160	3,160
Total Currently Available Supplies	***6,888***	***8,295***	***8,580***	***7,801***	***7,333***	***6,949***
Need (Demand – Supply)	***0***	***0***	***0***	***0***	***653***	***1,716***
Water Management Strategies						
Water Conservation	3	4	4	6	8	10
TRWD through Mansfield	269	2,076	3,421	4,198	4,664	5,046
Total Supplies from Strategies	***272***	***2,080***	***3,425***	***4,204***	***4,672***	***5,056***
Reserve (Shortage)	**1,389**	**4,255**	**5,309**	**4,685**	**4,019**	**3,340**

Keller

Keller is located in northern Tarrant County and is projected to reach buildout by 2030. The city's water supply is treated water from Fort Worth, which gets its raw water from Tarrant Regional Water District (TRWD). Water management strategies for Keller include conservation and additional water from Fort Worth. **Table 5E.367** shows the projected population and demand, the current supplies, and the water management strategies for Keller.

Table 5E.367 Summary of Water User Group – City of Keller

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**48,279**	**51,974**	**51,974**	**51,974**	**51,974**	**51,974**
Projected Demands						
Municipal Demand	12,339	13,148	13,073	13,028	13,013	13,012
Total Projected Demand	***12,339***	***13,148***	***13,073***	***13,028***	***13,013***	***13,012***
Currently Available Supplies						
TRWD through Fort Worth	12,339	11,586	10,217	9,187	8,448	7,817
Total Currently Available Supplies	***12,339***	***11,586***	***10,217***	***9,187***	***8,448***	***7,817***
Need (Demand – Supply)	***0***	***1,562***	***2,856***	***3,841***	***4,565***	***5,195***
Water Management Strategies						
Water Conservation	768	946	854	893	935	978
TRWD through Fort Worth	0	616	2,002	2,948	3,630	4,217
Total Supplies from Strategies	***768***	***1,562***	***2,856***	***3,841***	***4,565***	***5,195***
Reserve (Shortage)	**768**	**0**	**0**	**0**	**0**	**0**

Kennedale

Kennedale is located in southern Tarrant County and provides retail water supply to a portion of Tarrant County Manufacturing. The city's water supply is from groundwater (Trinity aquifer) and treated water from Fort Worth, which gets its raw water from Tarrant Regional Water District (TRWD). Water management strategies for Kennedale include conservation and additional water from Fort Worth (including an increase in delivery infrastructure) and connecting to and purchasing water from Arlington. **Table 5E.368** shows the projected population and demand, the current supplies, and the water management strategies for Kennedale.

Table 5E.368 Summary of Water User Group – City of Kennedale

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**8,044**	**9,250**	**10,883**	**12,632**	**14,381**	**16,130**
Projected Demands						
Municipal Demand	1,420	1,596	1,850	2,133	2,425	2,720
Manufacturing, Tarrant	*24*	*27*	*27*	*27*	*27*	*27*
Total Projected Demand	***1,444***	***1,623***	***1,877***	***2,160***	***2,452***	***2,747***
Currently Available Supplies						
Trinity Aquifer	838	838	838	838	838	838
TRWD through Fort Worth	606	445	594	734	864	945
Total Currently Available Supplies	***1,444***	***1,283***	***1,432***	***1,572***	***1,702***	***1,783***
Need (Demand – Supply)	***0***	***340***	***445***	***588***	***750***	***964***
Water Management Strategies						
Water Conservation	12	77	97	121	147	175
TRWD through Fort Worth	0	0	68	187	323	509
Additional delivery infrastructure from Ft Worth	*0*	*0*	*101*	*360*	*626*	*893*
TRWD through Arlington	0	280	280	280	280	280
Connect to Arlington	*0*	*280*	*280*	*280*	*280*	*280*
Total Supplies from Strategies	**12**	**357**	**445**	**588**	**750**	**964**
Reserve (Shortage)	**12**	**17**	**0**	**0**	**0**	**0**

Lake Worth

Lake Worth is located in western Tarrant County. The city gets its water supply from Fort Worth, which gets raw water from Tarrant Regional Water District (TRWD) and groundwater from the Trinity aquifer. Lake Worth's water management strategies include conservation and additional water from Fort Worth. **Table 5E.369** shows the projected population and demand, the current supplies, and the water management strategies for Lake Worth.

Table 5E.369 Summary of Water User Group – City of Lake Worth

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**5,157**	**5,798**	**6,431**	**7,457**	**8,750**	**11,932**
Projected Demands						
Municipal Demand	1,130	1,241	1,354	1,558	1,825	2,486
Total Projected Demand	***1,130***	***1,241***	***1,354***	***1,558***	***1,825***	***2,486***
Currently Available Supplies						
Trinity Aquifer	169	169	169	169	169	169
TRWD through Fort Worth	961	944	926	980	1,075	1,392
Total Currently Available Supplies	***1,130***	***1,113***	***1,095***	***1,149***	***1,244***	***1,561***
Need (Demand – Supply)	***0***	***128***	***259***	***409***	***581***	***925***
Water Management Strategies						
Water Conservation	10	57	66	82	101	151
TRWD through Fort Worth	0	71	193	327	480	774
Total Supplies from Strategies	***10***	***128***	***259***	***409***	***581***	***925***
Reserve (Shortage)	**10**	**0**	**0**	**0**	**0**	**0**

Lakeside

Lakeside is located in western Tarrant County. The city's water supply is groundwater from the Trinity aquifer. The water management strategies include conservation and new groundwater wells in the Trinity aquifer. **Table 5E.370** shows the projected population and demand, the current supplies, and the water management strategies for Lakeside.

Table 5E.370 Summary of Water User Group – City of Lakeside

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**1,350**	**1,400**	**1,450**	**1,500**	**1,500**	**1,500**
Projected Demands						
Municipal Demand	370	378	388	399	398	398
Total Projected Demand	***370***	***378***	***388***	***399***	***398***	***398***
Currently Available Supplies						
Trinity Aquifer	291	291	291	291	291	291
Total Currently Available Supplies	***291***	***291***	***291***	***291***	***291***	***291***
Need (Demand – Supply)	***79***	***87***	***97***	***108***	***107***	***107***
Water Management Strategies						
Water Conservation	21	26	26	28	30	31
New Well(s) in Trinity Aquifer	58	61	71	80	77	76
Total Supplies from Strategies	***79***	***87***	***97***	***108***	***107***	***107***
Reserve (Shortage)	**0**	**0**	**0**	**0**	**0**	**0**

Mansfield

The City of Mansfield is located in Ellis, Johnson and Tarrant Counties. Mansfield is a wholesale water provider (WWP) that currently purchases raw water from the Tarrant Regional Water District (TRWD) and has a 45 MGD water treatment plant. Mansfield sells water to Johnson County SUD, Grand Prairie and also serves some manufacturing demands within the city. Mountain Peak SUD is included as a potential future customer.

The recommended water management strategies for Mansfield include implementing water conservation measures, purchasing additional raw water from the TRWD, and expanding water treatment capacity. A summary of the recommended water plan for Mansfield is shown on **Table 5E.371**.

Table 5E.371 Summary of Wholesale Water Provider and Customers – Mansfield

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Demands						
Mansfield	19,230	24,366	29,084	35,990	41,385	46,797
Manufacturing, Tarrant	*220*	*239*	*239*	*239*	*239*	*239*
Grand Prairie	*673*	*3,621*	*2,993*	*2,993*	*2,993*	*2,993*
Johnson County SUD	*4,000*	*7,215*	*8,845*	*8,845*	*8,845*	*8,845*
Potential Future Customers						
Mountain Peak SUD	*705*	*1,699*	*2,140*	*5,229*	*6,398*	*7,505*
Total Projected Demand	***24,828***	***37,140***	***43,301***	***53,296***	***59,860***	***66,379***
Currently Available Supplies						
TRWD (45 MGD Peak WTP Capacity)[a]	22,482	25,223	25,223	25,223	25,223	25,223
Total Currently Available Supplies	***22,482***	***25,223***	***25,223***	***25,223***	***25,223***	***25,223***
Need (Demand – Supply)	***2,346***	***11,917***	***18,078***	***28,073***	***34,637***	***41,156***
Water Management Strategies						
Conservation (retail)	771	1,149	1,319	1,746	2,132	2,553
Conservation (wholesale)	296	686	727	1,048	1,240	1,419
TRWD[b]	1,279	10,082	16,032	25,279	31,265	37,184
15 MGD Existing WTP Expansion	*0*	*8,408*	*8,408*	*8,408*	*8,408*	*8,408*
35 MGD New WTP	*0*	*1,674*	*7,624*	*16,871*	*19,618*	*19,618*
20 MGD New WTP Expansion	*0*	*0*	*0*	*0*	*3,239*	*9,158*
Total Supplies from Strategies	***2,346***	***11,917***	***18,078***	***28,073***	***34,637***	***41,156***
Reserve (Shortage)	**0**	**0**	**0**	**0**	**0**	**0**

a. *Mansfield's existing WTP has a peak capacity of 45 MGD. A peaking factor of 2 was assumed to determine the average-day capacity constraint (22.5 MGD; 25,223 acre-feet per year).*

b. *In 2020 the supplies from TRWD are limited by TRWD supply availability instead of the City of Mansfield's WTP. No additional treatment infrastructure is necessary until the TRWD supply availability is greater than the existing WTP constraint (2030 and beyond).*

City of North Richland Hills

The current water supplies for the City of North Richland Hills include water purchased from Tarrant Regional Water District (TRWD) through Trinity River Authority (TRA) and Fort Worth. North Richland Hills is a wholesale water provider (WWP) and sells water to Watauga. The proposed water management strategies for North Richland Hills include implementing water conservation measures, additional water from TRWD (through TRA and Fort Worth) and adding another pipeline to Fort Worth. A summary of the recommended water plan for North Richland Hills is shown in **Table 5E.372**.

Table 5E.372 Summary of Wholesale Water Provider and Customers – North Richland Hills

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Demands						
North Richland Hills	12,812	13,457	13,254	13,140	13,116	13,115
Watauga	*2,844*	*2,740*	*2,655*	*2,608*	*2,600*	*2,599*
Total Projected Demand	***15,656***	***16,197***	***15,909***	***15,748***	***15,716***	***15,714***
Currently Available Supplies						
TRWD through TRA	*4,271*	*3,953*	*3,453*	*3,089*	*2,839*	*2,626*
TRWD through Fort Worth	*11,385*	*10,320*	*8,981*	*8,017*	*7,365*	*6,813*
Total Currently Available Supplies	***15,656***	***14,273***	***12,434***	***11,106***	***10,204***	***9,439***
Need (Demand – Supply)	***0***	***1,924***	***3,475***	***4,642***	***5,512***	***6,275***
Water Management Strategies						
Conservation (retail)	633	797	762	800	840	883
Conservation (Customers)	112	121	114	120	128	136
TRWD through TRA	0	0	203	491	693	863
TRWD through Fort Worth	0	1,006	2,396	3,231	3,851	4,393
New Pipeline from Fort Worth	*0*	*1,006*	*2,396*	*3,231*	*3,851*	*4,393*
Total Supplies from Strategies	***745***	***1,924***	***3,475***	***4,642***	***5,512***	***6,275***
Reserve (Shortage)	**745**	**0**	**0**	**0**	**0**	**0**

Pantego

Pantego is located in eastern Tarrant County. The city's water supply is groundwater from the Trinity aquifer. While the city has no needs, it is planning to increase the reliability of its existing supplies by purchasing treated water from Fort Worth and Arlington. Water management strategies for Pantego include conservation and connecting to and purchasing treated water from Fort Worth and Arlington, both of which get raw water from Tarrant Regional Water District (TRWD). **Table 5E.373** shows the projected population and demand, the current supplies, and the water management strategies for Pantego.

Table 5E.373 Summary of Water User Group – City of Pantego

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**2,653**	**2,653**	**2,653**	**2,653**	**2,653**	**2,653**
Projected Demands						
Municipal Demand	686	674	664	658	657	657
Total Projected Demand	***686***	***674***	***664***	***658***	***657***	***657***
Currently Available Supplies						
Trinity Aquifer	732	732	732	732	732	732
Total Currently Available Supplies	***732***	***732***	***732***	***732***	***732***	***732***
Need (Demand – Supply)	***0***	***0***	***0***	***0***	***0***	***0***
Water Management Strategies						
Water Conservation	5	7	7	9	11	13
TRWD through Fort Worth	0	30	30	29	28	27
Connect to Fort Worth	*0*	*30*	*30*	*29*	*28*	*27*
TRWD through Arlington	0	30	29	28	27	26
Connect to Arlington	*0*	*30*	*29*	*28*	*27*	*26*
Total Supplies from Strategies	***5***	***67***	***66***	***66***	***66***	***66***
Reserve (Shortage)	**51**	**125**	**134**	**140**	**141**	**141**

Pelican Bay

Pelican Bay is located in northwestern Tarrant County. The city's water supply is groundwater from the Trinity aquifer. Water management strategies for Pelican Bay include conservation, connecting to and purchasing water from Azle (which gets its raw water from Tarrant Regional Water District), and additional groundwater. **Table 5E.374** shows the projected population and demand, the current supplies, and the water management strategies for Pelican Bay.

Table 5E.374 Summary of Water User Group – City of Pelican Bay

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**1,684**	**1,716**	**1,748**	**1,779**	**1,810**	**1,841**
Projected Demands						
Municipal Demand	113	115	117	120	122	124
Total Projected Demand	***113***	***115***	***117***	***120***	***122***	***124***
Currently Available Supplies						
Trinity Aquifer	117	117	117	117	117	117
Total Currently Available Supplies	***117***	***117***	***117***	***117***	***117***	***117***
Need (Demand – Supply)	***0***	***0***	***0***	***3***	***5***	***7***
Water Management Strategies						
Water Conservation	1	2	1	2	2	2
Connect to and Purchase Water from Azle (TRWD)	0	0	0	1	3	5
New Well(s) in Trinity Aquifer	24	24	24	24	24	24
Total Supplies from Strategies	***25***	***26***	***25***	***27***	***29***	***31***
Reserve (Shortage)	**29**	**28**	**25**	**24**	**24**	**24**

Reno

Reno is located in northeastern Parker and northwest Tarrant County. The water supply plans for Reno are discussed under Parker County in **Section 5E.13**.

Richland Hills

Richland Hills is located in central Tarrant County. The city gets its water supply from Fort Worth, which gets raw water from Tarrant Regional Water District (TRWD) and groundwater from the Trinity aquifer. Richland Hills' water management strategies include conservation and water from Fort Worth. **Table 5E.375** shows the projected population and demand, the current supplies, and the water management strategies for Richland Hills.

Table 5E.375 Summary of Water User Group – City of Richland Hills

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**8,401**	**9,001**	**9,601**	**10,850**	**12,000**	**13,500**
Projected Demands						
Municipal Demand	1,148	1,185	1,228	1,371	1,512	1,700
Total Projected Demand	***1,148***	***1,185***	***1,228***	***1,371***	***1,512***	***1,700***
Currently Available Supplies						
Trinity Aquifer	242	242	242	242	242	242
TRWD through Fort Worth	906	831	770	796	825	875
Total Currently Available Supplies	***1,148***	***1,073***	***1,012***	***1,038***	***1,067***	***1,117***
Need (Demand – Supply)	***0***	***112***	***216***	***333***	***445***	***583***
Water Management Strategies						
Water Conservation	10	14	12	20	29	38
TRWD through Fort Worth	0	98	204	313	416	545
Total Supplies from Strategies	***10***	***112***	***216***	***333***	***445***	***583***
Reserve (Shortage)	**10**	**0**	**0**	**0**	**0**	**0**

River Oaks

River Oaks is located in western Tarrant County. The city operates its own water treatment plant and gets raw water from Tarrant Regional Water District (TRWD). Water management strategies for River Oaks includes conservation and purchasing water from TRWD. **Table 5E.376** shows the projected population and demand, the current supplies, and the water management strategies for River Oaks.

Table 5E.376 Summary of Water User Group – City of River Oaks

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**7,559**	**7,559**	**7,559**	**7,559**	**7,559**	**7,559**
Projected Demands						
Municipal Demand	856	823	796	781	778	778
Total Projected Demand	***856***	***823***	***796***	***781***	***778***	***778***
Currently Available Supplies						
TRWD	856	725	623	551	505	467
Total Currently Available Supplies	***856***	***725***	***623***	***551***	***505***	***467***
Need (Demand – Supply)	***0***	***98***	***173***	***230***	***273***	***311***
Water Management Strategies						
Water Conservation	11	13	8	10	13	16
TRWD	0	85	165	220	260	295
Total Supplies from Strategies	***11***	***98***	***173***	***230***	***273***	***311***
Reserve (Shortage)	**11**	**0**	**0**	**0**	**0**	**0**

Saginaw

Saginaw is located in northern Tarrant County. The city's water supply is treated water from Fort Worth, which gets raw water from Tarrant Regional Water District (TRWD). Water management strategies for Saginaw include conservation and treated water from Fort Worth. **Table 5E.377** shows the projected population and demand, the current supplies, and the water management strategies for Saginaw.

Table 5E.377 Summary of Water User Group – City of Saginaw

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**23,166**	**26,386**	**29,607**	**31,218**	**31,218**	**31,218**
Projected Demands						
Municipal Demand	3,169	3,528	3,903	4,087	4,080	4,079
Total Projected Demand	***3,169***	***3,528***	***3,903***	***4,087***	***4,080***	***4,079***
Currently Available Supplies						
TRWD through Fort Worth	3,169	3,109	3,050	2,882	2,648	2,451
Total Currently Available Supplies	***3,169***	***3,109***	***3,050***	***2,882***	***2,648***	***2,451***
Need (Demand – Supply)	***0***	***419***	***853***	***1,205***	***1,432***	***1,628***
Water Management Strategies						
Water Conservation	205	243	245	267	280	294
TRWD through Fort Worth	0	176	608	938	1,152	1,334
Total Supplies from Strategies	***205***	***419***	***853***	***1,205***	***1,432***	***1,628***
Reserve (Shortage)	**205**	**0**	**0**	**0**	**0**	**0**

Sansom Park Village

Sansom Park Village is located in western Tarrant County. The city gets its water supply from groundwater from the Trinity aquifer and treated water from Fort Worth, which gets raw water from Tarrant Regional Water District (TRWD). Sansom Park Village's water management strategies include conservation and water from Fort Worth. **Table 5E.378** shows the projected population and demand, the current supplies, and the water management strategies for Sansom Park Village.

Table 5E.378 Summary of Water User Group – Sansom Park Village

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**4,799**	**5,099**	**5,722**	**6,063**	**6,405**	**6,739**
Projected Demands						
Municipal Demand	534	544	591	617	649	683
Total Projected Demand	***534***	***544***	***591***	***617***	***649***	***683***
Currently Available Supplies						
Trinity Aquifer	578	578	578	578	578	578
TRWD through Fort Worth	0	0	10	27	45	63
Total Currently Available Supplies	***578***	***578***	***588***	***605***	***623***	***641***
Need (Demand – Supply)	***0***	***0***	***3***	***12***	***26***	***42***
Water Management Strategies						
Water Conservation	5	7	6	8	11	14
TRWD through Fort Worth	0	0	0	4	15	28
Total Supplies from Strategies	***5***	***7***	***6***	***12***	***26***	***42***
Reserve (Shortage)	**49**	**41**	**3**	**0**	**0**	**0**

Southlake

Southlake is located in northwestern Tarrant County, with some area in southern Denton County. The city's water supply is treated water from Fort Worth, which gets raw water from Tarrant Regional Water District (TRWD). Water management strategies for Southlake include conservation and additional treated water from Fort Worth, which requires additional delivery infrastructure from Fort Worth. **Table 5E.379** shows the projected population and demand, the current supplies, and the water management strategies for Southlake.

Table 5E.379 Summary of Water User Group – City of Southlake

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**27,709**	**31,192**	**36,524**	**41,900**	**47,341**	**52,848**
Projected Demands						
Municipal Demand	11,455	12,813	14,945	17,109	19,314	21,556
Total Projected Demand	***11,455***	***12,813***	***14,945***	***17,109***	***19,314***	***21,556***
Currently Available Supplies						
TRWD through Fort Worth	11,455	11,291	11,680	12,065	12,539	12,949
Total Currently Available Supplies	***11,455***	***11,291***	***11,680***	***12,065***	***12,539***	***12,949***
Need (Demand – Supply)	***0***	***1,522***	***3,265***	***5,044***	***6,775***	***8,607***
Water Management Strategies						
Water Conservation	509	712	807	981	1,170	1,380
TRWD through Fort Worth	0	810	2,458	4,063	5,605	7,227
Additional delivery infrastructure from Fort Worth	*0*	*0*	*1,807*	*3,797*	*5,813*	*7,845*
Total Supplies from Strategies	***509***	***1,522***	***3,265***	***5,044***	***6,775***	***8,607***
Reserve (Shortage)	**509**	**0**	**0**	**0**	**0**	**0**

Tarrant County Irrigation

Irrigation demand projections include the water necessary for irrigation activities, including field crops, orchards, pasture, turf grass, vineyards, golf courses irrigated by raw water, and limited aquaculture operations. The vast majority of irrigation use in Tarrant County is for golf course irrigation. The current supplies are local surface water supplies (Trinity run-of-river), groundwater (Trinity and Woodbine aquifers), indirect reuse through Grapevine, direct reuse from Azle and Fort Worth, supplies from TRWD (direct and through Arlington), and Fort Worth reuse through Arlington. Water management strategies for Tarrant County Irrigation includes water from TRWD (both direct and through Arlington). **Table 5E.380** shows the projected demand, the current supplies, and the water management strategies for Tarrant County Irrigation.

The Texas Water Development Board classifies the use of potable water for golf course irrigation as a part of municipal use. The use of raw water or reuse of treated wastewater effluent for golf course irrigation is classified as irrigation use.

Table 5E.380 Summary of Water User Group – Tarrant County Irrigation

(Values in Acre-feet per year)	2020	2030	2040	2050	2060	2070
Projected Demands						
Total Projected Demand	**4,926**	**4,926**	**4,926**	**4,926**	**4,926**	**4,926**
Currently Available Supplies						
Local Supplies	549	549	549	549	549	549
Trinity Aquifer	752	752	752	752	752	752
Woodbine Aquifer	632	632	632	632	632	632
Indirect Reuse from Dallas County Park Cities through Grapevine	1,121	1,121	1,121	1,121	1,121	1,121
Direct Reuse from Azle	300	300	300	300	300	300
TRWD	1,478	1,303	1,156	1,043	959	888
TRWD through Arlington	103	91	80	72	67	62
Fort Worth Reuse through Arlington	178	178	178	178	178	178
Direct Reuse from Fort Worth	2,000	2,000	2,000	2,000	2,000	2,000
Total Currently Available Supplies	***7,113***	***6,926***	***6,768***	***6,647***	***6,558***	***6,482***
Need (Demand – Supply)	***0***	***0***	***0***	***0***	***0***	***0***
Water Management Strategies						
TRWD	0	175	322	435	519	590
TRWD through Arlington	0	12	23	31	36	41
Total Supplies from Strategies	***0***	***187***	***345***	***466***	***555***	***631***
Reserve (Shortage)	**2,187**	**2,187**	**2,187**	**2,187**	**2,187**	**2,187**

Tarrant County Livestock

Livestock water use is defined as water used in the production of livestock, both for consumption and for cleaning and environmental purposes. The current supplies are local surface water supplies and groundwater from the Trinity aquifer. The only recommended water management strategy is new well(s) in the Trinity aquifer. **Table 5E.381** shows the projected demand, current supplies, and water management strategies for Tarrant County Livestock.

Table 5E.381 Summary of Water User Group – Tarrant County Livestock

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Demands						
Total Projected Demand	**627**	**627**	**627**	**627**	**627**	**627**
Currently Available Supplies						
Trinity Aquifer	110	110	110	110	110	110
Local Supplies	442	442	442	442	442	442
Total Currently Available Supplies	***552***	***552***	***552***	***552***	***552***	***552***
Need (Demand – Supply)	***75***	***75***	***75***	***75***	***75***	***75***
Water Management Strategies						
New Well(s) in Trinity Aquifer	75	75	75	75	75	75
Total Supplies from Strategies	***75***	***75***	***75***	***75***	***75***	***75***
Reserve (Shortage)	**0**	**0**	**0**	**0**	**0**	**0**

Tarrant County Manufacturing

Manufacturing water use is defined as water used to produce manufactured goods. Current supplies are water from the Tarrant Regional Water District (TRWD) through numerous water suppliers in the county, and groundwater from the Trinity aquifer. The water management strategies for this water user group are additional water from TRWD (through various water suppliers). **Table 5E.382** shows the projected demand, current supplies, and water management strategies for Tarrant County Manufacturing. Conservation was considered for this water user group, but it is not recommended because of the uncertainty in the ability to implement conservation measures given the multiple entities, facilities, and various manufacturing processes that make up this WUG.

Table 5E.382 Summary of Water User Group – Tarrant County Manufacturing

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Demands						
Total Projected Demand	**12,197**	**13,301**	**13,301**	**13,301**	**13,301**	**13,301**
Currently Available Supplies						
Trinity Aquifer	256	256	256	256	256	256
Trinity Aquifer through Kennedale	24	27	27	27	27	27
TRWD through Fort Worth	9,612	9,257	8,210	7,408	6,820	6,311
TRWD through Arlington	1,995	1,917	1,700	1,534	1,413	1,307
TRWD through Mansfield	205	170	146	125	113	102
TRWD through Grand Prairie	73	41	27	21	18	17
Total Currently Available Supplies	***12,165***	***11,668***	***10,366***	***9,371***	***8,647***	***8,020***
Need (Demand – Supply)	***32***	***1,633***	***2,935***	***3,930***	***4,654***	***5,281***
Water Management Strategies						
TRWD through Fort Worth	0	1,248	2,295	3,097	3,685	4,194
TRWD through Arlington	5	264	481	647	768	874
TRWD through Mansfield	15	69	93	114	126	137
TRWD through Grand Prairie	12	52	66	72	75	76
Total Supplies from Strategies	***32***	***1,633***	***2,935***	***3,930***	***4,654***	***5,281***
Reserve (Shortage)	**0**	**0**	**0**	**0**	**0**	**0**

Tarrant County Mining

Mining water demand includes water used for oil and gas development, as well as extraction of coal and lignite, sand aggregate, and other resources. Tarrant County Mining is supplied from local supplies, water from Tarrant Regional Water District (TRWD) direct and through Arlington, reuse water from Fort Worth and the Trinity aquifer. The only recommended water management strategy for this water user group is additional water from TRWD. **Table 5E.383** shows the projected demand, the current supplies, and the water management strategies for Tarrant County Mining. Conservation was considered for this water user group, but it is not recommended because of the uncertainty in the ability to implement conservation measures given the multiple companies, industries, facilities, and types of processes that make up this WUG.

Table 5E.383 Summary of Water User Group – Tarrant County Mining

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Demands						
Total Projected Demand	**11,535**	**6,562**	**1,589**	**1,537**	**1,497**	**1,464**
Currently Available Supplies						
Local Supplies	342	342	342	342	342	342
TRWD	3,566	901	0	0	0	0
TRWD through Arlington	105	92	82	74	68	63
Reuse through Fort Worth	1,754	1,811	1,677	1,677	1,677	1,677
Trinity Aquifer	5,768	5,768	5,768	5,768	5,768	5,768
Total Currently Available Supplies	***11,535***	***8,914***	***7,869***	***7,861***	***7,855***	***7,850***
Need (Demand – Supply)	***0***	***0***	***0***	***0***	***0***	***0***
Water Management Strategies						
TRWD	0	122	0	0	0	0
Total Supplies from Strategies	***0***	***122***	***0***	***0***	***0***	***0***
Reserve (Shortage)	**0**	**2,474**	**6,280**	**6,324**	**6,358**	**6,386**

Tarrant County Other

Tarrant County Other includes individual domestic supplies and water suppliers too small to be classified as water user groups (including the Dallas-Fort Worth International Airport). The Tarrant County Other supply comes from the Tarrant Regional Water District (TRWD) direct and through Fort Worth, reuse, Dallas Water Utilities (DWU), and groundwater (Trinity aquifer). The cities of Dallas and Fort Worth both serve the Dallas-Fort Worth International Airport. Water management strategies for these entities include conservation, and additional water from TRWD (direct and through Fort Worth), and additional water from DWU. An alternative future strategy would be to get water from the City of Euless in place of a portion of the supply from Fort Worth. **Table 5E.384** shows the projected population and demand, the current supplies, and the water management strategies for Tarrant County Other.

Table 5E.384 Summary of Water User Group – Tarrant County Other

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**31,254**	**29,358**	**27,021**	**49,948**	**69,001**	**97,840**
Projected Demands						
Municipal Demand	7,212	6,774	6,296	9,847	12,753	17,316
Total Projected Demand	***7,212***	***6,774***	***6,296***	***9,847***	***12,753***	***17,316***
Currently Available Supplies						
Trinity Aquifer	600	600	600	600	600	600
TRWD	231	184	144	255	330	442
TRWD through Fort Worth	5,014	4,051	3,185	5,254	6,629	8,739
Reuse through Fort Worth for DFW Airport	33	33	100	100	100	100
DWU for DFW Airport	1,281	1,219	1,105	1,019	971	932
Total Currently Available Supplies	***7,159***	***6,087***	***5,134***	***7,228***	***8,630***	***10,813***
Need (Demand – Supply)	***53***	***687***	***1,162***	***2,619***	***4,123***	***6,503***
Water Management Strategies						
Water Conservation	255	282	252	426	596	865
TRWD	0	25	41	107	178	294
TRWD through Fort Worth	0	264	639	1,770	2,985	4,941
DWU for DFW Airport	54	116	230	316	364	403
Total Supplies from Strategies	***309***	***687***	***1,162***	***2,619***	***4,123***	***6,503***
Reserve (Shortage)	**256**	**0**	**0**	**0**	**0**	**0**
Alternative Strategy						
Purchase Water from Euless	*0*	*1,000*	*1,000*	*2,000*	*2,000*	*2,000*

Tarrant County Steam Electric Power

Steam electric power demands do not include water that is used in cogeneration facilities (which is included in manufacturing projections), facilities which do not require water for production, or hydro-electric generation facilities. Tarrant County's Steam Electric Power demand is attributed to Luminant Generation Company LLC. Tarrant County SEP is supplied from run-of-the-river supplies and raw water from Tarrant Regional Water District (TRWD). Water management strategies for Tarrant County SEP include additional water from TRWD and reuse (from an unknown future Tarrant County wastewater treatment plant). **Table 5E.385** shows the projected demand, the current supplies, and the water management strategies for Tarrant County SEP. Conservation was considered for this water user group, but it is not recommended because the steam electric demand projections themselves included assumed future efficiency programs.

Table 5E.385 Summary of Water User Group – Tarrant County SEP

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Demands						
Total Projected Demand	**1,157**	**4,948**	**4,948**	**4,948**	**4,948**	**4,948**
Currently Available Supplies						
Run-of-River	959	959	959	959	959	959
TRWD	198	2,168	1,273	1,149	1,057	979
Total Currently Available Supplies	***1,157***	***3,127***	***2,232***	***2,108***	***2,016***	***1,938***
Need (Demand – Supply)	***0***	***1,821***	***2,716***	***2,840***	***2,932***	***3,010***
Water Management Strategies						
TRWD	0	293	356	480	572	650
Reuse	0	1,528	2,360	2,360	2,360	2,360
Total Supplies from Strategies	***0***	***1,821***	***2,716***	***2,840***	***2,932***	***3,010***
Reserve (Shortage)	**0**	**0**	**0**	**0**	**0**	**0**

Watauga

Watauga is located in northern Tarrant County. The city's water supply is treated water from North Richland Hills (which in turn buys treated water from Fort Worth, which gets raw water from Tarrant Regional Water District (TRWD)). Water management strategies for Watauga include conservation and additional treated water from North Richland Hills. **Table 5E.386** shows the projected population and demand, the current supplies, and the water management strategies for Watauga.

Table 5E.386 Summary of Water User Group – City of Watauga

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**24,525**	**24,525**	**24,525**	**24,525**	**24,525**	**24,525**
Projected Demands						
Municipal Demand	2,844	2,740	2,655	2,608	2,600	2,599
Total Projected Demand	***2,844***	***2,740***	***2,655***	***2,608***	***2,600***	***2,599***
Currently Available Supplies						
TRWD through North Richland Hills	2,844	2,415	2,075	1,839	1,688	1,561
Total Currently Available Supplies	***2,844***	***2,415***	***2,075***	***1,839***	***1,688***	***1,561***
Need (Demand – Supply)	***0***	***325***	***580***	***769***	***912***	***1,038***
Water Management Strategies						
Water Conservation	112	121	114	120	128	136
TRWD through North Richland Hills	0	204	466	649	784	902
Additional delivery infrastructure from Fort Worth (jointly with North Richland Hills)	*See North Richland Hills.*					
Total Supplies from Strategies	***112***	***325***	***580***	***769***	***912***	***1,038***
Reserve (Shortage)	**112**	**0**	**0**	**0**	**0**	**0**

Westlake

Westlake is located in northern Tarrant County and southern Denton County. The city's water supply is treated water from Fort Worth, which gets raw water from Tarrant Regional Water District (TRWD). Water management strategies for Westlake include conservation and additional treated water from Fort Worth. **Table 5E.387** shows the projected population and demand, the current supplies, and the water management strategies for Westlake.

Table 5E.387 Summary of Water User Group – City of Westlake

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**1,541**	**4,234**	**6,927**	**7,750**	**7,750**	**7,750**
Projected Demands						
Municipal Demand	1,782	4,884	7,982	8,927	8,925	8,925
Total Projected Demand	***1,782***	***4,884***	***7,982***	***8,927***	***8,925***	***8,925***
Currently Available Supplies						
TRWD through Fort Worth	1,782	4,303	5,951	5,989	5,690	5,362
Total Currently Available Supplies	***1,782***	***4,303***	***5,951***	***5,989***	***5,690***	***5,362***
Need (Demand – Supply)	***0***	***581***	***2,031***	***2,938***	***3,235***	***3,563***
Water Management Strategies						
Water Conservation	15	268	460	545	575	605
TRWD through Fort Worth	0	581	2,031	2,938	3,024	3,024
Total Supplies from Strategies	***15***	***849***	***2,491***	***3,483***	***3,599***	***3,629***
Reserve (Shortage)	**15**	**268**	**460**	**545**	**364**	**66**

Westover Hills

Westover Hills is located in western Tarrant County. The city purchases treated water from Fort Worth, which gets raw water from Tarrant Regional Water District (TRWD). Westover Hills' water management strategies includes conservation and water from Fort Worth. **Table 5E.388** shows the projected population and demand, the current supplies, and the water management strategies for Westover Hills.

Table 5E.388 Summary of Water User Group – City of Westover Hills

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**682**	**699**	**715**	**732**	**749**	**764**
Projected Demands						
Municipal Demand	929	949	968	990	1,013	1,033
Total Projected Demand	***929***	***949***	***968***	***990***	***1,013***	***1,033***
Currently Available Supplies						
TRWD through Fort Worth	929	836	756	699	658	621
Total Currently Available Supplies	***929***	***836***	***756***	***699***	***658***	***621***
Need (Demand – Supply)	***0***	***113***	***212***	***291***	***355***	***412***
Water Management Strategies						
Water Conservation	8	71	105	111	116	122
TRWD through Fort Worth	0	42	107	180	239	290
Total Supplies from Strategies	***8***	***113***	***212***	***291***	***355***	***412***
Reserve (Shortage)	**8**	**0**	**0**	**0**	**0**	**0**

Westworth Village

Westworth Village is located in western Tarrant County. The city's water supply is treated water from Fort Worth, which gets raw water from Tarrant Regional Water District (TRWD). Water management strategies for Westworth Village include conservation and treated water from Fort Worth. **Table 5E.389** shows the projected population and demand, the current supplies, and the water management strategies for Westworth Village.

Table 5E.389 Summary of Water User Group – Westworth Village

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**2,741**	**2,989**	**3,235**	**3,473**	**3,712**	**3,947**
Projected Demands						
Municipal Demand	401	423	447	475	506	538
Total Projected Demand	***401***	***423***	***447***	***475***	***506***	***538***
Currently Available Supplies						
TRWD through Fort Worth	401	373	349	334	328	323
Total Currently Available Supplies	***401***	***373***	***349***	***334***	***328***	***323***
Need (Demand – Supply)	***0***	***50***	***98***	***141***	***178***	***215***
Water Management Strategies						
Water Conservation	3	5	4	6	8	11
TRWD through Fort Worth	0	45	94	135	170	204
Total Supplies from Strategies	***3***	***50***	***98***	***141***	***178***	***215***
Reserve (Shortage)	**3**	**0**	**0**	**0**	**0**	**0**

White Settlement

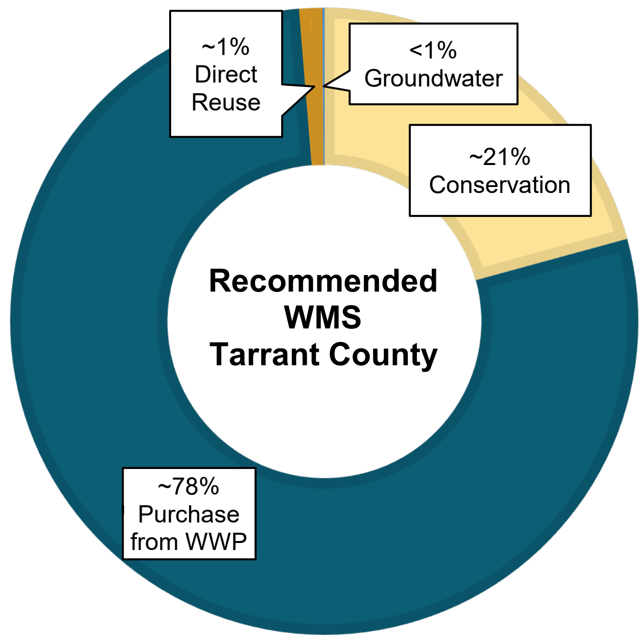
White Settlement is located in western Tarrant County. The city's water supply is treated water from Fort Worth, which gets raw water from Tarrant Regional Water District (TRWD) and groundwater from the Trinity aquifer. Water management strategies for White Settlement include conservation and additional treated water from Fort Worth. **Table 5E.390** shows the projected population and demand, the current supplies, and the water management strategies for White Settlement.

Table 5E.390 Summary of Water User Group – City of White Settlement

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**16,957**	**17,858**	**18,750**	**22,000**	**28,000**	**34,000**
Projected Demands						
Municipal Demand	2,081	2,107	2,145	2,472	3,132	3,797
Total Projected Demand	***2,081***	***2,107***	***2,145***	***2,472***	***3,132***	***3,797***
Currently Available Supplies						
Trinity Aquifer	610	610	610	610	610	610
TRWD through Fort Worth	1,471	1,320	1,200	1,313	1,638	1,915
Total Currently Available Supplies	***2,081***	***1,930***	***1,810***	***1,923***	***2,248***	***2,525***
Need (Demand – Supply)	***0***	***177***	***335***	***549***	***884***	***1,272***
Water Management Strategies						
Water Conservation	20	30	26	39	60	85
TRWD through Fort Worth	0	147	309	510	824	1,187
Total Supplies from Strategies	***20***	***177***	***335***	***549***	***884***	***1,272***
Reserve (Shortage)	**20**	**0**	**0**	**0**	**0**	**0**

5E.15.2 Summary of Costs for Tarrant County

Table 5E.391 summarizes the costs of the water management strategies recommended for the WUGs and WWPs who have the majority of their demand located in Tarrant County. Total quantities from **Table 5E.391** will not necessarily match total county demands. This is due mainly to water users whose sum of strategies results in a reserve as well as due to water users located in multiple counties (or wholesale water providers who develop strategies and then sell water to users in other counties). Quantities from infrastructure projects needed to deliver and/or treat water (shown in *gray italics*) are not included since the supplies are associated with other strategies. To avoid double-counting quantities of supplies, the quantities in gray italics are **not** included in the total.



The majority of the future supplies needed to meet demands within Tarrant County are projected to come through purchases from wholesale water providers. Other strategies include conservation, direct reuse and groundwater.

Table 5E.392 summarizes the recommended water management strategies within Tarrant County for individual WUGs and WWPs. Alternative strategies are also included. More detailed cost estimates are located in **Appendix H.**

Table 5E.391 Summary of Recommended Water Management Strategies for Tarrant County

Type of Strategy	Quantity (Ac-Ft/Yr)	Capital Costs
Conservation[a]	41,340	$230,769,607
Purchase from WWP	155,272	$0
Additional Infrastructure	*60,627*	*$268,465,000*
Direct Reuse	2,360	$13,150,000
Groundwater	179	$2,526,000
Total	**199,151**	**$514,910,607**

[a]The conservation quantities represent the sum of the individual water user groups who have the majority of their service areas located in the county, not the total conservation in the county.

Table 5E.392 Costs for Recommended and Alternative Water Management Strategies for Tarrant County

WWP or WUG	Strategy	Online by:	Quantity (Ac-Ft/Yr)[b]	Capital Costs[c]	Unit Cost ($/1000 gal) With Debt Service	Unit Cost ($/1000 gal) After Debt Service	Table
WWPs							
Arlington	Conservation (retail)	2020	5,837	$8,740,436	$1.03	$0.13	H.11
	Conservation (wholesale)	2020	Included with WUGs.				
	TRWD	2030	37,500	$0	$1.26	$1.26	None
Mansfield	Conservation (retail)	2020	2,553	$3,734,784	$1.28	$0.19	H.11
	Conservation (wholesale)	2020	Included with WUGs.				
	TRWD	2020	37,184	$0	$1.26	$1.26	None
	15 MGD Existing WTP Expansion	*2020*	*8,408*	*$44,021,000*	*$1.94*	*$0.81*	*H.13*
	35 MGD New WTP	*2030*	*19,618*	*$87,389,000*	*$1.65*	*$0.69*	*H.13*
	20 MGD New WTP Expansion	*2060*	*9,158*	*$54,863,000*	*$1.81*	*$0.76*	*H.13*
North Richland Hills	Conservation (retail)	2020	883	$2,095,999	$0.71	$0.13	H.11
	Conservation (wholesale)	2020	Included with WUGs.				
	TRWD through TRA	2040	863	$0	$3.61	$3.61	None
	TRWD through Fort Worth	2030	4,393	$0	$1.63	$1.63	None
	New Pipeline from Fort Worth (Cost share with Watagua)	*2030*	*4,393*	*$9,544,000*	*$0.64*	*$0.18*	*H.165*
WUGs							
Azle[a]	Conservation	2020	80	$269,308	$2.08	$0.00	H.11
	TRWD	2020	1,767	$0	$1.26	$1.26	None
	WTP Expansion	*2030*	*1,767*	*$25,410,000*	*$4.37*	*$1.92*	*H.13*
Bedford	Conservation	2020	592	$1,762,821	$0.38	$0.28	H.11
	TRWD through TRA	2040	3,530	$0	$3.61	$3.61	None
Benbrook	Conservation	2020	603	$273,621	$1.00	$0.54	H.11
	TRWD	2020	3,387	$0	$1.26	$1.26	None
	3 MGD WTP Expansion	*2030*	*1,682*	*$14,102,000*	*$3.37*	*$1.56*	*H.13*

WWP or WUG	Strategy	Online by:	Quantity (Ac-Ft/Yr)[b]	Capital Costs[c]	Unit Cost ($/1000 gal) With Debt Service	Unit Cost ($/1000 gal) After Debt Service	Table
Bethesda WSC[a]	Conservation	2020	196	$197,156	$0.88	$0.29	H.11
	Arlington	2030	989	$0	$3.38	$3.38	None
	Fort Worth	2030	2,172	$0	$1.63	$1.63	None
Burleson[a]	Conservation	2020	141	$132,685	$0.60	$0.05	H.11
	TRWD through Fort Worth	2030	5,063	$0	$1.63	$1.63	None
	Additional delivery infrastructure from Fort Worth	*2050*	*2,641*	*$4,688,000*	*$0.50*	*$0.12*	*H.156*
Colleyville	Conservation	2020	835	$1,615,494	$1.87	$0.11	H.11
	TRWD through TRA	2030	3,417	$0	$3.61	$3.61	None
Community WSC	Conservation	2020	10	$6,859	$0.49	$0.00	H.11
	TRWD	2030	186	$0	$1.26	$1.26	None
Crowley	Conservation	2020	296	$118,084	$0.27	$0.00	H.11
	Fort Worth	2030	2,975	$0	$1.63	$1.63	None
	Additional delivery infrastructure from Fort Worth	*2030*	*2,975*	$3,274,000	$0.32	$0.08	H.157
Dalworthington Gardens	Conservation	2020	58	$41,616	$1.12	$0.21	H.11
	Arlington	2030	157	$0	$3.38	$3.38	None
	Fort Worth	2030	176	$0	$1.63	$1.63	None
Edgecliff Village	Conservation	2020	27	$76,154	$3.29	$0.52	H.11
	Fort Worth	2030	162	$0	$1.63	$1.63	None
Euless	Conservation	2020	504	$1,541,130	$0.74	$0.00	H.11
	TRWD through TRA	2030	2,099	$0	$3.61	$3.61	None
	ALTERNATIVE TRWD through TRA (to replace groundwater)	2020	2,106	$0	$3.61	$3.61	None
Everman	Conservation	2020	25	$51,306	$0.53	$0.00	H.11
Flower Mound	Conservation	See Denton County.					
	DWU						
	UTRWD						
Forest Hill	Conservation	2020	63	$191,853	$2.96	$0.00	H.11
	TRWD through Fort Worth	2030	1,183	$0	$1.63	$1.63	None

WWP or WUG	Strategy	Online by:	Quantity (Ac-Ft/Yr)[b]	Capital Costs[c]	Unit Cost ($/1000 gal) With Debt Service	Unit Cost ($/1000 gal) After Debt Service	Table
Fort Worth[a]	Conservation	2020	21,247	$195,851,589	$1.63	$0.09	H-11
Fort Worth[a]	Other WMSs	See Fort Worth in **Chapter 5D**.					
Grand Prairie[a]	Conservation	See Dallas County.					
Grand Prairie[a]	Other WMSs						
Grapevine	Conservation	2020	1,303	$3,773,715	$0.85	$0.06	H.11
	TRWD through TRA	2020	3,576	$0	$3.61	$3.61	None
	DWU	2030	574	$0	$4.05	$4.05	None
	ALTERNATIVE Purchase unused Lake Grapevine yield from DCPCMUD	*2020*	*5,000*	*$0*	*$0.00*	*$0.00*	*None*
Haltom City	Conservation	2020	459	$761,824	$0.56	$0.00	H.11
	TRWD through Fort Worth	2030	2,169	$0	$1.63	$1.63	None
Haslet	Conservation	2020	331	$72,056	$3.11	$0.29	H.11
	TRWD through Fort Worth	2020	1,443	$0	$1.63	$1.63	None
Hurst	Conservation	2020	371	$1,062,568	$0.70	$0.18	H.11
	TRWD through Fort Worth	2030	2,058	$0	$1.63	$1.63	None
Johnson County SUD[a]	Conservation	2020	10	$6,197	$0.45	$0.00	H.11
	TRWD through Mansfield	2020	5,046	$0	$3.00	$3.00	None
Keller	Conservation	2020	978	$1,328,066	$0.37	$0.08	H.11
	TRWD through Fort Worth	2030	4,217	$0	$1.63	$1.63	None
Kennedale	Conservation	2020	175	$172,467	$3.10	$0.47	H.11
	TRWD through Fort Worth	2040	509	$0	$1.63	$1.63	None
	Additional Delivery Infrastructure from Ft Worth	*2040*	*893*	*$4,496,000*	*$1.27*	*$0.19*	*H.160*
	Arlington	2030	280	$0	$3.38	$3.38	None
	Connect to Arlington	*2030*	*280*	*$2,004,000*	*$1.86*	*$0.32*	*H.159*
Lake Worth	Conservation	2020	151	$2,384,665	$51.49	$0.39	H.11
	TRWD through Fort Worth	2030	774	$0	$1.63	$1.63	None
Lakeside	Conservation	2020	31	$9,846	$1.02	$0.56	H.11

WWP or WUG	Strategy	Online by:	Quantity (Ac-Ft/Yr)[b]	Capital Costs[c]	Unit Cost ($/1000 gal) With Debt Service	Unit Cost ($/1000 gal) After Debt Service	Table
	New Well(s) in Trinity Aquifer	2020	80	$1,413,000	$5.69	$1.87	H.14
Pantego	Conservation	2020	13	$105,058	$4.54	$0.00	H.11
	Arlington	2030	30	$0	$3.38	$3.38	None
	Connect to Arlington	*2030*	*30*	*$894,000*	*$7.30*	*$0.87*	*H.161*
	Fort Worth	2030	30	$0	$1.63	$1.63	None
	Connect to Fort Worth	*2030*	*30*	*$1,459,000*	*$11.98*	*$1.48*	*H.162*
Pelican Bay	Conservation	2020	2	$4,028	$0.87	$0.00	H.11
	TRWD through Azle	2030	5	$0	$3.00	$3.00	None
	Connect to Azle (TRWD)	*2030*	*5*	*$1,589,000*	*$37.66*	*$3.34*	*H.163*
	New Well(s) in Trinity Aquifer	2020	24	$529,000	$5.57	$0.81	H.14
Reno	Conservation	See Parker County.					
	Walnut Creek SUD						
Richland Hills	Conservation	2020	38	$62,079	$1.34	$0.11	H.11
	TRWD through Fort Worth	2030	545	$0	$1.63	$1.63	None
River Oaks	Conservation	2020	16	$118,161	$2.32	$0.00	H.11
	TRWD through Fort Worth	2030	295	$0	$1.26	$1.26	None
Saginaw	Conservation	2020	294	$1,169,389	$1.23	$0.00	H.11
	TRWD through Fort Worth	2030	1,334	$0	$1.63	$1.63	None
Sansom Park	Conservation	2020	14	$5,993	$0.26	$0.00	H.11
	TRWD through Fort Worth	2050	28	$0	$1.63	$1.63	None
Southlake[a]	Conservation	2020	1,380	$1,977,712	$0.99	$0.16	H.11
	TRWD through Fort Worth	2030	7,227	$0	$1.63	$1.63	None
	Additional Delivery Infrastructure from Ft Worth	*2040*	*7,845*	*$12,772,000*	*$0.44*	*$0.09*	*H.164*
Watauga	Conservation	2020	136	$451,306	$0.87	$0.00	H.11
	North Richland Hills	2030	902	$0	$3.00	$3.00	None

WWP or WUG	Strategy	Online by:	Quantity (Ac-Ft/Yr)[b]	Capital Costs[c]	Unit Cost ($/1000 gal) With Debt Service	Unit Cost ($/1000 gal) After Debt Service	Table
	Additional delivery infrastructure North Richland Hills/Fort Worth	*2030*	*902*	*$1,960,000*	*$0.64*	*$0.18*	*H.165*
Westlake[a]	Conservation	2020	605	$42,776	$0.62	$0.06	H.11
	TRWD through Fort Worth	2030	3,024	$0	$1.63	$1.63	None
Westover Hills	Conservation	2020	122	$295,923	$7.99	$1.02	H.11
	TRWD through Fort Worth	2030	290	$0	$1.63	$1.63	None
Westworth Village	Conservation	2020	11	$62,467	$4.50	$0.00	H.11
	TRWD through Fort Worth	2020	204	$0	$1.63	$1.63	None
White Settlement	Conservation	2020	85	$53,447	$0.58	$0.00	H.11
	TRWD through Fort Worth	2030	1,187	$0	$1.63	$1.63	None
County Other and Non-Municipal							
County Other, Tarrant	Conservation	2020	865	$165,969	$0.32	$0.15	H.11
	TRWD	2030	294	$0	$1.26	$1.26	None
	TRWD through Fort Worth	2030	4,941	$0	$1.63	$1.63	None
	DWU	2020	403	$0	$4.05	$4.05	None
	ALTERNATIVE Water from Euless (TRA/TRWD) to DFW Airport (in lieu of portion of Ft Worth supply)	*2030*	*2,000*	*$6,417,000*	*$3.86*	*$3.16*	*H.166*
Irrigation, Tarrant	Arlington	2020	41	$0	$3.38	$3.38	None
	TRWD	2030	590	$0	$1.26	$1.26	None
Livestock, Tarrant	New Well(s) in Trinity Aquifer	2020	75	$584,000	$2.09	$0.41	H.14
Manufacturing, Tarrant	TRWD	2020	5,281	$0	$1.26	$1.26	None
Mining, Tarrant	TRWD	2030	122	$0	$1.26	$1.26	None
Steam Electric Power, Tarrant	TRWD	2030	650	$0	$1.26	$1.26	None
	Direct reuse	2030	2,360	$13,150,000	$1.96	$0.75	H.167

WWP or WUG	Strategy	Online by:	Quantity (Ac-Ft/Yr)[b]	Capital Costs[c]	Unit Cost ($/1000 gal)		Table
					With Debt Service	After Debt Service	

[a]Water User Groups extend into more than one county

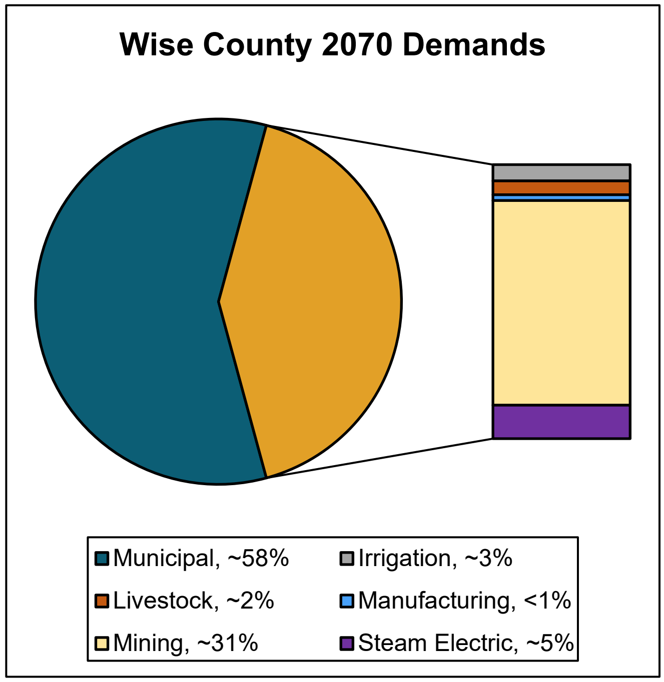
[b]Quantities listed are for the WUG only. They do not include the WUG's customers.
[c]Purchases from wholesale water providers that require no new infrastructure have no capital costs. The unit costs shown in the table represent the cost to purchase water from the WWP.

5E.16 Wise County

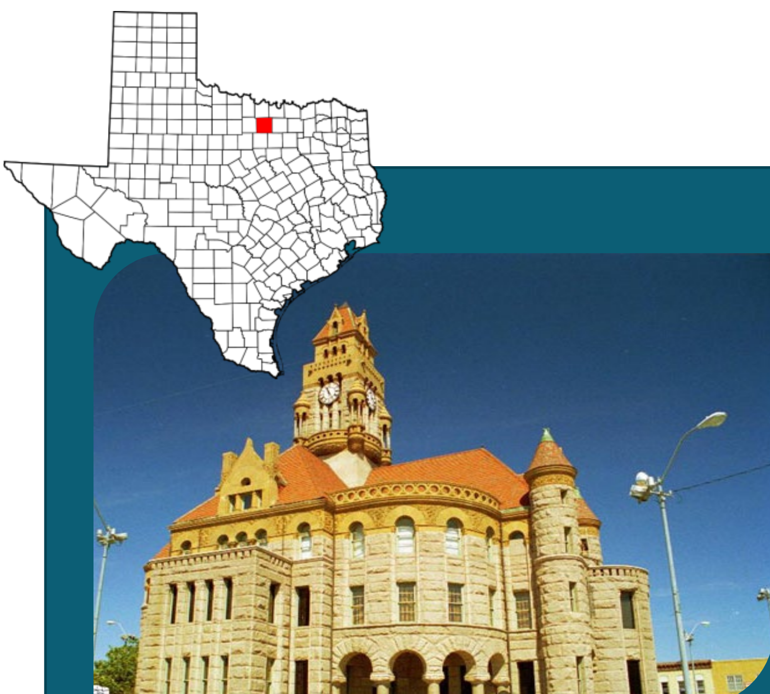
Wise County is located in the northwest portion of Region C. **Figure 5E.32** shows the service areas for water user groups in Wise County.

The population of Wise County is projected to more than double between 2020 and 2070. Wise County is a rural county, with Decatur and Bridgeport being its largest cities.

Municipal demands account for a little over half of the total county demand. Mining and steam electric power are the second and third largest demands. Livestock, irrigation and manufacturing demands combined account for approximately 5 percent of the total county demand.



An overall summary of the county's projections are shown in **Table 5E.393** and water management strategies for individual WWPs and WUGs are discussed on the following pages.



Wise County Quick Facts

2010 Population: 59,127

Projected 2070 Population: 208,872

Projected 2070 Demand: 51 MGD

County Seat: Decatur

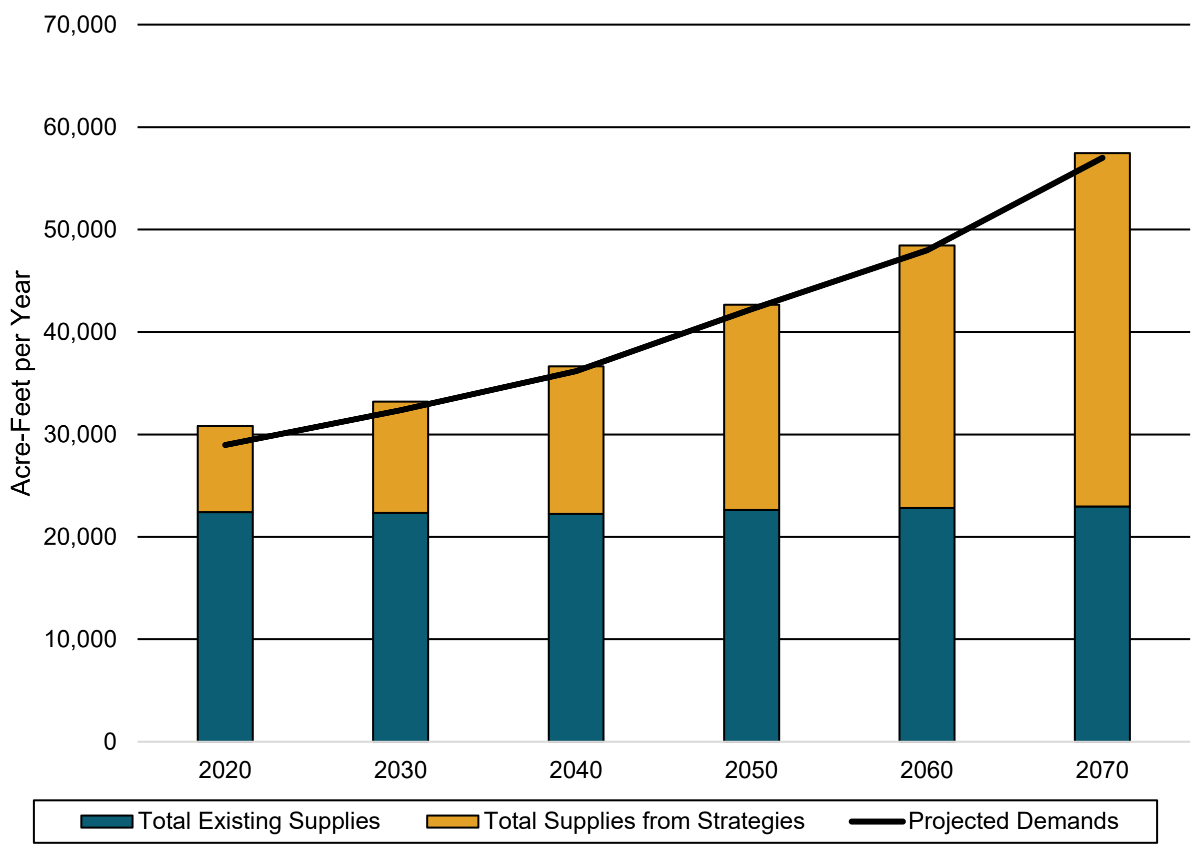
Economy: Petroleum; sand and gravel; agribusiness

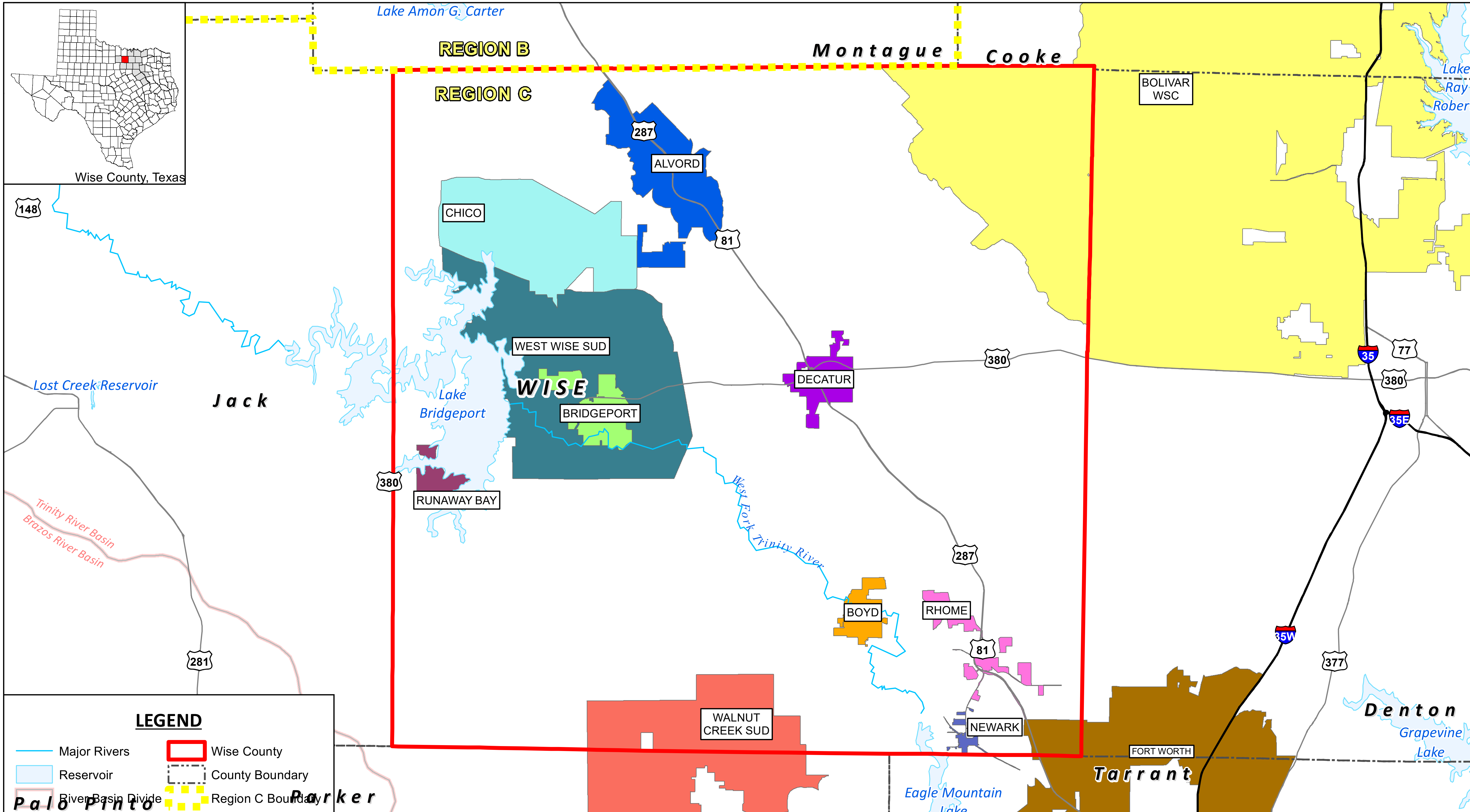
River Basins: Trinity (100%)

Table 5E.393 Summary of Wise County

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**79,882**	**95,086**	**110,343**	**135,797**	**162,282**	**208,872**
Projected Demands	**28,966**	**32,369**	**36,157**	**42,212**	**47,969**	**56,998**
Municipal	12,694	15,211	17,821	22,238	26,592	33,305
Irrigation	1,406	1,406	1,406	1,406	1,406	1,406
Livestock	1,198	1,198	1,198	1,198	1,198	1,198
Manufacturing	454	501	501	501	501	501
Mining	10,320	11,159	12,337	13,975	15,378	17,694
Steam Electric	2,894	2,894	2,894	2,894	2,894	2,894
Total Existing Supplies	**22,404**	**22,354**	**22,255**	**22,627**	**22,824**	**22,968**
Need (Demand - Supply)	**6,562**	**10,015**	**13,902**	**19,585**	**25,145**	**34,030**
Total Supplies from Strategies	**8,431**	**10,861**	**14,371**	**20,049**	**25,601**	**34,482**
Reserve (Shortage)	**1,869**	**846**	**469**	**464**	**456**	**452**

Figure 5E.31 Summary of Wise County





REGION C
Water Planning for North Texas

2021 Region C Water Plan

WISE COUNTY, TEXAS

FIGURE 5E.32

1 in = 4 miles
0 1 2 4 6
Miles

N W E S

Data Source(s): ESRI, USGS, TNRIS

TR116409: H:\WR_PLANNING\1 - Working\5E_County WMS\Wise1.mxd

5E.16.1 Wholesale Water Providers and Water User Groups

Water management strategies for Wise County wholesale water providers (WWPs) and water user groups (WUGs) are discussed below (in alphabetical order). The costs and a summary for Wise County are presented in **Section 5E.16.2.**

Alvord

Alvord is located in northern Wise County. The city's water supply is groundwater from the Trinity aquifer. Water management strategies for Alvord include conservation and treated water from West Wise SUD. **Table 5E.394** shows the projected population and demand, the current supplies, and the water management strategies for Alvord.

Table 5E.394 Summary of Water User Group – City of Alvord

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**1,625**	**1,957**	**2,297**	**2,800**	**3,200**	**3,600**
Projected Demands						
Municipal Demand	228	274	322	392	448	504
Total Projected Demand	***228***	***274***	***322***	***392***	***448***	***504***
Currently Available Supplies						
Trinity Aquifer	228	228	228	228	228	228
Total Currently Available Supplies	***228***	***228***	***228***	***228***	***228***	***228***
Need (Demand – Supply)	***0***	***46***	***94***	***164***	***220***	***276***
Water Management Strategies						
Water Conservation	2	3	3	5	7	10
TRWD through West Wise SUD	0	43	91	159	213	266
Connect to West Wise SUD	*0*	*43*	*91*	*159*	*213*	*266*
Total Supplies from Strategies	***2***	***46***	***94***	***164***	***220***	***276***
Reserve (Shortage)	**2**	**0**	**0**	**0**	**0**	**0**

Bolivar Water Supply Corporation

Bolivar WSC serves wholesale and retail customers in southern Cooke County and in Denton and Wise Counties. Plans for Bolivar WSC are covered under Denton County in **Section 5E.4**.

Boyd

Boyd is located in southeastern Wise County. The city's water supply is groundwater from the Trinity aquifer and treated water from Walnut Creek SUD, which gets its raw water from Tarrant Regional Water District (TRWD). Water management strategies for Boyd include conservation and additional treated water from Walnut Creek SUD. **Table 5E.395** shows the projected population and demand, the current supplies, and the water management strategies for Boyd.

Table 5E.395 Summary of Water User Group – City of Boyd

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**1,304**	**1,414**	**2,001**	**2,501**	**3,502**	**3,802**
Projected Demands						
Municipal Demand	217	229	316	391	547	593
Total Projected Demand	***217***	***229***	***316***	***391***	***547***	***593***
Currently Available Supplies						
Trinity Aquifer	153	153	153	153	153	153
TRWD through Walnut Creek SUD	50	50	94	100	119	100
Total Currently Available Supplies	***203***	***203***	***247***	***253***	***272***	***253***
Need (Demand – Supply)	***14***	***26***	***69***	***138***	***275***	***340***
Water Management Strategies						
Water Conservation	3	18	40	5	9	12
TRWD through Walnut Creek SUD	11	8	29	133	266	328
Total Supplies from Strategies	***14***	***26***	***69***	***138***	***275***	***340***
Reserve (Shortage)	**0**	**0**	**0**	**0**	**0**	**0**

Bridgeport

Bridgeport is located in western Wise County. The city buys raw water from Tarrant Regional Water District (TRWD) from Lake Bridgeport and operates its own water treatment plant. Water management strategies for Bridgeport include conservation, additional raw water from TRWD, water treatment plant expansions, and expansion for the lake intake and pump station. **Table 5E.396** shows the projected population and demand, the current supplies, and the water management strategies for Bridgeport.

Table 5E.396 Summary of Water User Group – City of Bridgeport

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**7,337**	**8,999**	**10,702**	**14,762**	**19,682**	**24,603**
Projected Demands						
Municipal Demand	1,273	1,526	1,793	2,456	3,268	4,083
Total Projected Demand	***1,273***	***1,526***	***1,793***	***2,456***	***3,268***	***4,083***
Currently Available Supplies						
TRWD	1,273	1,345	1,395	1,630	1,700	1,700
Total Currently Available Supplies	***1,273***	***1,345***	***1,395***	***1,630***	***1,700***	***1,700***
Need (Demand – Supply)	***0***	***181***	***398***	***826***	***1,568***	***2,383***
Water Management Strategies						
Water Conservation	10	82	110	162	225	296
TRWD	0	99	288	664	1,343	2,087
2 MGD WTP Expansion					*670*	*1,121*
1 MGD WTP Expansion						*293*
Expand Capacity of Lake intake and Pump Station					*670*	*1,414*
Total Supplies from Strategies	***10***	***181***	***398***	***826***	***1,568***	***2,383***
Reserve (Shortage)	**10**	**0**	**0**	**0**	**0**	**0**

Chico

Chico is located in western Wise County. The city's water supply is groundwater from the Trinity aquifer and treated water from West Wise SUD, which gets raw water from Tarrant Regional Water District (TRWD). Water management strategies for Chico include conservation and additional treated water from West Wise SUD with increased delivery infrastructure from West Wise SUD. **Table 5E.397** shows the projected population and demand, the current supplies, and the water management strategies for Chico.

Table 5E.397 Summary of Water User Group – City of Chico

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**1,412**	**1,487**	**1,565**	**2,955**	**3,761**	**4,702**
Projected Demands						
Municipal Demand	278	286	296	551	700	875
Total Projected Demand	***278***	***286***	***296***	***551***	***700***	***875***
Currently Available Supplies						
Trinity Aquifer	194	194	194	194	194	194
TRWD through West Wise SUD	84	81	79	111	111	111
Total Currently Available Supplies	***278***	***275***	***273***	***305***	***305***	***305***
Need (Demand – Supply)	***0***	***11***	***23***	***246***	***395***	***570***
Water Management Strategies						
Water Conservation	2	15	18	35	47	62
TRWD through West Wise SUD	0	0	5	211	348	508
Additional delivery capacity from West Wise SUD	*0*	*0*	*5*	*211*	*348*	*508*
Total Supplies from Strategies	***2***	***15***	***23***	***246***	***395***	***570***
Reserve (Shortage)	**2**	**4**	**0**	**0**	**0**	**0**

Decatur

Decatur is located in central Wise County. The city's water supply is treated water from the Wise County WSD, which gets its raw water from Tarrant Regional Water District (TRWD). Water management strategies for Decatur include conservation and additional treated water from Wise County WSD. **Table 5E.398** shows the projected population and demand, the current supplies, and the water management strategies for Decatur.

Table 5E.398 Summary of Water User Group – City of Decatur

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**8,509**	**11,740**	**15,254**	**19,752**	**23,227**	**27,002**
Projected Demands						
Municipal Demand	2,319	3,149	4,060	5,240	6,157	7,156
Total Projected Demand	***2,319***	***3,149***	***4,060***	***5,240***	***6,157***	***7,156***
Currently Available Supplies						
TRWD through Wise County WSD	1,805	1,806	1,810	1,814	1,818	1,820
Total Currently Available Supplies	***1,805***	***1,806***	***1,810***	***1,814***	***1,818***	***1,820***
Need (Demand – Supply)	***514***	***1,343***	***2,250***	***3,426***	***4,339***	***5,336***
Water Management Strategies						
Water Conservation	118	198	254	345	426	519
TRWD through Wise County WSD	396	1,145	1,996	3,081	3,913	4,817
Total Supplies from Strategies	***514***	***1,343***	***2,250***	***3,426***	***4,339***	***5,336***
Reserve (Shortage)	**0**	**0**	**0**	**0**	**0**	**0**

Newark

Newark is located in southeastern Wise County. The city gets its water supply from the Trinity aquifer. Water management strategies for Newark include conservation and the purchase of treated water from Rhome (which gets treated water from Walnut Creek SUD which in turn uses Tarrant Regional Water District (TRWD) raw water). **Table 5E.399** shows the projected population and demand, the current supplies, and the water management strategies for Newark.

Table 5E.399 Summary of Water User Group – City of Newark

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**1,772**	**2,339**	**3,302**	**4,458**	**6,216**	**8,300**
Projected Demands						
Municipal Demand	194	248	344	462	643	857
Total Projected Demand	***194***	***248***	***344***	***462***	***643***	***857***
Currently Available Supplies						
Trinity Aquifer	125	125	125	125	125	125
Total Currently Available Supplies	***125***	***125***	***125***	***125***	***125***	***125***
Need (Demand – Supply)	***69***	***123***	***219***	***337***	***518***	***732***
Water Management Strategies						
Water Conservation	2	3	3	6	11	17
TRWD through Rhome	67	120	216	331	507	715
Connect to Rhome	*67*	*120*	*216*	*331*	*507*	*715*
Total Supplies from Strategies	***69***	***123***	***219***	***337***	***518***	***732***
Reserve (Shortage)	**0**	**0**	**0**	**0**	**0**	**0**

Rhome

Rhome is located in southeastern Wise County. The city will potentially provide water to the City of Newark in the future. Rhome's water supply is treated water from Walnut Creek SUD, which gets its raw water from Tarrant Regional Water District (TRWD), and groundwater from the Trinity aquifer. Water management strategies for Rhome include conservation and additional treated water from Walnut Creek SUD. **Table 5E.400** shows the projected population and demand, the current supplies, and the water management strategies for Rhome.

Table 5E.400 Summary of Water User Group – City of Rhome

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**2,304**	**3,255**	**4,230**	**6,765**	**9,085**	**11,598**
Projected Demands						
Municipal Demand	397	552	712	1,135	1,523	1,943
County Other, Wise	*728*	*734*	*723*	*755*	*777*	*1,202*
Newark (Future)	*69*	*123*	*219*	*337*	*518*	*732*
Total Projected Demand	***1,194***	***1,409***	***1,654***	***2,227***	***2,818***	***3,877***
Currently Available Supplies						
Trinity Aquifer	169	169	169	169	169	169
TRWD through Walnut Creek SUD	744	740	733	727	644	679
Total Currently Available Supplies	***913***	***909***	***902***	***896***	***813***	***848***
Need (Demand – Supply)	***281***	***500***	***752***	***1,331***	***2,005***	***3,029***
Water Management Strategies						
Water Conservation	38	61	65	104	144	194
TRWD through Walnut Creek SUD	243	439	687	1,227	1,861	2,835
Total Supplies from Strategies	***281***	***500***	***752***	***1,331***	***2,005***	***3,029***
Reserve (Shortage)	**0**	**0**	**0**	**0**	**0**	**0**

Runaway Bay

Runaway Bay is located in western Wise County. The city buys raw water from Tarrant Regional Water District (TRWD) and operates its own water treatment plant. Water management strategies for Runaway Bay include conservation, additional raw water from TRWD, water treatment plant expansion, and increasing the capacity of the lake intake. **Table 5E.401** shows the projected population and demand, the current supplies, and the water management strategies for Runaway Bay.

Table 5E.401 Summary of Water User Group – City of Runaway Bay

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**1,447**	**1,631**	**1,821**	**2,200**	**2,500**	**3,000**
Projected Demands						
Municipal Demand	527	588	652	785	891	1,069
County Other, Wise	*731*	*759*	*709*	*856*	*957*	*2,894*
Total Projected Demand	***1,258***	***1,347***	***1,361***	***1,641***	***1,848***	***3,963***
Currently Available Supplies						
TRWD	572	572	572	572	572	572
Total Currently Available Supplies	***572***	***572***	***572***	***572***	***572***	***572***
Need (Demand – Supply)	***686***	***775***	***789***	***1,069***	***1,276***	***3,391***
Water Management Strategies						
Water Conservation	45	62	62	82	102	172
TRWD	658	713	727	987	1,174	3,219
3 MGD WTP Expansion – 1	*658*	*713*	*727*	*987*	*1,174*	*1,682*
3 MGD WTP Expansion – 2						*1,537*
Increase capacity of Lake Intake	*658*	*713*	*727*	*987*	*1,174*	*3,219*
Total Supplies from Strategies	***703***	***775***	***789***	***1,069***	***1,276***	***3,391***
Reserve (Shortage)	**17**	**0**	**0**	**0**	**0**	**0**

Walnut Creek Special Utility District

Walnut Creek SUD is a wholesale water provider that offers wholesale and retail service in parts of Parker and Wise Counties. The plan for the SUD is described under Parker County in **Section 5E.13.1**.

West Wise Special Utility District

West Wise SUD serves western Wise County and provides water to Chico. The SUD buys water from Tarrant Regional Water District (TRWD) directly as well as through Walnut Creek SUD and Chico. Water management strategies for West Wise SUD include conservation and additional raw water from TRWD, including water treatment plant expansion. **Table 5E.402** shows the projected population and demand, the current supplies, and the water management strategies for West Wise SUD.

Table 5E.402 Summary of Water User Group – West Wise SUD

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**3,899**	**4,036**	**4,177**	**4,323**	**4,474**	**4,631**
Projected Demands						
Municipal Demand	478	478	481	490	506	523
Chico	*84*	*92*	*102*	*357*	*506*	*681*
Total Projected Demand	***562***	***570***	***583***	***847***	***1,012***	***1,204***
Currently Available Supplies						
TRWD	517	461	428	438	423	409
TRWD through Walnut Creek SUD	19	16	14	11	8	6
Total Currently Available Supplies	***536***	***477***	***442***	***449***	***431***	***415***
Need (Demand – Supply)	***26***	***93***	***141***	***398***	***581***	***789***
Water Management Strategies						
Water Conservation	6	20	23	42	55	72
TRWD	22	77	118	356	526	717
1.5 MGD WTP Expansion	*0*	*0*	*0*	*233*	*388*	*565*
Total Supplies from Strategies	***28***	***97***	***141***	***398***	***581***	***789***
Reserve (Shortage)	**2**	**4**	**0**	**0**	**0**	**0**

Wise County Irrigation

Irrigation demand projections include the water necessary for irrigation activities, including field crops, orchards, pasture, turf grass, vineyards, golf courses irrigated by raw water, and limited aquaculture operations. The current supplies are local surface water supplies (Trinity run-of-river), groundwater from the Trinity aquifer, and water from the Tarrant Regional Water District (TRWD). The only recommended water management strategy for Wise County Irrigation is water from the TRWD to meet current contracts. **Table 5E.403** shows the projected demand, the current supplies, and the water management strategies for Wise County Irrigation.

Table 5E.403 Summary of Water User Group – Wise County Irrigation

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Demands						
Total Projected Demand	**1,406**	**1,406**	**1,406**	**1,406**	**1,406**	**1,406**
Currently Available Supplies						
Local Supplies	139	139	139	139	139	139
Trinity Aquifer	680	680	680	680	680	680
TRWD	587	517	459	414	381	352
Total Currently Available Supplies	***1,406***	***1,336***	***1,278***	***1,233***	***1,200***	***1,171***
Need (Demand – Supply)	***0***	***70***	***128***	***173***	***206***	***235***
Water Management Strategies						
Water Conservation	0	1	3	4	4	5
TRWD	0	70	128	173	206	235
Total Supplies from Strategies	***0***	***71***	***131***	***177***	***210***	***240***
Reserve (Shortage)	**0**	**1**	**3**	**4**	**4**	**5**

Wise County Livestock

Livestock water use is defined as water used in the production of livestock, both for consumption and for cleaning and environmental purposes. The current supplies are local surface water supplies and groundwater from the Trinity aquifer. These sources are sufficient to meet projected demands, and there are no water management strategies for this water user group. **Table 5E.404** shows the projected demand, current supplies, and water management strategies for Wise County Livestock.

Table 5E.404 Summary of Water User Group – Wise County Livestock

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Demands						
Total Projected Demand	**1,198**	**1,198**	**1,198**	**1,198**	**1,198**	**1,198**
Currently Available Supplies						
Trinity Aquifer	458	458	458	458	458	458
Local Supplies	1,117	1,117	1,117	1,117	1,117	1,117
Total Currently Available Supplies	***1,575***	***1,575***	***1,575***	***1,575***	***1,575***	***1,575***
Need (Demand – Supply)	***0***	***0***	***0***	***0***	***0***	***0***
Water Management Strategies						
None	0	0	0	0	0	0
Total Supplies from Strategies	***0***	***0***	***0***	***0***	***0***	***0***
Reserve (Shortage)	**377**	**377**	**377**	**377**	**377**	**377**

Wise County Manufacturing

Manufacturing water use is defined as water used to produce manufactured goods. Current supplies include water from the Tarrant Regional Water District (TRWD) through Wise County WSD and groundwater (Trinity aquifer). The water management strategies for this water user group include additional water from TRWD and new well(s) in the Trinity aquifer. **Table 5E.405** shows the projected demand and current supplies for Wise County Manufacturing. Conservation was considered for this water user group, but it is not recommended because of the uncertainty in the ability to implement conservation measures given the multiple entities, facilities, and various manufacturing processes that make up this WUG.

Table 5E.405 Summary of Water User Group – Wise County Manufacturing

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Demands						
Total Projected Demand	**454**	**501**	**501**	**501**	**501**	**501**
Currently Available Supplies						
Trinity Aquifer	250	250	250	250	250	250
TRWD through Wise County WSD	45	44	40	36	32	30
Total Currently Available Supplies	***295***	***294***	***290***	***286***	***282***	***280***
Need (Demand – Supply)	***159***	***207***	***211***	***215***	***219***	***221***
Water Management Strategies						
TRWD through Wise County WSD	0	6	10	14	18	20
New Well(s) in Trinity Aquifer	201	201	201	201	201	201
Total Supplies from Strategies	***201***	***207***	***211***	***215***	***219***	***221***
Reserve (Shortage)	**42**	**0**	**0**	**0**	**0**	**0**

Wise County Mining

Mining water demand includes water used for oil and gas development, as well as extraction of coal and lignite, sand aggregate, and other resources. Wise County Mining is supplied from run-of-river water from the Trinity River, water from Tarrant Regional Water District (TRWD) direct and through Bridgeport, and the Trinity aquifer. The recommended water management strategy is additional water from TRWD and conservation. **Table 5E.406** shows the projected demand, the current supplies, and the water management strategies for Wise County Mining.

Table 5E.406 Summary of Water User Group – Wise County Mining

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Demands						
Total Projected Demand	**10,320**	**11,159**	**12,337**	**13,975**	**15,378**	**17,694**
Currently Available Supplies						
Run-of-River	133	133	133	133	133	133
Trinity Aquifer	2,155	2,155	2,155	2,155	2,155	2,155
TRWD (through Bridgeport and Direct Connection)	2,896	2,896	2,896	2,896	2,896	2,896
Total Currently Available Supplies	***5,184***	***5,184***	***5,184***	***5,184***	***5,184***	***5,184***
Need (Demand – Supply)	***5,136***	***5,975***	***7,153***	***8,791***	***10,194***	***12,510***
Water Management Strategies						
Conservation	6,261	6,261	6,348	7,495	8,477	10,098
TRWD	0	0	805	1,296	1,717	2,412
Total Supplies from Strategies	***6,261***	***6,261***	***7,153***	***8,791***	***10,194***	***12,510***
Reserve (Shortage)	**1,125**	**286**	**0**	**0**	**0**	**0**

Wise County Other

Wise County Other includes individual domestic supplies and water suppliers too small to be classified as water user groups. Wise County Other supplies come from the Tarrant Regional Water District (TRWD) through Runaway Bay and Walnut Creek SUD and groundwater (Trinity aquifer). Water management strategies for Wise County Other include conservation and additional water from the TRWD. **Table 5E.407** shows the projected population and demand, the current supplies, and the water management strategies for Wise County Other.

Table 5E.407 Summary of Water User Group – Wise County Other

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Population	**33,674**	**34,939**	**35,204**	**37,470**	**38,735**	**60,000**
Projected Demands						
Municipal Demand	4,043	4,077	4,016	4,195	4,318	6,680
Total Projected Demand	***4,043***	***4,077***	***4,016***	***4,195***	***4,318***	***6,680***
Currently Available Supplies						
Trinity Aquifer	2,584	2,584	2,584	2,584	2,584	2,584
TRWD through Runaway Bay	79	101	112	87	79	53
TRWD through Walnut Creek SUD	567	486	419	319	235	274
Total Currently Available Supplies	***3,230***	***3,171***	***3,115***	***2,990***	***2,898***	***2,911***
Need (Demand – Supply)	***813***	***906***	***901***	***1,205***	***1,420***	***3,769***
Water Management Strategies						
Water Conservation	33	47	40	56	72	134
TRWD through Runaway Bay	635	634	577	739	838	2,746
TRWD through Walnut Creek SUD	145	225	284	410	510	889
Total Supplies from Strategies	***813***	***906***	***901***	***1,205***	***1,420***	***3,769***
Reserve (Shortage)	**0**	**0**	**0**	**0**	**0**	**0**

Wise County Steam Electric Power

Steam electric power demands do not include water that is used in cogeneration facilities (which is included in manufacturing projections), facilities which do not require water for production, or hydro-electric generation facilities. Wise County Steam Electric Power is supplied by raw water from Tarrant Regional Water District (TRWD). The water management strategy for Wise County SEP is water from TRWD. **Table 5E.408** shows the projected demand, the current supplies, and the water management strategies for Wise County SEP. Conservation was considered for this water user group, but it is not recommended because the steam electric demand projections themselves considered future efficiency programs.

Table 5E.408 Summary of Water User Group – Wise County SEP

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Demands						
Total Projected Demand	**2,894**	**2,894**	**2,894**	**2,894**	**2,894**	**2,894**
Currently Available Supplies						
TRWD	2,894	2,550	2,261	2,041	1,879	1,738
Total Currently Available Supplies	***2,894***	***2,550***	***2,261***	***2,041***	***1,879***	***1,738***
Need (Demand – Supply)	***0***	***344***	***633***	***853***	***1,015***	***1,156***
Water Management Strategies						
TRWD	0	344	633	853	1,015	1,156
Total Supplies from Strategies	***0***	***344***	***633***	***853***	***1,015***	***1,156***
Reserve (Shortage)	**0**	**0**	**0**	**0**	**0**	**0**

Wise County Water Supply District

Wise County WSD is a wholesale water provider (WWP) that supplies water to Decatur and Wise County Manufacturing. Wise County WSD is expected to continue serving these customers in the future.

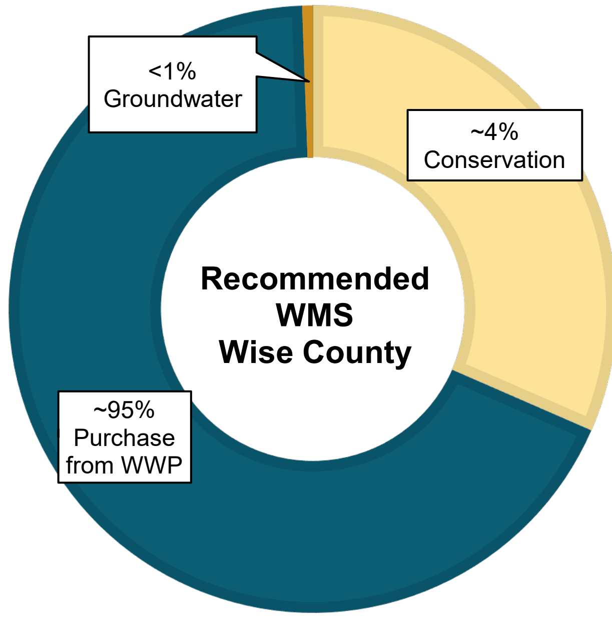
The current water supply for Wise County WSD is water purchased from the Tarrant Regional Water District (TRWD). This supply is limited by Wise County WSD's current treatment capacity. The recommended strategies for Wise County WSD include implementing water conservation measures, purchasing additional water from TRWD (increasing contract amounts as needed in the future), and expanding water treatment capacity. **Table 5E.409** shows the recommended water management strategies for the Wise County WSD.

Table 5E.409 Summary of Wholesale Water Provider and Customers – Wise County WSD

(Values in Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Demands						
Decatur	2,319	3,149	4,060	5,240	6,157	7,156
Manufacturing, Wise	45	50	50	50	50	50
Total Projected Demand	***2,364***	***3,199***	***4,110***	***5,290***	***6,207***	***7,206***
Currently Available Supplies						
TRWD (limited by WTP capacity)	*1,850*	*1,850*	*1,850*	*1,850*	*1,850*	*1,850*
Total Currently Available Supplies	***1,850***	***1,850***	***1,850***	***1,850***	***1,850***	***1,850***
Need (Demand – Supply)	***514***	***1,349***	***2,260***	***3,440***	***4,357***	***5,356***
Water Management Strategies						
Conservation	118	198	254	345	426	519
TRWD	396	1,151	2,006	3,095	3,931	4,837
10 MGD WTP Expansion	*396*	*1,151*	*2,006*	*3,095*	*3,931*	*4,837*
Total Supplies from Strategies	***514***	***1,349***	***2,260***	***3,440***	***4,357***	***5,356***
Reserve (Shortage)	**0**	**0**	**0**	**0**	**0**	**0**

5E.16.2 Summary of Costs for Wise County

Table 5E.410 summarizes the costs of the water management strategies recommended for the WUGs and WWPs who have the majority of their demand located in Wise County. Total quantities from **Table 5E.410** will not necessarily match total county demands. This is due mainly to water users whose sum of strategies results in a reserve as well as due to water users located in multiple counties (or wholesale water providers who develop strategies and then sell water to users in other counties). Quantities from infrastructure projects needed to deliver and/or treat water (shown in *gray italics*) are not included since the supplies are associated with other strategies. To avoid double-counting quantities of supplies, the quantities in gray italics are **not** included in the total.



The majority of the future supplies needed to meet demands within Wise County are projected to come through purchases from wholesale water providers. Other strategies include conservation and groundwater.

Table 5E.411 summarizes the recommended water management strategies within Wise County for individual WUGs and WWPs. Alternative strategies are also included. More detailed cost estimates are located in **Appendix H.**

Table 5E.410 Summary of Recommended Water Management Strategies for Wise County

Type of Strategy	Quantity (Ac-Ft/Yr)	Capital Costs
Conservation[a]	11,378	$517,194
Purchase from WWP	24,498	$0
Additional Infrastructure	16,157	$145,902,000
Groundwater	201	$502,000
Total	**36,077**	**$146,921,194**

[a]The conservation quantities represent the sum of the individual water user groups who have the majority of their service areas located in the county, not the total conservation in the county.

Table 5E.411 Costs for Recommended and Alternative Water Management Strategies for Wise County

WWP or WUG	Strategy	Online by:	Quantity (Ac-Ft/Yr)[b]	Capital Costs[c]	Unit Cost ($/1000 gal) With Debt Service	Unit Cost ($/1000 gal) After Debt Service	Table
WWPs							
Wise County WSD	Conservation (wholesale)	2020	Included with WUGs.				
	TRWD	2020	4,837	$0	$1.26	$1.26	None
	9 MGD WTP Expansion	*2020*	*4,837*	*$53,339,000*	*$3.93*	*$1.65*	*H.13*
WUGs							
Alvord	Conservation	2020	10	$5,247	$0.57	$0.00	H.11
	TRWD through West Wise SUD	2030	266	$0	$3.00	$3.00	None
	Connect to West Wise SUD	*2030*	*266*	*$6,790,000*	*$6.41*	*$0.90*	*H.168*
Bolivar WSC[a]	Conservation	See Denton County.					
	UTRWD						
	Connect to Gainesville						
Boyd	Conservation	2020	12	$4,837	$0.35	$0.00	H.11
	Walnut Creek SUD	2020	328	$0	$6.11	$6.11	None
Bridgeport	Conservation	2020	296	$39,597	$0.85	$0.78	H.11
	TRWD	2040	2,087	$0	$1.26	$1.26	None
	2 MGD WTP Expansion	*2060*	*1,121*	*$11,377,000*	*$4.22*	*$2.02*	*H.13*
	1 MGD WTP Expansion	*2070*	*293*	*$8,651,000*	*$6.74*	*$3.41*	*H.13*
	Expand Capacity of Lake intake and Pump Station	2060	1,414	$1,421,000	$0.29	$0.08	H.169
Chico	Conservation	2020	62	$7,070	$0.76	$0.75	H.11
	West Wise SUD	2040	508	$0	$3.00	$3.00	None
	Additional Delivery Infrastructure from West Wise SUD	*2040*	*508*	*$4,422,000*	*$2.22*	*$0.34*	*H.170*
Decatur	Conservation	2020	519	$287,594	$1.23	$0.49	H.11
	Wise County WSD	2020	4,817	$0	$3.00	$3.00	None
Fort Worth[a]	Conservation	See Fort Worth in **Chapter 5D**.					

WWP or WUG	Strategy	Online by:	Quantity (Ac-Ft/Yr)[b]	Capital Costs[c]	Unit Cost ($/1000 gal) With Debt Service	Unit Cost ($/1000 gal) After Debt Service	Table
	Other WMS						
Newark	Conservation	2020	17	$1,083	$0.12	$0.00	H.11
	Rhome	2020	715	$0	$3.00	$3.00	None
	Connect to Rhome (TRWD through Walnut Creek SUD)	*2020*	*715*	*$1,584,000*	*$0.52*	*$0.05*	*H.171*
Rhome	Conservation	2020	138	$10,212	$1.36	$0.82	H.11
	Walnut Creek SUD	2020	1,231	$0	$6.11	$6.11	None
Runaway Bay	Conservation	2020	77	$15,113	$0.85	$0.44	H.11
	TRWD	2020	1,534	$0	$1.26	$1.26	None
	3 MGD WTP Expansion-1	*2020*	*1,682*	*$19,823,000*	*$4.63*	*$2.09*	*H.13*
	3 MGD WTP Expansion-2	*2060*	*1,537*	*$19,823,000*	*$4.63*	*$2.09*	*H.13*
	Increase capacity of Lake Intake	*2020*	*3,219*	*$8,657,000*	*$0.73*	*$0.15*	*H.172*
Walnut Creek SUD[a]	Conservation	See Parker County.					
	Other WMSs						
West Wise SUD	Conservation	2020	10	$32,789	$1.77	$0.00	H.11
	TRWD	2020	717	$0	$1.26	$1.26	None
	1.5 MGD WTP Expansion	*2050*	*565*	*$10,015,000*	*$5.06*	*$2.49*	*H.13*
County Other and Non-Municipal							
Wise County Other	Conservation	2020	134	$122,652	$0.80	$0.00	H.11
	TRWD through Runaway Bay	2020	2,746	$0	$3.00	$3.00	None
	TRWD through Walnut Creek SUD	2020	889	$0	$6.11	$6.11	None
Wise County Irrigation	Conservation	2030	5	$0	$0.94	$0.94	H.11F
	TRWD	2030	235	$0	$1.26	$1.26	None
Wise County Livestock	None	None					
	TRWD	2030	20	$0	$1.26	$1.26	None

WWP or WUG	Strategy	Online by:	Quantity (Ac-Ft/Yr)[b]	Capital Costs[c]	Unit Cost ($/1000 gal) With Debt Service	Unit Cost ($/1000 gal) After Debt Service	Table
Wise County Manufacturing	New Well(s) in Trinity Aquifer	2020	201	$502,000	$0.67	$0.13	H.14
Wise County Mining	Conservation	2020	10,098	$0	$0.45	$0.45	H.11F
	TRWD	2020	2,412	$0	$1.26	$1.26	None
Wise County Steam Electric	TRWD	2030	1,156	$0	$1.26	$1.26	None

[a]Water User Groups extend into more than one county

[b]Quantities listed are for the WUG only. They do not include the WUG's customers.
[c]Purchases from wholesale water providers that require no new infrastructure have no capital costs. The unit costs shown in the table represent the cost to purchase water from the WWP.

5E.17 Chapter 5E List of References

(1) R.W. Harden and Associates, Inc., HDR Engineering, Inc., LBG-Guyton Associates, Freese and Nichols, Inc., United States Geological Survey, and Dr. Joe Yelderman: *Northern Trinity/Woodbine Aquifer Groundwater Availability Model*, prepared for the Texas Water Development Board, Austin, August 31, 2004.

(2) Freese and Nichols, Inc., Alan Plummer Associates, Inc., Chiang, Patel & Yerby, Inc., and Cooksey Communications, Inc.: *2006 Region C Water Plan*, prepared for the Region C Water Planning Group, Fort Worth, January 2006.

(3) Mid-East Texas Groundwater Conservation District created by the Texas Legislature, Chapter 1507, Art. 4 (HB 1784) and Ch. 966, Art. 3, Part 15, (SB 1), 77th Leg., September 2001, confirmed November 2002.

(4) Lesikar, B., R. Kaiser, V. Silvy, *Questions about Groundwater Conservation Districts in Texas*, published by the Texas Cooperative Extension, College Station, June 2002.

(5) Neches and Trinity Valleys Groundwater Conservation District created by the Texas Legislature, Ch. 1387, 77th Leg., September 2001 (SB 1821), confirmed November 2001.

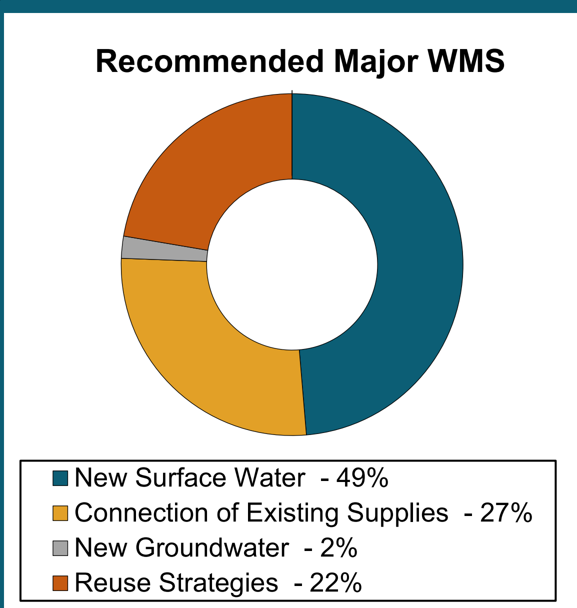
5F Chapter 5 Summary

5F.1 Chapter 5 Summary

Chapter 5 presents the water management strategies (WMS) that were evaluated to meet the identified water needs in Region C for the 2021 Regional Water Plan. Municipal demands make up most of the Region C demands and most of the recommended WMS meet the increased municipal demands associated with the projected population growth in the coming decades.

Conservation and reuse are extremely important in Region C. The region has already made great strides in reducing water demands and expects to further reduce demands in the future. In addition to previous conservation savings and projected savings included in demand projections, conservation strategies will reduce demand by over 200,000 acre-feet per year by 2070. However, these demand reductions are not enough to meet the water needs caused by the region's growing population. Development of new supplies will be required, and infrastructure projects are needed to connect to existing and future water sources.

Most of the additional supply for Region C will be developed by the Region's major water providers (DWU, NTMWD, TRWD, UTRWD, TRA, and Fort Worth), and major water management strategies (generally, strategies that provide 30,000 acre-feet per year or more) account for about 82% percent of the total additional supplies for the region.



5 New Reservoirs
- Bois d'Arc Lake (NTMWD)
- Lake Ralph Hall (UTRWD)
- Marvin Nichols (TRWD, NTMWD, & UTRWD)
- Lake Tehuacana (TRWD)
- Lake Columbia (DWU)

Major Connection Projects
- IPL (TRWD & DWU)
- Neches Run-of-River (DWU)
- Regional Water System (GTUA)

Major Reuse Projects
- Main Stem Balancing Reservoir (DWU)
- Cedar Creek Wetland Reuse (TRWD)
- Expanded Wetland Reuse (NTMWD)

There are over 250 recommended strategies and 35 alternative strategies for Region C providers. The greatest amount of new supplies for Region C will be developed from surface water, reuse and connecting to existing sources.

In total, by 2070 Region C is expected to conserve over 200,000 acre-feet per year and develop over 1,670,000 acre-feet per year of new supplies.

Table 5F.1 shows the recommended strategy volumes by strategy type for the region. **Table 5F.2** shows the capital cost of strategies.

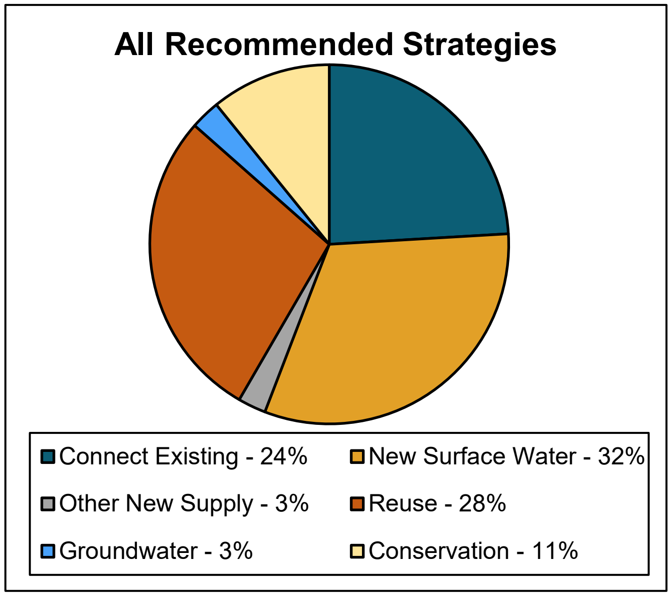


Table 5F.1 Recommended Strategy Volumes by Strategy Type

	Values in Ac-Ft/Yr					
WWP or WUG	**Connect Existing Supplies**	**New *Surface Water***	**Other New Supplies**	**Reuse**	**Ground-water**	**Conservation**
DWU	101,555	56,000	47,250	158,388		*72,870*
Fort Worth				14,527		*32,591*
NTMWD	230,119	285,124		76,290		*44,428*
TRWD	56,676	188,594		188,762	37,000	*68,958*
TRA						*2,985*
UTRWD	8,848	65,060		31,469		*8,487*
GTUA	35,872					*4,418*
Corsicana	11,210					*847*
Counties[a]	6,230			55,003	12,893	202,676
Totals	**450,510**	**594,778**	**47,250**	***524,439***	***49,893***	***202,676***

[a]Counties include all wholesale water providers or water user groups that are not major or regional water providers.

Table 5F.2 Recommended Strategies Capital Costs

WWP or WUG	Capital Cost Including Conservation	Capital Cost Without Conservation
Dallas	$5,136,772,907	$5,119,839,000
Fort Worth	$2,190,881,589	$1,995,030,000
NTWMD	$10,035,421,000	$10,035,421,000
TRWD	$6,310,640,000	$6,310,640,000
TRA	$0	$0
UTRWD	$2,142,573,000	$2,142,573,000
GTUA	$589,173,000	$589,173,000
Corsicana	$103,736,621	$103,116,000
Total	**$26,509,198,117**	**$26,295,792,000**
Counties[a]	$4,038,120,107	$3,705,547,000
Totals	**$30,333,912,107**	**$30,001,339,000**

[a]Counties include all wholesale water providers or water user groups that are not major or regional water providers.

5F.1.1 Unmet Water Needs

Region C worked closely with water providers to meet the projected needs identified in the plan. However, there were some instances where the projected needs could not be met. In most cases this was because there are insufficient groundwater resources to meet projected demands. TWDB rules require the use of Modeled Available Groundwater (MAG) supplies for regional planning, and these MAG supplies were significantly less than historical use in several Region C counties. For Freestone Steam Electric Power, projected demands appear to exceed current contract and water right availability, and the facility on which the demands are based is no longer operating. Therefore, a water management strategy was not developed to meet all of the projected need. A summary of the unmet needs in the region is shown on **Table 5F.3**.

Table 5F.3 Unmet Needs Summary

WUG	County	Values in Ac-Ft/Yr 2020	2030	2040	2050	2060	2070
Hickory Creek SUD	Multiple	(11)	(23)	(34)	(46)	(63)	(85)
Irrigation	Ellis	(747)	(729)	(711)	(701)	(692)	(684)
Irrigation	Fannin	(2,243)	(2,226)	(2,210)	(2,202)	(2,194)	(2,186)
Mining	Fannin	(502)	(279)	(56)	(56)	(56)	(56)
Mining	Freestone	(4,335)	(4,103)	(4,239)	(4,274)	(4,344)	(4,570)
Steam Electric Power	Freestone	(6,766)	(6,766)	(6,766)	(6,766)	(6,766)	(6,766)
Mining	Kaufman					(58)	(226)
Mining	Navarro	(217)	(262)	(306)	(596)	(830)	(1,100)
Total		**(14,821)**	**(14,388)**	**(14,322)**	**(14,641)**	**(15,003)**	**(15,673)**

5F.2 Texas Water Development Board Required Tables

The Texas Water Development Board requires summary tables showing specific information on all water management strategies. Those tables can be found in **Appendix D** of this report. The tables are based on information from the Texas Water Development Board online planning database (DB22) and reflect the most current information in the database at the time of the printing of this report. Due to limitations associated with DB22, Region C would like to review the DB22 data and make subsequent adjustments if there are any significant differences between DB22 and the actual strategies described in this plan. These adjustments should be allowed without TWDB requiring an errata or amendment to the plan. There may be slight numerical differences between DB22 and this printed regional water plan due to rounding associated with the regional water plan preparation and online data entry. In any instances where numbers in the regional water plan and the online planning database differ by an inconsequential amount, the data in the online planning database (DB22) shall take precedence over the associated number in the regional water plan for the purpose of development of the State Water Plan and for the purposes of TWDB financing through the State Water Implementation Fund for Texas (SWIFT) fund.

6 Impacts of Regional Water Plan and Consistency with Protection of Water Resources, Agricultural Resources, and Natural Resources

The previous section presented a set of recommended water management strategies for Region C wholesale water providers and water user groups. This section discusses the impacts of the recommended water management strategies on key parameters of water quality, the impacts of moving water from rural and agricultural areas and impacts to third parties. It also discusses how the regional water plan is consistent with the long-term protection of the state's water, agricultural, and natural resources.

Chapter Outline

Related Appendices

6.1 Impacts of Recommended Water Management Strategies on Key Water Quality Parameters

For a given water resource, the impact of water management strategies on key water quality parameters is evaluated by comparing current water quality conditions with anticipated water quality conditions when water management strategies are in place. Many of the recommended water management strategies involve diverting water from one water body and transferring this water to another water body. For these strategies, the difference in the quality of the two waters, the quantity of water transferred, and the effectiveness of any mitigation are used to project the impact on the receiving water. Selection of the key water quality parameters used for this comparison is based on the importance of these parameters to the use of the water resource.

The recommended water management strategies can be grouped into the following strategy types:

- **Existing surface water sources**
- **New surface water sources**
- **Existing groundwater sources**
- **New groundwater sources**
- **Direct and Indirect Reuse**
- **Conservation**
- **Desalination**
- **Aquifer Storage and Recovery**

In general, each strategy within a strategy type is anticipated to have a similar qualitative impact on key water quality parameters in the receiving water. Exceptions to this generalization are addressed where appropriate. The strategy type defined as "other" includes strategies that do not involve transfer from one source to another and, therefore, have no impact on water quality in the receiving water. Examples of strategies in this category include increased pipeline capacity to a particular water user group or connection of a water user group to a wholesale provider.

The following sections define the parameters selected as key water quality parameters and present the evaluation of impacts of recommended water management strategies on these key parameters.

6.1.1 Selection of Key Water Quality Parameters

The selection of key water quality parameters involved a two-stage approach. First, a list of candidate water quality parameters was compiled from several sources. Then, key water quality parameters were selected from the list of potential parameters based on the general guidelines described below.

Candidate water quality parameters were identified using the following sources:

- Parameters regulated by the Texas Commission on Environmental Quality (TCEQ) in the Texas Surface Water Quality Standards (TSWQS)[1]
- Parameters considered for the TCEQ Water Quality Inventory in evaluation of whether water body uses are supported, not supported, or have water quality concerns. The designated water body uses included in the Water Quality Inventory are:
    - Aquatic life use
    - Contact recreation use
    - General use
    - Fish consumption use

- Public water supply use
- Parameters that may impact suitability of water for irrigation
- Parameters that may impact treatability of water for municipal or industrial supply

The first two categories above represent environmental water quality parameters, and the last two categories represent water quality as related to water uses.

To develop a manageable and meaningful list of key water quality parameters, the following general guidelines were established for parameter selection:

- Selected parameters should be representative of water quality conditions that may be impacted on a regional scale and that are likely to be impacted by multiple water management strategies within the region. Water quality issues associated with localized conditions (such as elevated levels of a toxic material within one water body) will be addressed as necessary within the environmental impact evaluations of the individual water management strategies for each water user group.
- Sufficient data must be available for a parameter to include it as a key water quality parameter. If meaningful statistical summaries cannot be carried out on the parameter, it should not be designated as a key water quality parameter.

The TCEQ has adopted several changes to the TSWQS since the development of the 2016 Plan. Additional aquatic life criteria were adopted for Acrolein and Carbaryl. There were revisions to 55 existing human health criteria based on updated toxicity information. In addition, human health criteria were proposed for four new parameters: Epichlorohydrin, Ethylene Glycol, Bisphenol A and Methyl tertbutyl ether. These parameters will be addressed as necessary within the environmental impact evaluations of the individual water management strategies for each water user group. In addition, dissolved oxygen (DO) concentrations are protected during wastewater discharge permitting, and any agency that proposes to discharge biochemical oxygen demand (BOD) as part of a water management strategy would have to show that the discharge would meet local DO standards to obtain a discharge permit. Finally, little has changed since the 2016 Plan in terms of parameters that may impact suitability for irrigation, municipal, or industrial purposes.

For the *2021 Region C Water Plan*, the Region C RWPG has added two key water quality parameters to those that were used in the 2006, 2011, and 2016 Plans. Chloride and sulfate were added as key parameters for both surface water and groundwater. These parameters were added because, similar to total dissolved solids (TDS), they are regulated in the TSWQS, there are secondary drinking water standards for both parameters, and there is sufficient data to provide a baseline summary. A detailed discussion of the selection of key water quality parameters and definitions of baseline conditions for these parameters is included in **Appendix K**.

The key water quality parameters selected by the Region C Water Planning Group include:

- Surface Water
    - Ammonia Nitrogen
    - Nitrate Nitrogen
    - Total Phosphorus
    - Chlorophyll-a
    - Total Dissolved Solids (TDS)
    - Chloride (NEW)
    - Sulfate (NEW)
- Groundwater

- Total Dissolved Solids (TDS)
- Chloride (NEW)
- Sulfate (NEW)

6.1.2 Evaluation of Water Quality Impacts

Impacts of recommended water management strategies on key water quality parameters were assessed by comparing the water quality of the source water for a given strategy with that of the receiving water. This comparison included an evaluation of historical median concentrations of key parameters, together with consideration of data quality, relative quantities of water, and planned mitigation measures (e.g., treatment, blending, or other operational strategies that serve to mitigate water quality impacts). Each recommended strategy was assigned one of the following five anticipated impact ratings: low, medium low, medium, medium high, and high. (The quantitative impacts on key water quality parameters are discussed in more detail in **Appendix K**.) No recommended or alternative water management strategy is anticipated to have more than a “medium” impact on key water quality parameters. A “medium” impact is considered to be an impact that results in some changes in water quality but does not result in impairment of the designated uses of the water body. The following sections present a discussion of the anticipated water quality impacts for each strategy type.

Table 6.1 summarizes the range of anticipated water quality impacts within these strategy types.

Table 6.1 Range of Anticipated Impacts on Key Water Quality Parameters by Strategy Type

Strategy Type	Range of Anticipated Impacts on Key Water Quality Parameters	Comments
Existing Surface Water Sources	Low to Medium	Lake Texoma strategies assumed to include mitigation for TDS, chloride and sulfate.
Existing Groundwater Sources	Low to Medium Low	
New Surface Water Sources	Low to Medium	Water quality in new sources difficult to predict.
New Groundwater Sources	Medium Low to Medium	
Direct Reuse	Low/Positive	Potential positive impact resulting from reduced nutrient and TDS loadings to surface waters.
Indirect Reuse	Medium	Assumes mitigation to control impacts on nutrients, TDS, chloride and sulfate, if necessary.
Conservation	Low	
Other	Low	Includes strategies not involving blending of two water sources (e.g. direct pipeline to a treatment plant).

6.1.3 Existing Surface Water Sources

For strategies utilizing existing surface water sources, impacts on key water quality parameters vary depending on a number of factors, including the location of the source and the intended destination of the water transfer. For strategies that involve pumping existing surface water directly to a water treatment plant, no impact on water quality is anticipated (resulting in a rating of "low"). However, when water is pumped from one source to another, the impacts will depend on the existing water quality of the two sources, as well as the quantities to be transferred and any mitigation that may be applied.

Several of the recommended and alternative strategies call for increased use of water from East Texas reservoirs. In general, reservoirs in East Texas have higher concentrations of nutrients (i.e., nitrogen and phosphorus) than many of the Region C reservoirs. The ultimate impact of importing water with higher nutrient concentrations to Region C reservoirs is difficult to predict due to the complex kinetic relationships between nutrients and chlorophyll-a.

Strategies that involve importing water from East Texas reservoirs to Region C reservoirs may result in increases in ammonia, nitrate, total phosphorus, and/or chlorophyll-a, but are not likely to lead to impacts that would impair the designated uses of the Region C water bodies. In general, the dissolved solids (TDS, chloride and sulfate) concentrations in East Texas reservoirs are lower than in Region C reservoirs. Therefore, in nearly all cases, transfer of East Texas water to Region C reservoirs will decrease dissolved solids concentrations in the receiving water bodies. All of the recommended water management strategies involving importation of East Texas water to Region C are anticipated to have a "low" or "medium low" impact on key water quality parameters.

In addition to strategies that include transfers from East Texas reservoirs to Region C reservoirs, several recommended and alternative strategies include intermediate transfers between reservoirs outside of Region C. These include transfers from Wright Patman Lake to Lake Fork Reservoir and Chapman Lake and from Toledo Bend Reservoir to Lake Fork Reservoir, Lake Tawakoni, and Chapman Lake. Although there are some minor variations in water quality among these reservoirs, these strategies are all anticipated to have no more than a "medium-low" impact on the key water quality parameters.

Lake Texoma is included in the recommended and alternative strategies for multiple entities. The water will be transported directly to a water treatment plant, and dissolved solids from Lake Texoma will not directly impact any reservoirs in Region C. However, due to indirect reuse strategies, much of the dissolved solids from Lake Texoma will eventually be discharged to Region C reservoirs. Using TDS as an example, currently, typical TDS concentrations in Lake Texoma are in the 800-1,200 milligram per liter (mg/L) range. Most Trinity River Basin reservoirs in Region C have TDS standards (from the TSWQS) in the 400-500 mg/L range. Therefore, to import a significant quantity of Lake Texoma water into the Trinity River Basin, mitigation will likely be needed in the form of desalination or blending with another lower TDS water (such as an East Texas source) to meet drinking water standards, to prevent significant increases in TDS concentrations in receiving water bodies, and to prevent violation of the Texas Surface Water Quality Standard for TDS. To project the impact of strategies involving use of Lake Texoma water, it has been assumed that mitigation measures will be used to maintain TDS concentrations in the receiving water body at levels that do not violate the Texas Surface Water Quality Standard for TDS. In addition, for strategies that use desalination treatment as mitigation, disposal of the highly saline reject stream can result in increased TDS concentrations, depending on the method and location of disposal. Based on these issues, the recommended strategy involving importation of Lake Texoma water to Region C is anticipated to have no more than a "medium" impact on key water quality parameters.

6.1.4 New Surface Water Sources

In general, the impact of the development of new surface water sources on key water quality parameters will be similar to that of existing reservoir sources. All of the proposed reservoir sites identified as potential Region C sources are located in the Red, Trinity, Sulphur, or Neches River Basins. As such, the impacts on key water quality parameters of importing water from new reservoirs are likely to be similar to the impacts of importing water from existing East Texas sources to the Trinity River Basin. (The proposed reservoir in the Red River Basin, Bois d'Arc Lake, is on a low-TDS tributary of the Red River.) All strategies involving the importation of water from new reservoirs to Trinity River Basin reservoirs are anticipated to have no more than a "medium" impact on key water quality parameters.

One new surface water strategy involves the transfer of water between reservoirs that are both outside of Region C. That is a recommended strategy for Dallas Water Utilities involving transfer of Lake Columbia water to Lake Palestine. Another recommended strategy for Dallas Water Utilities is to use run-of-river supplies from the Neches River operated as a system with Lake Palestine. Both of these strategies are anticipated to have no more than a "medium" impact on water quality parameters.

6.1.5 Existing Groundwater Sources

Since none of the recommended strategies involving existing groundwater sources include blending of groundwater within a supply reservoir, no significant impacts on key surface water quality parameters are expected. Potential impacts on key water quality parameters resulting from alternative and recommended strategies in this category are anticipated to be "low" or "medium low".

6.1.6 New Groundwater Sources

There are no new major groundwater sources included in the recommended water management strategies for Region C. However, three alternative strategies propose obtaining water from groundwater sources that are new to the region. They are:

- **Carrizo-Wilcox Aquifer groundwater in Anderson County for NTWMD;**
- **Carrizo-Wilcox Aquifer groundwater in Wood, Upshur, and Smith Counties for DWU; and**
- **Carrizo-Wilcox Aquifer groundwater in Anderson and Freestone Counties for TRWD.**

Additional information on these projects is found in **Chapter 5C** of this report.

Lake Lavon (North Texas Municipal Water District) is the potential receiving water body for Anderson County groundwater. Anderson County groundwater, drawn from the Carrizo-Wilcox aquifer, has a median TDS concentration that is similar to that in Lake Lavon. Median sulfate and chloride concentration in the groundwater are lower than those in Lake Lavon. As a result, this strategy is anticipated to have a “low” impact on key water quality parameters.

Lake Fork (current supply for DWU and others) is the potential receiving water body for Wood, Upshur, and Smith Counties groundwater. The Carrizo-Wilcox aquifer in these counties has a median TDS concentration that is higher than that in Lake Fork Reservoir and somewhat greater than the surface water quality standard for Lake Fork Reservoir. The TDS concentration in Wood, Upshur, and Smith Counties groundwater relative to the surface water quality standard may limit the use of this resource in Region C. In addition, the median nitrate concentration appears to be high in comparison to the median nitrate concentration in Lake Fork Reservoir. As a result, this strategy is anticipated to have a “medium” impact on key water quality parameters.

TRWD’s potential Carrizo-Wilcox groundwater would be transported to the existing Integrated Pipeline and further transported to TRWD’s service area in Tarrant County. The groundwater can either be delivered directly to a water treatment plant or to Lake Benbrook. Carrizo-Wilcox groundwater from Anderson County has a median TDS concentration that is somewhat greater than that in Lake Benbrook. As a result, this strategy is anticipated to have a “medium low” impact on key water quality parameters.

6.1.7 Direct Reuse

By definition, direct reuse involves the transfer of treated wastewater effluent directly to a point of use and not into another water body. As such, the impact on key water quality parameters for all direct reuse strategies is anticipated to be “low.” In some cases, there may be a positive impact. By reducing the quantity of effluent discharged into a stream or reservoir segment, the nutrient and TDS loads to that segment will also be reduced, thereby potentially improving downstream water quality.

6.1.8 Indirect Reuse

Indirect reuse is a recommended strategy for multiple entities within Region C. This strategy involves the discharge of treated wastewater effluent into a body of water used for water supply. Treated wastewater can contain nutrient and dissolved solids concentrations that are high in comparison to the receiving water. However, for most of the recommended strategies that include indirect reuse, some form of mitigation (e.g., advanced wastewater treatment, constructed wetlands, blending, etc.) is planned to address potential water quality impacts associated with nutrients and dissolved solids. For the purposes of this evaluation, it is assumed that some form of mitigation for potential water quality impacts associated with the key parameters will be implemented, if necessary, such that the designated uses of the water body will not be impaired. For this reason, recommended indirect reuse strategies are anticipated to have no more than a “medium” impact on key water quality parameters.

6.1.9 Conservation

Conservation is a recommended strategy for all municipal water user groups in

Region C, including those without shortages. Water conservation is the development of water resources and practices to reduce the consumption or loss of water, increase the recycling and reuse of water, and improve the efficiency in the use of water. Water conservation plans are designed to implement practices to conserve water and quantitatively project water savings. The water conservation measures recommended in Region C are not expected to affect water quality adversely. The results should generally be beneficial because the demand on surface and groundwater resources will be decreased. Quantifying such positive impacts could be very difficult. **Chapter 5B** contains additional discussion of water conservation.

6.1.10 Summary

The recommended water management strategies in this plan were developed based on the principle that designated water quality and related water uses as shown in the state water quality management plan shall be improved or maintained. Based on the projected impacts of recommended water management strategies on key water quality parameters, some strategies may require mitigation or advanced treatment to obtain the permits necessary for implementation.

6.2 Impacts of Recommended Water Management Strategies on Moving Water from Rural and Agricultural Areas and Impacts to Third Parties

This section discusses the potential impacts of the *2021 Region C Water Plan* on rural and agricultural activities and possible impacts to third party entities, and specifically focuses on the impacts associated with moving water from rural and agricultural areas. This section also discusses the considerations given during the development of the plan to protect rural and agricultural activities.

6.2.1 Impact on Agricultural Resources

The *2021 Region C Water Plan* includes several strategies that move water from rural areas to urban centers. These strategies fall into two general categories:

- New connections to existing water sources: Toledo Bend Reservoir to NTMWD and TRWD, Lake Palestine to DWU, Texoma to NTMWD and GTUA, Oklahoma water to NTMWD, etc.
- New reservoirs: Marvin Nichols, Lake Ralph Hall, Lake Columbia, Lake Tehuacana, and Bois d'Arc Lake

Large groundwater projects also may move large quantities of water from rural to urban areas, but these are not recommended strategies. Alternative strategies of Carrizo-Wilcox groundwater from Anderson, Wood, Upshur, and Smith Counties, are located outside of the Region C planning area.

The impacts from the recommended water management strategies will vary depending on the location of the project, current use of the water, and the quantity of water that is being transferred. The types of impacts that may occur include:

- Transfer of water rights from agricultural use to other uses
- Removal of agriculture through inundation from new reservoirs
- Changes in stream flow immediately downstream of a new reservoir
- Increased water level fluctuations at existing lakes as more water is used

The recommended water plan considered many different factors as strategies were developed and recommended for inclusion. One consideration is the development of a plan that minimizes the potential impacts to rural and agricultural areas through utilization of existing sources with a strong emphasis on conservation and reuse. The existing and recommended 2070 water conservation and reuse strategies, including those that are assumed in the demands, will meet more than one million acre-feet per year of the pre-conservation demand. The emphasis on conservation and reuse reduces the number of strategies and amount of water needed from other sources, including transfers of water from rural and agricultural areas.

Other protections for agricultural and rural uses were incorporated in the process of evaluating and allocating water supplies. Specifically, these include:

- Existing and proposed surface water supplies were evaluated under the prior appropriation doctrine that governs surface water rights and protects senior water rights. In the final *2021 Region C Water Plan*, there are no transfers of irrigation water rights to urban uses.
- The amount of available supplies from existing sources was limited to firm yield. Existing uses from these sources were protected through the allocation process and only the amount of water that is currently permitted (up to the firm yield) was considered for transfer to Region C. Three existing reservoirs (Texoma, Wright Patman and Toledo Bend) are currently seeking or are recommended to seek additional water rights. This additional water would not impact agricultural or rural activities.
- Supplies from new reservoirs considered instream flow releases in accordance with the planning guidelines set forth by the TWDB. These releases protect recreational and non-consumptive water needs downstream of the proposed reservoir sites.

In Region C there is little irrigated agriculture, with irrigated cropland making up less than 2 percent of harvested cropland(2). Most of the irrigation water demand is associated with golf course irrigation in and near urban areas, and much of this water need will be met through reuse. There are no recommended transfers of needed irrigation to other uses and all irrigation and livestock water needs are met through the recommended plan.

The potential impacts to agricultural and rural areas are limited to the loss of land from inundation of new reservoirs. The total acreage that would be flooded if all recommended water management strategies from the *2021 Region C Water Plan* were implemented is almost 131,000 acres, with almost half of that being from the proposed Marvin Nichols Reservoir. More detailed information about the impacts of this reservoir on agricultural land is included in **Appendix J.** Impacts from new reservoirs will be mitigated as part of the permitting process. New reservoirs also can stimulate the rural economy through new recreational business and local improvements. The new reservoirs will provide a new water source for rural activities. Each of the proposed reservoir sites includes water set aside for local water supplies.

6.2.2 Third Party Impacts of Moving Water from Rural and Agricultural Areas

Possible third party impacts include loss of land and timber, impacts to existing recreational business on existing lakes due to lower lake levels, and impacts to recreational stream activities. Economic studies have been conducted for two of the reservoirs proposed for Region C, and in each case they indicate a significant net economic benefit to the region of origin[(3),(4)].

6.2.3 Impacts of Recommended Water Management Strategies on Groundwater and Surface Water Inter-relationships

The impacts of recommended water management strategies in Region C on groundwater and surface water relationships are expected to be minimal. For surface water, the supplies used do not exceed the firm yield of the reservoir. For groundwater, the desired future conditions, as adopted by the GMAs, were honored for both currently developed supplies and potential future strategies. By not exceeding the MAG, long-term effects on groundwater and surface water interrelationships were minimized since these complex relationships are considered by the GMA when selecting the DFCs.

6.2.4 Other Factors

The impacts to recreational activities and recreational businesses at existing lakes are expected to be low. While water levels at local and rural lakes may fluctuate more under the recommended plan, these water level changes are within the design constraints of the reservoirs. Five of the major water transmission strategies have water sources that are located in highly prolific rainfall areas. Significant changes in water levels at these sources would be limited to extreme drought conditions. Impacts to recreational stream activities are mitigated through the permitting process and requirements for instream flow releases. New reservoirs offer new recreational opportunities and recreational business growth that could spur the local economies of rural areas.

6.2.5 Interbasin Transfers of Surface Water

Several recommended and alternative water management strategies involve interbasin transfers of surface water to Region C. These strategies propose moving water from the Red, Neches, Sabine, and Sulphur Basins to the Trinity Basin. The needs, as reported in DB22, for each of these basins of origin and the receiving basin (Trinity) are included in **Table 6.2**. By 2040, the needs in the Trinity Basin exceed the needs in each of the basins of origin.

6.3 Invasive and Harmful Species

The appearance of several invasive and/or harmful species (including zebra mussels, giant salvinia, and golden algae) poses a potential threat to water supplies throughout the state of Texas. Monitoring and management by water suppliers in Region C will be necessary in the coming decades. Invasive species will likely be an ongoing area of interest to Region C, as the appearance of additional invasive species in the future remains a possibility. The issue of invasive and harmful species should be considered as plans for interbasin transfers of water supplies are implemented. A more extensive discussion of these invasive species is found in **Chapter 1** of this report.

6.4 Description of How the Regional Water Plan is Consistent with Long-Term Protection of the State's Water Resources, Agricultural Resources, and Natural Resources

The development of viable strategies to meet the demand for water is the primary focus of regional water planning. However, another important goal of water planning is the long-term protection of resources that contribute to water availability and to the quality of life in the state.

The purpose of this section is to describe how the *2021 Region C Water Plan* is consistent with the long-term protection of the state's water resources, agricultural resources, and natural resources. The requirement to evaluate the consistency of the regional water plan with protection of resources is found in 31 TAC Chapter 357.35(c) and 357.41.

Table 6.2 Water Needs by Basin and Region Related to Interbasin Transfers (Acre-Feet per Year)

Basin	Region	2020	2030	2040	2050	2060	2070
Red	A	23,028	29,991	33,283	38,542	43,769	49,653
	B	24,200	26,442	29,501	32,312	35,601	40,877
	C	4,972	5,740	6,308	9,213	16,903	35,876
	D	4,270	4,288	4,290	4,292	4,313	4,358
	G	2,977	3,457	2,719	2,299	2,239	2,677
	O[a]	1,366	1,466	2,139	2,922	3,771	4,671
	Total	**60,813**	**71,384**	**78,240**	**89,580**	**106,596**	**138,112**
Neches	D	54	104	144	190	235	280
	H	8,182	8,464	8,761	9,101	9,477	9,879
	I	128,310	169,099	167,711	172,042	177,872	184,139
	Total	**136,546**	**177,667**	**176,616**	**181,333**	**187,584**	**194,298**
Sabine	C	24	954	1,824	3,687	6,306	8,813
	D	7,754	10,680	13,820	18,232	24,568	33,506
	I	10,919	12,914	15,097	17,847	21,260	21,353
	Total	**18,697**	**24,548**	**30,741**	**39,766**	**52,134**	**63,672**
Sulphur	C	215	229	219	299	504	650
	D	29,784	30,701	31,312	32,164	33,282	34,624
	Total	**29,999**	**30,930**	**31,531**	**32,463**	**33,786**	**35,274**
Trinity	B	545	50	51	136	226	323
	C	58,912	297,441	518,690	751,539	983,723	1,220,076
	D	38	72	123	235	374	582
	G	7,159	8,079	9,194	11,342	14,122	17,224
	H	12,552	13,850	14,140	14,766	15,581	16,449
	I	0	0	0	0	0	146
	Total	**79,206**	**319,492**	**542,198**	**778,018**	**1,014,026**	**1,254,800**

[a]Region O needs do not include irrigation needs.

6.4.1 Consistency with the Protection of Water Resources

Five river basins provide surface water for Region C, and six aquifers provide groundwater to the region. The four major river basins within Region C boundaries are the Trinity River Basin, the Red River Basin, the Brazos River Basin, and the Sabine River Basin. Only a small portion of the Sulphur River Basin lies within the Region C boundaries, but this basin provides important surface water supplies for Region C from Chapman Lake. The region's groundwater resources include two major aquifers, the Trinity and Carrizo-Wilcox, and three minor aquifers, the Woodbine, the Nacatoch, and the Queen City. The extents of these aquifers within the region are depicted in **Chapter 1**.

The Trinity River Basin provides the largest amount of water supply in Region C. Surface reservoirs in the Trinity Basin in Region C with conservation storage over 50,000 acre-feet include:

- **Bridgeport Reservoir**
- **Eagle Mountain Reservoir**
- **Benbrook Lake**
- **Joe Pool Lake**
- **Grapevine Lake**
- **Ray Roberts Lake**
- **Lewisville Lake**
- **Lavon Lake**
- **Lake Ray Hubbard**
- **Bardwell Lake**
- **Navarro Mills Lake**
- **Richland-Chambers Reservoir**
- **Cedar Creek Reservoir**
- **Lake Fairfield**

Other major reservoirs supplying surface water to Region C include the following:

- Lake Texoma in the Red River Basin
- Only a small portion of the Sabine River Basin lies within Region C; however, Region C receives water from two major water supply reservoirs located in Region D and the Sabine Basin (Lake Tawakoni and Lake Fork Reservoir).
- Only small portions of the Brazos River Basin lie within Region C, and no Brazos River Basin reservoirs with conservation storage over 50,000 acre-feet are located in Region C.
- Chapman Lake is located in the Sulphur River Basin in Region D.
- Lake Palestine is permitted for use in Region C, but is located in the Neches River Basin in Region I.

Of the groundwater resources in Region C, the Trinity aquifer provides about 67 percent of the region's groundwater, and about 17 percent comes from the Woodbine aquifer. The remainder of the groundwater is from the Carrizo-Wilcox (10 percent), and 6 percent is from minor and undesignated aquifers.

To be consistent with the long-term protection of water resources, the plan must recommend strategies that minimize threats to the region's sources of water over the planning period. The water management strategies identified in **Chapter 5** were evaluated for threats to water resources. The state-developed surface Water Availability Models (WAMs) and Groundwater Availability Models (GAMs) were used to evaluate surface water and groundwater supplies, respectively. The results from these models were used to determine the amount of water supply that could be allocated while still protecting the sustainability of the water resources. The recommended strategies represent a comprehensive plan for meeting the needs of the region while effectively minimizing threats to water resources.

Descriptions of the major strategies and the ways in which they minimize threats include the following:

- **Water Conservation.** Strategies for water conservation have been recommended that will significantly reduce the demand for water, thereby reducing the impact on the region's groundwater and surface water sources. Not including reuse, water conservation practices are expected to reduce the municipal water use in Region C by 192,405 acre-feet per year by 2070 and reduce non-municipal water use by 4,276 acre-feet per year by 2070, reducing impacts on both groundwater and surface water resources (Table 5B.11).
- **Reuse Projects.** Existing and recommended reuse projects in Region C account for a total water

supply of 413,729 acre-feet per year as of 2070 (Table 5B.8). The majority of the recommended reuse is for municipal use. A portion of the reuse water is for golf course and general irrigation in municipal areas and for steam electric power generation. These strategies will provide an economical and environmentally desirable source of water for Region C and delay the need for development of new water supplies.

- **Conservation and Reuse.** The existing and recommended 2070 water conservation and reuse strategies, including those that are assumed in the demands, will meet more than 1.35 million acre-feet per year (or 42.9 percent) of the pre-conservation demand.
- **Full Utilization of Existing Surface Supplies Committed to Region C.** A number of recommended strategies for Region C are intended to make full use of existing supplies. Most reservoirs in Region C will be utilized at or near their firm yield capacities but not beyond, thus protecting these reservoirs and allowing the continued water supplies throughout a drought similar to the drought of record. In addition, by fully utilizing the existing water supplies, water providers will delay the need for new supplies.
- **Investigation of Existing Supplies Not Committed to Region C.** As part of this planning process, the Region C Water Planning Group investigated the cost and availability of existing water supplies that might be made available to Region C. Cost-effective existing supplies are included in the *2021 Region C Water Plan*.
- **Optimal Use of Groundwater.** This strategy is recommended for entities with limited alternative sources and sufficient groundwater supplies to meet their needs. Groundwater availability reported in the plan maintains the long-term sustainability of the aquifer and is based on aquifer recharge.
- **New Surface Reservoirs.** A number of new surface reservoirs have been recommended as water management strategies. They include: Bois d'Arc Lake in 2020, Lake Ralph Hall in 2030, Tehuacana Reservoir in 2040, Marvin Nichols Reservoir in 2050, and Lake Columbia in 2070. These reservoirs will have significant impacts on the land, homes, and habitat that will be inundated and on the existing stream segments which will be altered. As part of reservoir development, the Corps of Engineers will determine the quantity of land that should be set aside to mitigate for impacts to aquatic and wildlife habitats. Landowners within the reservoir sites will be compensated for their land. These new reservoirs will make releases for environmental water needs in accordance with environmental regulations and permit conditions, which will help sustain aquatic and wildlife habitat downstream from the reservoir. Water right permits for these reservoirs will be granted based on results from the WAMs which will ensure that these new water rights do not interfere with existing prior water rights, thus protecting existing water resources of the state.

6.4.2 Consistency with Protection of Agricultural Resources

Many areas of Region C are heavily urbanized, and the region has comparatively little irrigated agriculture. In the year 2016, 4 percent of the region's total water use was for irrigation and livestock and most of the irrigation shown in that table was used for golf course irrigation rather than agricultural irrigation.

None of the recommended water management strategies involve transferring water rights from agricultural use to another use. Thus, the Region C plan protects current agricultural water use.

The proposed reservoirs in the *2021 Region C Water Plan* will inundate some agricultural areas, but agricultural use in the reservoir sites is limited. The proposed reservoirs located in Region C include Bois d'Arc Lake, Lake Ralph Hall and Lake Tehuacana. Very little agricultural activity exists in the area of these proposed reservoirs. During the permitting process, site specific analyses would address this topic in more detail.

The proposed Marvin Nichols Reservoir in the Region C Plan is located outside of Region C. The area of the proposed Marvin Nichols Reservoir site has some agricultural activity, including cattle raising and timber.

This area is also known to have some hunting leases for game animals. A quantitative analysis of the impacts of the proposed Marvin Nichols Reservoir on agricultural and natural resources is included in **Appendix J**.

The proposed Lake Columbia in the Region C Plan is located outside of Region C. The area of the proposed Lake Columbia site has 11,330 acres. Very little agricultural activity exists in this area and site specific analyses will be conducted during the permitting process.

6.4.3 Consistency with Protection of Natural Resources

Region C contains many natural resources that must be considered in water planning. Natural resources include threatened or endangered species; local, state and federal parks and public land; and energy/mineral reserves.

The Region C plan is consistent with the long-term protection of these resources. A brief discussion of consistency of the plan with protection of natural resources follows.

Threatened/Endangered Species. A list of threatened or endangered species located within Region C is contained in two tables in **Chapter 1**. Federally and state listed species are summarized utilizing data from the Texas Parks and Wildlife Department's listing[5] and from the U.S. Fish and Wildlife Service [6].

All recommended strategies in Region C have been chosen with the possible effects on these threatened and endangered species in mind. For example, strategies that are likely to disturb threatened or endangered species habitat include mitigation allowances that set aside additional land for that habitat.

Wetland Habitats. The Region C plan includes some projects that would have impacts to existing wetland habitats. The Marvin Nichols Reservoir project would inundate a portion of the state's Priority 1 bottomland hardwoods. These wetlands are considered high value to key waterfowl species and would require comparable mitigation. As discussed in **Section 6.4.1**, state and federal agencies will determine the quantity of land that should be set aside to mitigate for impacts to aquatic and wildlife habitats during reservoir development. The quantity and quality of the mitigation lands will be designed to achieve no net loss of wetlands functions and values. In addition, the development of a lake will create new wetland and aquatic habitats.

Parks and Public Lands. The Texas Parks and Wildlife Department operates several state parks in Region C listed below [7]:

- Bonham State Park in Fannin County
- Cedar Hill State Park in Dallas County
- Eisenhower State Park in Grayson County
- Fairfield Lake State Park in Freestone County
- Lake Mineral Wells State Park in Parker County
- Fort Richardson & Lost Creek Reservoir State Park in Jack County
- Purtis Creek State Park partially in Henderson County
- Caddo National Grasslands Wildlife Management Area in Fannin County
- Ray Roberts State Park in Cooke, Denton, and Grayson Counties
- Richland Creek Wildlife Management Area in Freestone and Navarro Counties
- Ray Roberts Lake Wildlife Management Area in Cooke, Denton, and Grayson Counties
- Cedar Creek Islands Wildlife Management Area in Henderson County

Federal government natural resource holdings in Region C include the following:

- Parks and other land around all of the Corps of Engineers lakes in the region (Texoma, Ray Roberts, Lewisville, Lavon, Grapevine, Benbrook, Joe Pool, Bardwell, and Navarro Mills)
- Hagerman National Wildlife Refuge on the shore of Lake Texoma in Grayson County
- Lyndon B. Johnson National Grasslands in Wise County
- The Caddo National Grasslands in Fannin County

In addition, there are a number of city parks, recreational facilities, and public lands located throughout the region. Increased utilization of some reservoirs may lower the lake levels during a severe drought. This may affect the parks and public lands surrounding these reservoirs, but the strategies recommended in the Region C plan will have no additional impact on these water resources beyond what has already been allowed for in their water right permits. None of the recommended water management strategies evaluated for the Region C plan are expected to adversely impact parks or public lands.

Energy Reserves. Oil and natural gas fields are important natural resources in portions of Region C. Most of the oil production is in Jack, Wise, Cooke, Navarro, and Grayson Counties [8], and most of the natural gas production is in Freestone, Parker, Denton, Tarrant, and Wise Counties [9]. Gas production in the Barnett Shale has rapidly increased in the past decade due in large part to improvements in hydraulic fracture stimulation technologies [10]. This use of water in gas production has significantly increased the mining use in Region C. None of the recommended water management strategies are expected to impact oil or gas production in the region. The proposed Tehuacana Reservoir location in Freestone County is underlain, in parts, by lignite coal deposits. In 1982, the US Army Corps of Engineers conducted a feasibility report on the recovery of these resources [11].

This report concluded that there was economic impetus to mine this deposit to 150 feet. However, the economic environment for the mining and use of coal for power generation has changed substantially since 1982. One major assumption in the report is that the coal could be used at the Luminant's Big Brown Plant near Fairfield, which is only a short distance from the potential mine location near Tehuacana. However, in 2011, Luminant ceased coal production at their three current lignite mines and no longer uses lignite coal at the Big Brown Plant due to the EPA Cross-State Air Pollution Rule [(12)]. Furthermore, in 2014 the EPA proposed a new Clean Power Plan Rule [(13)], which if it passes, may make coal fired power generation even less attractive. While it is impossible to predict future market changes and conditions, given the current regulatory environment and the trend of closing lignite mines, it is unlikely that the construction of the Tehuacana Reservoir will result in adverse impacts on the coal industry.

6.4.4 Consistency with Protection of Navigation

No commercial navigation activities occur in Region C at this time. For the two river segments identified by the Corps of Engineers as "navigable waters" (Trinity River downstream of Fort Worth and the Red River downstream of Warren's Bend in Cooke County), there are no known plans to initiate navigation activities. This plan has no impact to navigation in Region C.

The Region C recommended strategies also do not impact navigation activities in other regions. Analysis of the proposed reuse projects found that there are limited impacts to stream flows from reuse projects, thus protecting potential downstream navigation activities. The recommended reservoirs located in adjacent regions include sufficient releases that would protect instream uses and downstream navigation activities.

6.5 Impacts of Not Meeting Municipal Water Needs

6.5.1 Unmet Needs in Region C

There is one municipal WUG and seven non-municipal WUGs with unmet needs in Region C. The WUGs with unmet needs are

- Hickory Creek SUD
- Ellis County Irrigation,
- Fannin County Irrigation
- Fannin County Mining,
- Freestone County Mining,
- Freestone County Steam Electric Power,
- Kaufman County Mining, and
- Navarro County Mining.

The unmet need for Hickory Creek SUD is due to limitations of the MAG in Hunt County. Since the SUD's water source is not within a groundwater conservation district, the SUD intends to further develop its groundwater to meet the projected water needs.

For both Ellis and Fannin County Irrigation, the current use is groundwater, and the anticipated future use is also groundwater. However, there is not enough MAG supply to allocate to these WUGs as a WMS to fully meet their needs.

For Freestone County Mining, the need is unmet because the demand is a function of how the TWDB classifies the mining operation, not an "actual" demand. The demand is from the de-watering of lignite mines from shallow aquifers. It is the amount of water produced by dewatering rather than a true demand, and no supply is needed.

For Freestone County Steam Electric Power, the demand projections include use from an unidentified new facility based on state and federal reports (See **Appendix C** for Steam Electric Power Memo). It is unclear where the facility would get its supply. In addition, in the previous plan, 6 MGD of this need was met by a WMS of TRA reuse water. In this plan, however, TRA has identified other users for its reuse supply and none is available for Freestone County SEP.

For Kaufman and Navarro County Mining, the current use is groundwater and the anticipated future use is also groundwater. However, there is no MAG supply to allocate to these WUGs as a WMS.

For Fannin County Mining, the current use is run-of-river water. There is no additional firm supply of run-of-river and no additional MAG groundwater supply to allocate to this use. Additionally, the new surface water in Fannin County is not authorized for mining use.

6.5.2 Socioeconomic Impacts

If no additional water supplies are developed, Region C will face substantial shortages in water supply over the next 50 years. The Texas Water Development Board (TWDB) provides technical assistance to regional water planning groups in the development of specific information on the socio-economic impacts of failing to meet projected water needs. This information is presented in **Appendix L**. A summary of the TWDB's socio-economic report is presented in this section. The TWDB analysis of socio-economic impacts is based on information on potential Region C shortages provided to the TWDB by Region C through TWDB's online database (DB22). TWDB based the socio-economic analysis on the information in DB22 as of September 2019. In November 2019, Region C made adjustments to some of the data in DB22 which slightly changed the overall shortages. These changes represent a 1.5 percent decrease in 2070 water needs. The socio-economic analysis was not updated to incorporate this new data. The minimal change in shortages would mostly likely have minimal effect on the outcome of the socio-economic analysis. Therefore, the results presented in this section remain a valid representation of the effects of not meeting all water needs.

Table 6.3, Figure 6.1 and **Figure 6.2** summarize the TWDB's analysis of the impacts of a severe drought occurring in a single year at each decadal period in Region C. It was assumed that all of the projected shortage was attributed to drought. Under these assumptions, the TWDB's findings can be summarized as follows:

- With the projected shortages, the region's projected 2070 population would be reduced by 86,839.
- Without any additional supplies, the projected water needs would reduce the region's projected 2070 employment by almost 473,000 jobs.
- By not meeting water needs in Region C, the annual combined lost income in 2070 is estimated at $48.1 billion.
- The lost water utility revenues (municipal sector only) in 2070 are $4.6 billion.

The projected impact on population and jobs over the planning period is shown on **Figure 6.1.** The impacts to income by use category are shown on **Figure 6.2.** It is important to note that this socio-economic impact analysis only considers a severe drought occurring in a single year. A drought several years long would have an even greater impact on the region.

6.6 Consistency with State Water Planning Guidelines

To be considered consistent with long-term protection of the state's water, agricultural, and natural resources, the Region C plan must be determined to be in compliance with the following regulations:

- **31 TAC Chapter 357.35**
- **31 TAC Chapter 357.40**
- **31 TAC Chapter 357.41**
- **31 TAC Chapter 358.3**

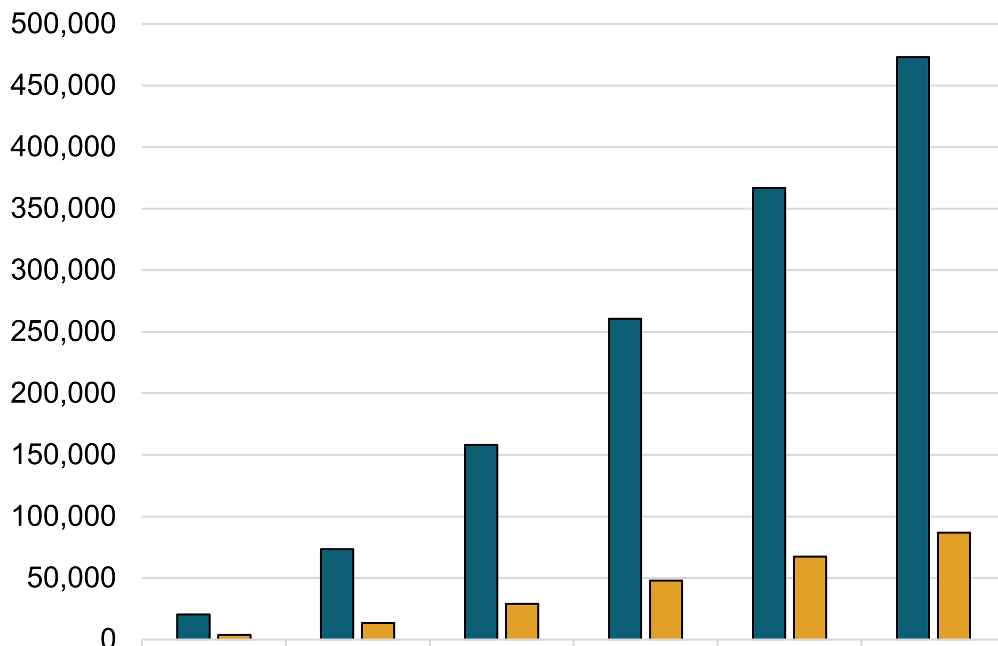
The information, data, evaluation, and recommendations included in the Region C plan collectively comply with these regulations. To assist with demonstrating compliance, Region C has developed a matrix addressing the specific recommendations contained in the above referenced regulations. The matrix is a checklist highlighting each pertinent paragraph of the regulations. The content of the *2021 Region C Water Plan* has been evaluated against this matrix.

Appendix A contains a completed matrix.

Table 6.3 Socio-Economic Impacts in Region C of Not Meeting Projected Demands

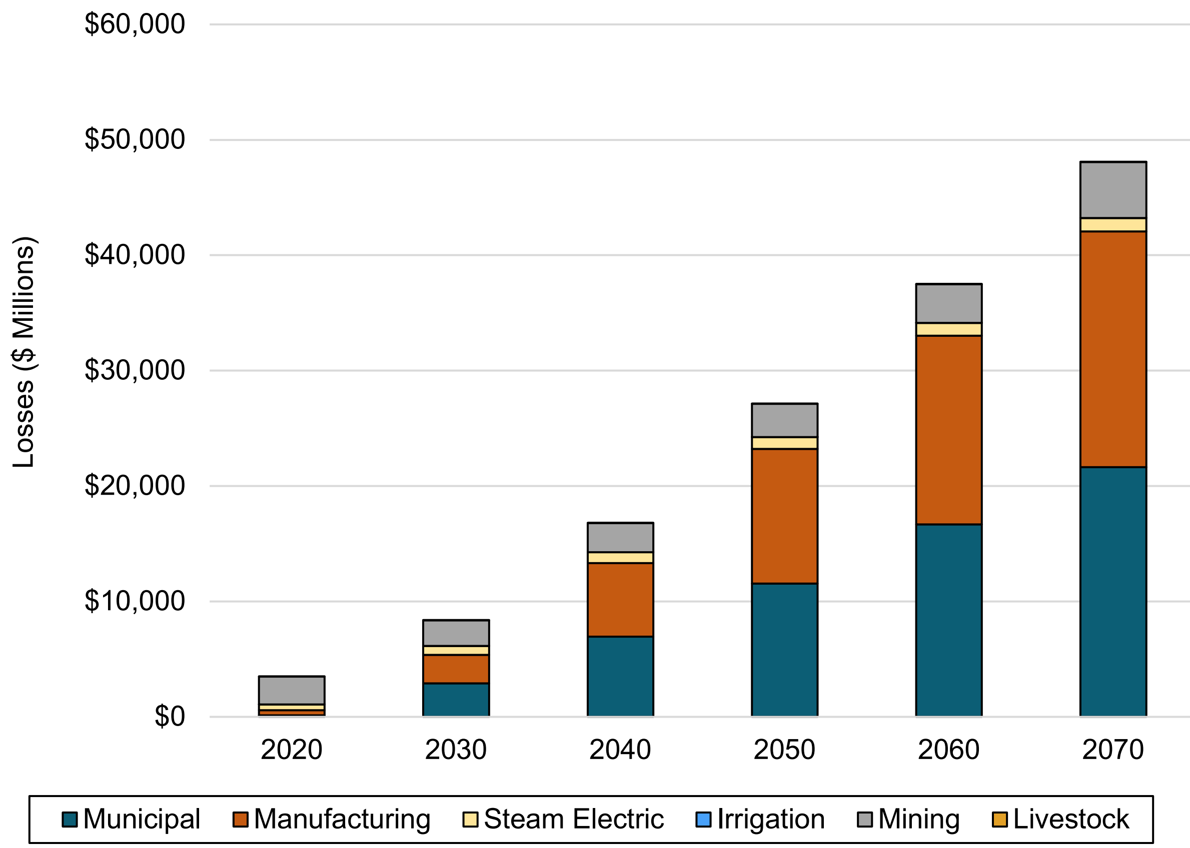
Year	Income ($ Millions)	Tax Losses on Production and Imports ($ Millions)	Jobs Lost	Population Losses
2020	$3,505	$279	20,437	3,752
2030	$8,361	$582	73,315	13,461
2040	$16,791	$1,123	158,102	29,027
2050	$27,127	$1,777	260,573	47,841
2060	$37,499	$2,461	366,762	67,338
2070	$48,071	$3,221	472,979	86,839

Figure 6.1 Population and Job Losses Associated with Not Meeting Projected Demands



	2020	2030	2040	2050	2060	2070
Jobs Lost	20,437	73,315	158,102	260,573	366,762	472,979
Population Losses	3,752	13,461	29,027	47,841	67,338	86,839

Figure 6.2 Projected Loss of Income with Not Meeting Projected Demands



6.7 Chapter 6 List of References

(1) Texas Administrative Code, Title 30, Chapter 307, [Online], Available URL: http://www.tceq.state.tx.us/assets/public/legal/rules/rules/pdflib/307%60.pdf, January 2010.

(2) U.S. Department of Agriculture: 2007 Census of Agricultural, Volume 1, Chapter 2: Texas County Level Data, Table 1, [Online], Available URL: http://www.agcensus.usda.gov/Publications/2007/Full_Report/index.asp, February 2010.

(3) Weinstein, B. L. and T. L. Clower: The Economic, Fiscal, and Developmental Impacts of the Proposed Marvin Nichols Reservoir Project, prepared for the Sulphur River Basin Authority, Denton, March 2003.

(4) Clower, T. L. and B. L. Weinstein: The Economic, Fiscal, and Developmental Impacts of the Proposed Lower Bois d'Arc Reservoir Project, prepared for the North Texas Municipal Water District, Denton, September 2004.

(5) Texas Parks and Wildlife Department, Wildlife Division, Diversity and Habitat Assessment Programs: County Lists of Texas' Special Species. Region C Counties, January 20, 2009.

(6) U.S. Fish and Wildlife Service: Listed Species Information Center, [Online], Available URL: http://www.fws.gov/southwest/es/EndangeredSpecies/lists/ListSpecies.cfm, January 2008.

(7) Texas Parks and Wildlife Department: State Parks and Destinations, [Online], Available URL : http://www.tpwd.state.tx.us/ , February, 2010.

(8) Texas Railroad Commission: Well Distribution by County, Oil Well Counts, Austin, [Online], Available URL : http://www.rrc.state.tx.us/data/wells/wellcount/oilwellct_0210.pdf , February 2010.

(9) Texas Railroad Commission: Well Distribution by County, Gas Well Counts, Austin, [Online], Available URL: http://www.rrc.state.tx.us/data/wells/wellcount/gaswellct_0210.pdf , February 2010.

(10) R.W. Harden & Associates, Inc, Freese & Nichols, Inc, Bureau of Economic Geology: Northern Trinity/Woodbine GAM, Assessment of Groundwater Use in the Northern Trinity Aquifer Due to Urban Growth and Barnett Shale Development, Austin, January 2007.

(11) U.S. Army Corps of Engineers, Feasibility Report Lignite Resource Recovery Richland and Tehuacana Lake Sites Freestone and Navarro Counties, Texas, Fort Worth District, August 1982.

(12) Nelson, Gabriel: Texas Utility to Ide Boilers, Cole Mines in Response to New EPA Rule, New York Times [Online], Available URL:

http://www.nytimes.com/gwire/2011/09/12/12greenwire-texas-utility-to-idle-boilers-coal-mines-in-re-68196.html, September 2011.

(13) Environmental Protection Agency, Clean Power Plan Proposed Rule [Online] Available URL: http://www2.epa.gov/carbon-pollution-standards/clean-power-plan-proposed-rule, June 2014.

(14) Texas Water Development Board: Chapter 357, Regional Water Planning Guidelines, Austin, October 1999, amended February 18, 2008.

(15) Texas Water Development Board: Chapter 358, State Water Planning Guidelines, Austin, October 1999, amended December 6, 2004.

7 Drought Response

Drought is a natural and recurring meteorological phenomenon that occurs when precipitation is significantly below "normal" for a period of time. Relatively mild, short-duration droughts are common throughout Texas and typically result in relatively mild impacts. However, extended and severe drought conditions can have serious impacts on water supplies, water suppliers, and water users including:

- Reduction in available water supply leading to shortage conditions;
- Increases in water demand, particularly for seasonal demands such as landscape irrigation;
- Stress on water utility infrastructure due to elevated seasonal peak water demands;
- Deterioration of source water quality;
- Lifestyle and financial impacts to water users associated with restrictions on non-essential water uses (e.g., loss of landscaping); and
- Financial impacts on water suppliers due to reduced revenues from water sales during periods of water demand curtailment.

Due to the potentially devastating effects of drought on communities and the State's economy, it is important that water suppliers and users consider the potential impacts of drought and develop robust plans to address supply or demand management under drought conditions. This chapter presents information concerning historical droughts in the Region, current drought preparation and responses, recommendations for region-specific drought responses, and region-specific model drought contingency plans.

Chapter Outline

Section 7.1 – Drought of Record in the Regional Water Planning Area

Section 7.2 – Current Preparations for Drought in Region C

Section 7.3 – Existing and Potential Emergency Interconnects

Section 7.4 – Emergency Responses to Local Drought Conditions or Loss of Municipal Supply

Section 7.5 – Region-Specific Drought Response Recommendations

Section 7.6 – Drought Management WMS

Section 7.7 – Other Recommendations

Related Appendices

Appendix M –Summary of Existing Drought Plans and Potential Emergency Connections

7.1 Drought of Record in the Regional Water Planning Area

7.1.1 Regional Drought of Record

The Drought of Record (DOR) is typically defined as the worst drought to occur for a particular area during the available period of hydrologic record. Due to the variety of ways in which drought may be characterized (deviation from normal precipitation, temperature, agricultural impacts, economic losses, duration, impacts to reservoirs, etc.), defining which drought is the DOR for an area can be a complex issue. For much of the State, the DOR is generally considered to have occurred from 1950 through 1957. This drought combined severe reductions in rainfall with a multi-year duration, resulting in reduction or cessation of flows for many springs and streams, losses to livestock production and irrigated agriculture, and widespread impacts to vegetation. By the end of the drought in late 1956 or early 1957, nearly all of the counties in the State had been declared disaster areas. The drought of record for most water supplies used in Region C occurred from 1950 through 1957. The two drought periods recently experienced in Region C (2003 through 2006 and 2011 through 2015) caused low inflows and low water levels for many Region C lakes. Analysis using hydrologic data from recent years has indicated that Jim Chapman (Cooper) Lake in the Sulphur River Basin has recently experienced a new drought of record (2011 through 2015), reducing the yield by approximately 7 percent from what was in the *2016 Region C Plan*. Yields of proposed projects in the Sulphur Basin show as much as a 24 percent reduction in yield. For other Region C supplies, the drought of the 1950s remains the drought of record.

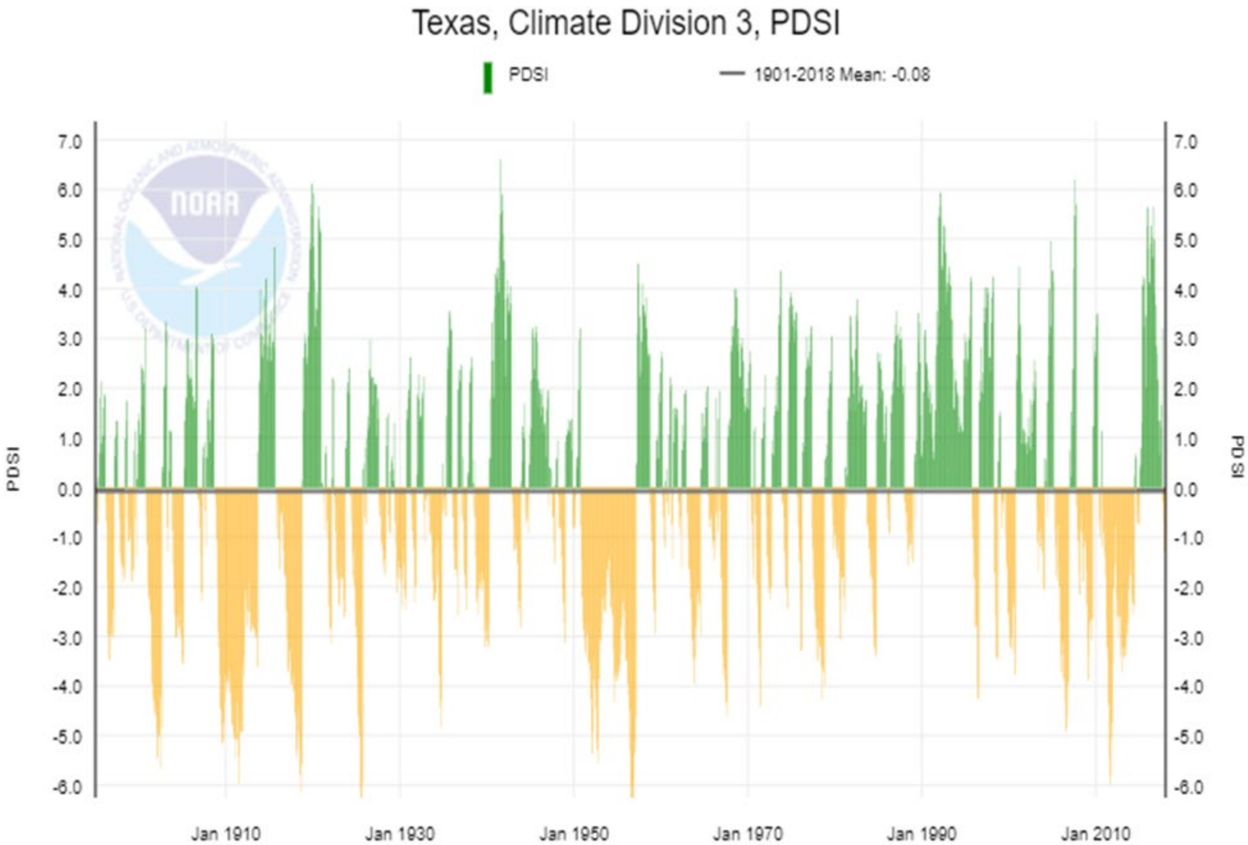
7.1.2 Surface Water Drought Indication

The significance of drought for the Region can be illustrated in several ways. For reservoir supplies, which make up a large portion of the water supply for Region C, the DOR corresponds to the period that reaches the minimum storage in the reservoir under an assumed demand. While many of the major water supply reservoirs serving Region C were not yet constructed during the DOR, their performance under a repeat of historical hydrology including the DOR can be assessed using the Texas Commission on Environmental Quality (TCEQ) Water Availability Model (WAM); this assessment is directly associated with the use of the WAM model to determine firm availability of surface water.

7.1.3 Palmer Drought Severity Index

Another indicator commonly used by federal and state agencies to characterize drought severity is the Palmer Drought Severity Index (PDSI). The PDSI is an estimate of soil moisture conditions calculated based on precipitation and temperature. The PDSI classifies soil moisture on a scale ranging from approximately -6.0 to 6.0, with values of approximately -0.49 to +0.49 reflecting normal conditions, and -4.0 or lower representing extreme drought. The annual PDSI for the North Central Texas area, which includes the majority of the population in Region C, is shown in **Figure 7.1**. As illustrated in the figure, the 1950s drought is among the most severe in terms of PDSI and is also prolonged.

Figure 7.1 Palmer Drought Severity Index for North Central Texas



7.1.4 Other Regional Droughts

The Region C area, like much of Texas, has experienced a number of droughts in addition to the DOR, including several more recent dry periods. The recent drought period which began in approximately year 2010-2011 resulted in extremely low rainfall and soil moisture and high temperatures and created a new drought of record in some locations in the state. In Region C this drought, while intense, was not as long as the 1950's drought. Consequently, most water supplies, besides those mentioned in **Section 7.1.1**, were not impacted to the extent that would occur in a repeat of the DOR.

7.2 Current Preparations for Drought in Region C

7.2.1 Drought Contingency Planning Overview

The TCEQ, in accordance with the Texas Administrative Code (TAC), requires all wholesale public water suppliers, retail public water suppliers, irrigation districts, and applicants for new or amended water rights to prepare and submit to the TCEQ drought contingency plans (DCPs) meeting the requirements of 30 TAC §288(b) and to update these plans at least every five years. TCEQ administrative rules define a drought contingency plan as “a strategy or combination of strategies for temporary supply management and demand management responses to temporary and potentially recurring water supply shortages and other water supply emergencies”. TCEQ rules and associated guidance for documents for drought contingency planning embody several key principles including:

- Drought and its potential impacts on both water supply and demand, as well as water supply infrastructure, can be expected to occur;
- Drought response measures and implementation procedures can be defined in advance of drought;
- Through timely implementation of drought response measures, it is possible to avoid, minimize, or mitigate the risks and impacts of water shortages and other drought-related water supply emergencies;
- Some water demands are considered essential to public health and safety or to the economy while others can be considered non-essential or discretionary; and
- Drought contingency plans should be tailored to the unique circumstances of each water supplier (e.g., vulnerability of water supply and/or infrastructure to drought, end-users and demand characteristics, objectives, etc.).

Although each water supplier faces unique circumstances, there are a few elements that are found in most drought contingency plans and are consistent with the requirements for municipal DCPs in 30 TAC §288.20. These include:

- Criteria and procedures for determining when to initiate and when to terminate drought response measures. These are typically referred to as drought triggers. Common examples of drought triggers include indicators of supply availability (e.g., quantity of water supply remaining in a source) and demand indicators (e.g., daily demand relative to infrastructure capacity).
- Successive stages of drought response that require the implementation of increasingly stringent measures in response to increasingly severe drought conditions. A typical drought contingency plan will have an initial stage of voluntary measures followed by two or three successive stages of increasing stringent mandatory measures.
- Demand reduction goals or targets for each stage.
- Predetermined drought response measures for each stage that may include supply management, such as the temporary use of an alternative water source, and/or demand management, such as restrictions on non-essential water uses.
- Procedures for plan implementation and enforcement.

- Public information (e.g., notification) and education.

Most drought contingency plans place a heavy emphasis on demand management measures that are designed to reduce water demands by means of curtailment of certain uses. It is important to note that demand management in this context is distinctly different from water conservation, although the terms are often used interchangeably. The objective of water conservation is to achieve lasting, long-term reductions in water use through improved water use efficiency, reduced waste, and through reuse and recycling. By contrast, demand curtailment is focused on temporary reductions in water use in response to temporary and potentially recurring water supply shortages or other water supply emergencies (e.g., equipment failures caused by excessively high peak water demands). Common approaches to water demand curtailment, applied individually or in combination, include:

- Prescriptive restrictions or bans on non-essential water uses and waste. In a municipal setting, such restrictions commonly target landscape irrigation, car washing, ornamental fountains, etc.
- Use of water pricing strategies, such as excess use surcharges, to encourage compliance with water use restrictions or to penalize excessive water use.
- Water rationing, where water is allocated to users on some proportionate or pro rata basis.

7.2.2 Current Drought Preparation

All wholesale public water providers and most municipalities in Region C have made preparation for responding to drought conditions, including the development of individual drought contingency plans to be implemented when necessary.

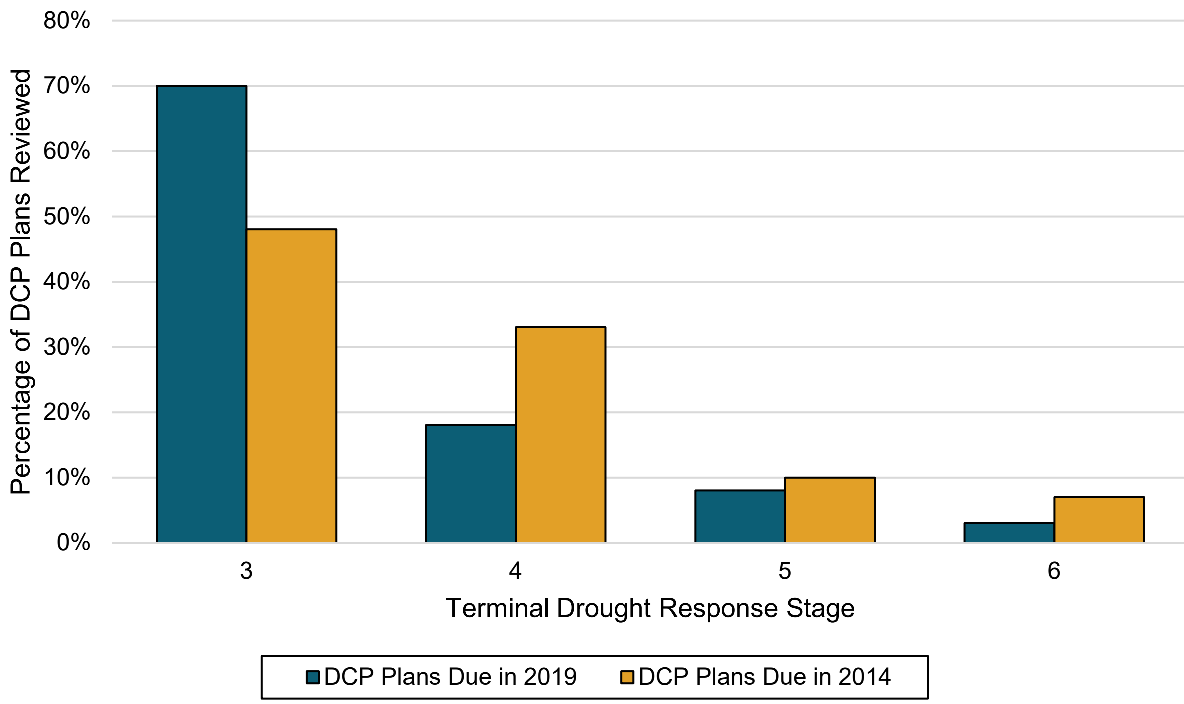
7.2.3 Regional Coordination

In an effort to become more consistent across the region, the major water providers (MWPs) and municipal suppliers held a series of meetings (2013-2014) to reach consensus on the number of stages in their DCPs and the primary outdoor irrigation restrictions. As a result of those meetings, most of the MWPs (Dallas, Fort Worth, North Texas Municipal Water District, Tarrant Regional Water District and Upper Trinity Regional Water District) modified their DCPs to have three stages which included the following irrigation restrictions for the following stages.

- **Stage 1** - Mandatory no more than twice per week watering (exception for hand watering, drip irrigation and soaker hoses).
- **Stage 2** - Mandatory no more than once per week watering (exception for hand watering, drip irrigation and soaker hoses).
- **Stage 3** - No outdoor irrigation (some exceptions for hand watering, drip irrigation and soaker hoses for trees and foundations).

The MWPs also encouraged their customers to adopt similar DCPs. As a result of the regional initiative, most of the reviewed DCPs have Stage 3 as the terminal stage (as shown in **Figure 7.2**), and the total number of stages in many plans has been reduced.

Figure 7.2 Terminal Drought Response Stage in Reviewed DCPs



7.2.4 Summary of Existing Triggers and Responses

As part of the effort associated with Task 7 of the RWP, the RCWPG performed an assessment of existing drought triggers and planned responses in the region based on available DCPs. TCEQ rules and 30 TAC §288(b) require that DCPs include documentation of coordination with the RWPGs to ensure consistency with the regional plans. The RCWPG was able to obtain DCPs for 63 entities in the Region, including named water user groups (WUGs), and retail suppliers within the County Other WUGs.

A Region C drought contingency plan database was developed to store information on the available DCPs, including sponsor information, number of stages, and the trigger and response types associated with each stage. Each drought stage was also characterized by the reduction type (percent demand, unit reduction, etc.), and associated reduction quantity value (percentage, MGD, or other). The results of this analysis are summarized in **Appendix M**. The Drought Response summary table in **Appendix M** is organized by WWP since many of the customer's triggers are dependent on the WWP triggers.

The drought management strategies for most suppliers include some sort of limitation on outdoor irrigation. Many of the entities included measures for twice per week, once per week and no outdoor irrigation for the first three stages. This was a regional consistency initiative sponsored by the major suppliers**. Table 7.1** shows statistics based on the analysis of the DCPs for measures that were included in more than 50 percent of the plans. Measures typically increase in number and/or restrictiveness as more severe drought stages are triggered. Reductions are predominantly defined in the DCPs as a percentage of water demand.

Table 7.1 Statistics for Common Drought Contingency Plan Measures

Drought Response Measure	Percentage of Plans Specifying Strategy	Average Stage Initiated
No irrigation with hose-end sprinklers	96.8%	3.3
No irrigation with automatic irrigation systems	95.2%	3.3
Prohibit non-essential water uses - hosing of buildings or other structures except for fire protection	87.3%	2.6
No draining and filling of pools and spas	87.3%	2.9
Public awareness/ customer awareness measures	84.1%	1.1
Mandatory no more than twice per week irrigation limits	82.5%	1.3
Prohibit non-essential water uses - hosing of paved areas	81.0%	2.5
No operation of ornamental fountains/ ponds	79.4%	2.9
Mandatory no more than once per week irrigation limits	76.2%	2.1
No irrigation of golf course fairways	73.0%	3.2
No vehicle washing outside commercial facilities	71.4%	3.1
Encourage delay in establishing new landscaping	68.3%	1.3
No irrigation of athletic fields	66.7%	3.3
Discontinue non-essential water use by city/utility	65.1%	1.9
Use alternative supply sources	65.1%	2.7
No new permits for swimming pools, Jacuzzis, spas, ornamental ponds, or fountains	63.5%	3.1
No new landscaping or watering of new landscaping	63.5%	3.1
Water rationing/ reductions by set percentages for commercial/ industrial customers	63.5%	3.2
No irrigation of public areas	63.5%	3.4
No irrigation of landscaped areas, such as gardens, trees, and flowers	63.5%	3.5
No irrigation by hand-watering, with soaker hoses, or by drip irrigation	61.9%	3.5
Investigate alternative water sources	60.3%	1.6
Request wholesale customers implement Stage 1 or similar measures	57.1%	1.0
Discourage/ reduce frequency of draining and filling of pools and spas	57.1%	1.0
Increased enforcement; add personnel	57.1%	1.3
Prohibit non-essential water uses - flushing gutters, allowing runoff, not repairing leaks	57.1%	1.8
Request wholesale customers implement Stage 2 or similar measures	57.1%	2.0
Mandatory limit on irrigation hours	55.6%	1.4
Request wholesale customers implement Stage 3 or similar measures	55.6%	3.0
Vehicle washing only with bucket and/or handheld hose with shutoff nozzle (outside of commercial facilities)	52.4%	1.3
Mandatory maximum once weekly landscape watering schedule for private parks and golf courses	52.4%	2.0
Intensify public awareness/ customer awareness measures	52.4%	2.1
Implement rate surcharges	50.8%	2.0

7.2.5 Effectiveness of Drought Response Measures and Challenges in Quantification

The information available to the RWPG through submitted DCP documents does not quantify the historical or potential reductions in water use associated with implementation of the DCPs.

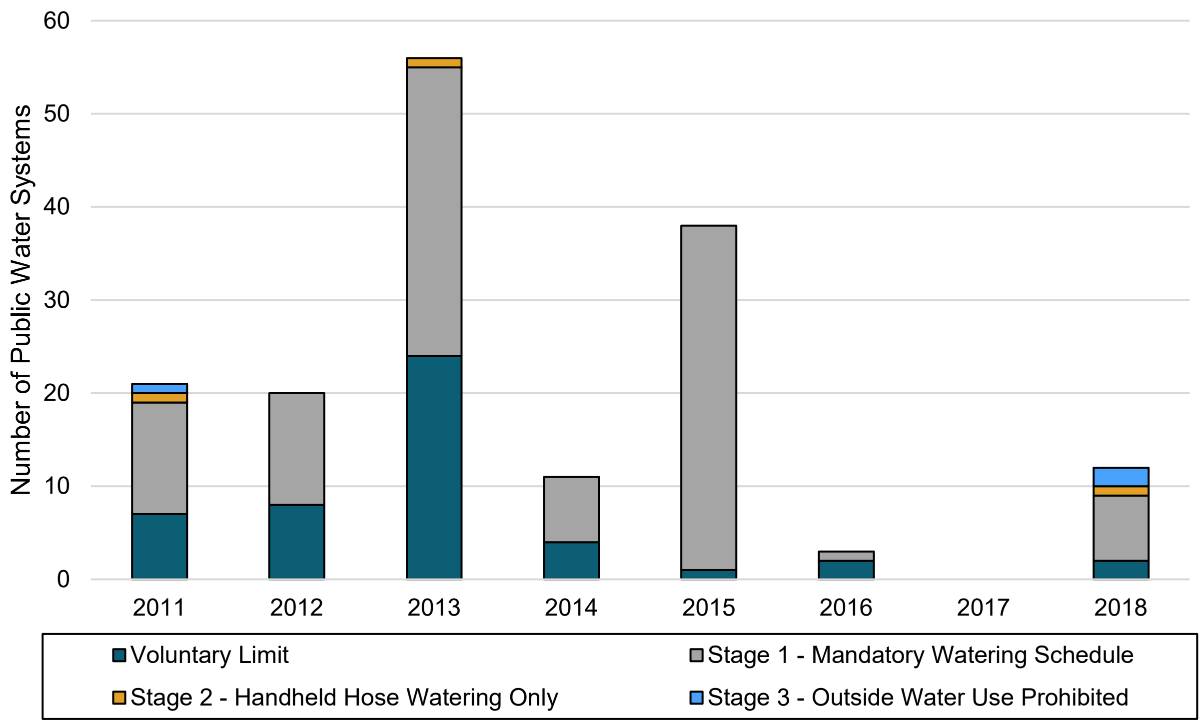
7.2.6 Recent Implementation of Drought Contingency Measures in Region C

TCEQ collects data on Texas public water systems (PWSs) that reported water use restrictions and priority levels due to drought or emergency conditions. The most recent list of Texas PWSs limiting water use is found here: https://www.tceq.texas.gov/drinkingwater/trot/droughtw.html.

The Region C RWPG conducted an analysis of TCEQ records between May 2011 and December 2018 to determine which Region C PWSs implemented water restrictions and to what extent the restrictions were implemented.

The results of this analysis are shown in **Figure 7.3**. The impacts of the 2011 drought and continuing dry conditions through 2015 are apparent, as nearly 146 Region C PWSs reported water use restrictions during that time span. Since the publication of the 2016 Region C RWP, reports have decreased significantly, as only 15 PWSs have reported watering restrictions. No Region C entities have reported insufficient water supply to meet at least 180 days of demand.

Figure 7.3 Region C Public Water Systems Restricting Outdoor Water Use due to Drought



7.3 Existing and Potential Emergency Interconnects

In accordance with the requirements of the Texas Water Development Board (TWDB) and the Texas Administrative Code, the RCWPG was required to collect information on existing water infrastructure that may be used for emergency interconnects. To meet this requirement, Region C included a question regarding this on the November 2017 WUG survey and asked for this information during WWP meetings. Information was requested regarding interconnect relationships, facilities, general locations, and supply volumes and sources. At the June 24, 2019 Region C Water Planning Group meeting, the RCWPG determined that a separate subcommittee was not needed to review the list of emergency interconnects. The RCWPG approved the Region C consultants to submit the list to the TWDB separately from the Regional Water Plan.

In reviewing Drought Contingency Plans submitted to Region C, a number of non-confidential emergency interconnects (existing and potential) were found. They are: Bonham interconnection with Bois d'Arc MUD, Saginaw emergency connections to current supplier (Fort Worth) at two alternative locations, River Oaks emergency interconnection with Fort Worth for treated water, Walnut Creek SUD emergency interconnections with Community WSC and Azle, Dallas County Park Cities MUD interconnection with Dallas, Red River Authority emergency interconnects with an unspecified number of small entities, Grand Prairie's emergency interconnections with Arlington and Mansfield, Pilot Point potential interconnection with Mustang SUD, East Cedar Creek FWSD potential interconnection with viable public water entities, and Woodbine WSC potential interconnection with unspecified water supplier.

7.4 Emergency Responses to Local Drought Conditions or Loss of Municipal Supply

In addition to regional or statewide droughts, entities may be subject to localized drought conditions or loss of existing water supplies due to infrastructure failure, temporary water quality impairment, or other unforeseen conditions. Loss of existing supplies, while relatively uncommon, is particularly challenging to address as the causes are often difficult to anticipate. Numerous entities within Region C have DCPs which include an emergency response stage and corresponding measures for droughts exceeding the DOR or for other emergency water supply conditions. Some entities, including a number of WWPs, also have emergency action plans which establish procedures for responding rapidly and effectively to emergency conditions.

Because it is not possible for water providers to predict all emergency conditions and because responses or repairs may require an extended period of time, it is important to consider the range of options for emergency water supply sources available under emergency conditions. A high-level analysis of options was performed to assess potential emergency water supply options for WUGs in Region C with estimated Year 2010 population of 7,500 or less that rely on a sole source for existing supply, as well as for all County Other WUGs (these parameters were set forth in the scope of work for regional planning). Consideration of emergency supply options for these entities is particularly important as many smaller WUGs may not have existing access to backup supplies through interconnect facilities with adjacent systems. It was assumed that the entities evaluated for emergency responses to local drought conditions or loss of municipal supply were assumed to have 180 days or less of remaining supply. Applicable WUGs were characterized by projected Year 2020 population, Year 2020 demand, existing supply source type (surface water, groundwater, or blend), and other WUG-specific information. These characteristics were then used to identify potentially feasible emergency supply options and associated infrastructure requirements. The results of this analysis are presented in **Appendix M.**

7.5 Region-Specific Drought Response Recommendations

7.5.1 Drought Response Recommendation for Surface Water

The RCWPG acknowledges that the DCPs for surface water suppliers provide the best drought management tools for surface supplies and recommends that the DCPs developed by the operators of these supplies serve as the RCWPG triggers for surface water. The RCWPG also recognizes that these triggers are subject to change as providers periodically reassess their needs and encourages both wholesale providers and other entities using surface water to examine their DCPs regularly.

In particular, reservoirs are a major source of surface water in Region C, and drought triggers for direct providers and direct users of surface water in Region C are typically tied to reservoir levels or storage volume.

7.5.2 Drought Response Recommendation for Groundwater and Other Sources

Region C has historically relied primarily on surface water sources for most of its supply. Only a small percentage of the overall supply in the region comes from groundwater sources. Groundwater production is generally local to points of use, and aquifer properties vary spatially.

Likewise, the characteristics of other sources such as reuse are specific to the associated supplier. As such, many providers using these sources have developed their DCPs in the context of their individual supply portfolios. The RCWPG acknowledges that the DCPs for groundwater suppliers are the best drought management tools for groundwater supplies and recommends that the DCPs developed by the operators of these supplies serve as the RCWPG triggers for groundwater. The RCWPG also recognizes that these triggers are subject to change as providers periodically reassess their needs and encourage both wholesale providers and other entities to examine their DCPs regularly.

The RCWPG recommends that water providers regularly review the U.S. Drought Monitor as a tool for tracking drought conditions and in drought planning efforts leading up to drought measure implementation. (https://droughtmonitor.unl.edu/CurrentMap/StateDroughtMonitor.aspx?TX)

The drought monitor is easily accessible, regularly updated, and does not require entities to directly monitor specific sources to benefit from its information. Its simplicity also facilitates its use in communicating drought conditions to customers and other water users. **Table 7.2** shows the categories of the U.S. Drought Monitor with corresponding Palmer Drought Severity Index values.

Table 7.2 U.S. Drought Monitor Categories

Category	Description	Possible Impacts	Palmer Drought Index
D0	Abnormally Dry	Going into drought: short-term dryness slowing planting, growth of crops or pastures. Coming out of drought: some lingering water deficits; pastures or crops not fully recovered	-1.0 to -1.9
D1	Moderate Drought	Some damage to crops, pastures; streams, reservoirs, or wells low, some water shortages developing or imminent; voluntary water-use restrictions requested	-2.0 to -2.9
D2	Severe Drought	Crop or pasture losses likely; water shortages common; water restrictions imposed	-3.0 to -3.9
D3	Extreme Drought	Major crop/pasture losses; widespread water shortages or restrictions	-4.0 to -4.9
D4	Exceptional Drought	Exceptional and widespread crop/pasture losses; shortages of water in reservoirs, streams, and wells creating water emergencies	-5.0 or less

The RCWPG recommends the following actions based on each of the drought classifications listed:

- **Abnormally Dry.** Entities should begin to review their DCP, status of current supplies and current demands to determine if implementation of a DCP stage is necessary.
- **Moderate Drought.** Entities should review their DCP, status of current supplies and current demands to determine if implementation of a DCP stage is necessary.
- **Severe Drought.** Entities should review their DCP, status of current supplies and current demands to determine if implementation of a DCP stage or changing to a more stringent stage is necessary. At this point if the review indicates current supplies may not be sufficient to meet reduced demands the entity should begin considering alternative supplies.
- **Extreme Drought.** Entities should review their DCP, status of current supplies and current demands to determine if implementation of a DCP stage or changing to a more stringent stage is necessary. At this point if the review indicates current supplies may not be sufficient to meet reduced demands the entity should consider alternative supplies.
- **Exceptional Drought.** Entities should review their DCP, status of current supplies and current demands to determine if implementation of a DCP stage or changing to a more stringent stage is necessary. At this point if the review indicates current supplies are not sufficient to meet reduced demands the entity should implement alternative supplies.

7.5.3 Recommendations for Entities Not Required to Submit a DCP

While wholesale suppliers, retail public water suppliers, and irrigation districts are required to have a DCP, there are a number of users such as industrial operations and individual irrigators which are not. While some of these users receive water from providers with established drought management procedures, all water users are subject to the impacts of drought. For entities not required to have a DCP and not under the DCP of a supplier, the RCWPG recommends that they consider developing a DCP based on one of the model plans provided on the Region C website. Links are provided in **Section 7.5.4** of this document.

The RCWPG recommends that these entities regularly monitor drought conditions to facilitate decision making processes. Several resources are available for monitoring drought. For users which receive water from an outside supplier, communication and notifications of anticipated or implemented drought stages are key resources.

The following references are also recommended for consideration:

- **Palmer Drought Severity Index**: https://www.drought.gov/drought/data-maps-tools/current-conditions
- **U.S. Drought Monitor (Texas detail):** https://droughtmonitor.unl.edu/CurrentMap/StateDroughtMonitor.aspx?TX
- **TCEQ drought information:** https://www.tceq.texas.gov/response/drought
- **TWDB drought information:** https://www.waterdatafortexas.org/drought

7.5.4 Model Drought Contingency Plans

Model drought contingency plans addressing the requirements of 30 TAC §288(b) were developed for Region C and are available on the Region C website. Model plans were developed for municipal providers, irrigation users, manufacturing users, and steam electric water users. These model plans were largely based on templates provided by the TCEQ, with several modifications made to elaborate on notification procedures, provide consistency with region-wide efforts to have three standard stages, and incorporate other components.

These plans are available at regioncwater.org.

7.6 Drought Management Water Management Strategies

The RCWPG does not support drought management measures as WMS in the Region C RWP. Such measures are not designed to address long-term growth in demands but, rather, are inherently temporary strategies intended to conserve water supplies or reduce adverse impacts during times of drought or emergency and are not active under more hydrologically favorable conditions. Drought management measures would not be implemented until well into a drought of record and would be lifted shortly after the drought has subsided. Because drought management is only active and beneficial under certain periods of time, its reliable yield is essentially zero when considered in an analogous manner to surface water, groundwater, reuse, or conservation. Also, as discussed previously, the efficacy of individual drought response measures is difficult to quantify and can vary considerably from one entity to another and one drought to another due to hydrologic and human factors. This creates additional uncertainty in the use of drought response as a reliable measure for addressing water needs. While drought management measures are not included as WMS in the Region C RWP, drought management is an important component of water supply management. The RCWPG supports implementation of DCPs under appropriate conditions by water providers to prolong supply availability and reduce impacts to water users and local economies.

7.7 Other Recommendations

7.7.1 Texas Drought Preparedness Council

The Texas Drought Preparedness Council is composed of representatives from multiple State agencies and plays an important role in monitoring drought conditions, advising the governor and other groups on significant drought conditions, and facilitating coordination among local, State, and federal agencies in drought-response planning. The Council meets regularly to discuss drought indicators and conditions across the state and releases Situation Reports summarizing its findings.

Additionally, the Council has developed the State Drought Preparedness Plan, which sets forth a framework for approaching drought in an integrated manner to minimize impacts to people and resources. The RCWPG supports the ongoing efforts of the Texas Drought Preparedness Council and recommends that water providers and other interested parties regularly review the Situation Reports as part of their drought monitoring procedures. In a letter dated August 1, 2019 the Council provided two recommendations to all RWPGs which are addressed in this chapter.

- Follow the outline template for **Chapter 7** provided to the regions by the Texas Water Development Board.
- Develop region-specific model drought contingency plans for all water use categories in the region that account for more than 10 percent of water demands in any decade over the 50-year planning horizon.

To meet these recommendations the RCWPG has developed this chapter to correspond with the sections of TWDB's outline template. Regarding the second recommendation, the only use category in Region C that accounts for more than 10 percent of water demand in any decade is Municipal. To address this recommendation, a municipal model drought contingency plan was developed. Going beyond this recommendation, Region C also developed model drought contingency plans for irrigation, manufacturing, and steam electric use categories.

7.7.2 Development, Content, and Implementation of DCPs

The RCWPG recognizes that the DCPs developed by water providers in the Region are the best available tools for drought management, and recommends the following actions regarding development, content, and implementation of DCPs:

- In addition to any monitoring procedures included in the DCP, regular monitoring of resources and information from TCEQ, TWDB, the Texas Drought Preparedness Council, and the U.S. Drought Monitor.
- Coordination with wholesale providers regarding drought conditions and potential implementation of drought stages, particularly during times of limited precipitation.
- Review of the DCP by appropriate water provider representatives, particularly during times of limited precipitation.
- Regular consideration of updates to the DCP document to accommodate changes in supply sources, infrastructure, water demands, or service area.
- Communication with customers during times of decreased supply or precipitation to facilitate potential implementation of drought measures and reinforce the importance of compliance with any voluntary measures.
- Designation of appropriate resources to allow for consistent application of enforcement procedures as established in the DCP.

7.7.3 House Bill 807 Requirements

House Bill 807 was passed by the 86th Texas Legislature and signed by the Governor on June 10, 2019 and became effective immediately, meaning that the requirements of the Bill would apply to the current round of planning and must be included in the 2021 Regional Water Plans. The Bill amended Section 16.053 of the Texas Water Code to include, among others, the requirement that RWPGs "identify unnecessary or counterproductive variations in specific drought response strategies, including outdoor watering restrictions, among user groups in the regional water planning area that may confuse the public or otherwise impede drought response efforts" (TWC §16.053(e)(3)(E)).

TWDB provided the following guidance to meet this requirement: “RWPGs should review information collected through current requirements outlined in 31 TAC Section 357.42(c) and (i) and Section 7.5 of Exhibit C” and “Drought response strategies determined to be ‘unnecessary or counterproductive’ should be documented in **Chapter 7** of the RWP.” This information has been reviewed, and this chapter has been updated with the following information showing how Region C water providers have made efforts to reduce any confusing or counterproductive variations in drought response strategies.

In the past, many water suppliers in Region C had different drought stages, triggers, and responses that may have been counterproductive to the efforts of drought response. Since most of the region shares common news outlets reporting the drought responses, these different stages, triggers and responses often confused the public and may have impeded drought response efforts. In an effort to become more consistent across the region, the major water providers (MWPs) and municipal suppliers held a series of meetings (2013-2014) to reach consensus on the number of stages in their DCPs and the primary outdoor irrigation restrictions. As a result of those meetings, the MWPs (Dallas, Fort Worth, North Texas Municipal Water District, Tarrant Regional Water District and Upper Trinity Regional Water District) modified their DCPs to have three stages which include irrigation restrictions.

The MWPs also encouraged their customers to adopt similar DCPs. As a result of the regional initiative, most of the reviewed DCPs have Stage 3 as the terminal stage, and the total number of stages in many plans has been reduced.

8 Unique Stream Segments, Unique Reservoir Sites, and Legislative Recommendations

Regional Water Planning Guidelines, Title 31, Part 10, Chapter 357 of the Texas Administrative Code, call for regional water planning groups to make recommendations regarding ecologically unique river and stream segments; unique sites for reservoir construction; and regulatory, administrative, or legislative actions that will facilitate the orderly development, management, and conservation of water resources. At the April 9, 2018 Region C Water Planning Group (RCWPG) meeting, the group voted to establish a subgroup to review each of these topics and make recommendations to the entire planning group. This subgroup consisted of Adam Whisenant (Texas Parks and Wildlife Department), Tom Kula, Grace Darling, Bob Riley, Jack Stevens, Wendy Chi-Babulal (alternate for Chris Harder), Tim Fisher, Rick Shaffer, Kevin Ward, and John Lingenfelder. The subgroup met on August 20, 2018 and presented their recommendations to the RCWPG at the February 25, 2019 public meeting. The RCWPG voted unanimously to approve the subgroup's recommendations which are reflected in this chapter.

Chapter Outline

Texas State Capital Building in Austin

8.1 Summary of Recommendations

Recommendations for Ecologically Unique River and Stream Segments

- Convene a working group comprised of representatives of TWDB, TPWD, TCEQ, and the sixteen regions to bring clarity, purpose, and direction to the legislative mandate to "identify river and stream segments of unique ecological value [1]."

Recommendations for Unique Sites for Reservoir Construction

- Recommend that the Texas Legislature continue to designate the following sites as unique sites for reservoir construction:
    - Ralph Hall
    - Bois d'Arc Lake
    - Marvin Nichols
    - Tehuacana
    - Fastrill
    - Columbia
- Recommend that the Texas Legislature designate George Parkhouse (North) as a unique site for reservoir construction.
- Encourage continued affirmative votes by sponsors of these proposed reservoirs to make expenditures necessary to construct or apply for required permits and avoid termination of unique reservoir site designations. **Section 8.3** describes actions that sponsors have taken to preserve the unique reservoir site designations for the designated reservoirs.

Policy and Legislative Recommendations

- Regional Water Planning Process
    - Encourage formation of a Working Group on Stream Segments of Unique Ecological Value.
    - Support legislative and state agency findings regarding water use evaluation.
    - Allow waivers of plan amendments for entities with small strategies.
    - Coordination between TWDB and TCEQ to determine the appropriate data and tools for use in regional water planning and in permitting.
    - TWDB's recognition of Region C's designation of the Sulphur River Basin Authority as a wholesale water provider in the regional water planning process.
    - Provide clear separation between regional water plans and regional flood plans.
    - Eliminate supplemental requirements added to the regional water plans after contracts have been executed, when additional funding is not provided.
- TCEQ Policy and Water Rights
    - Legislature should remove some of the unnecessary barriers to interbasin transfers.
    - Support recent changes to water code that exempt certain water right permits from cancellation for non-use.
- State Funding and Water Supply Programs
    - Continue and expand State funding for TWDB SWIFT, WIF, and other loans and programs.
    - Expand eligibility for SWIFT funding to include

consistency with adopted regional water plans.
    - More State funding for water conservation efforts.
    - State funding for reservoir site acquisition.
    - Consider alternative financing arrangements for large projects.
    - Adequate funding of Groundwater Conservation Districts
    - Funding for NRCS structures as a form of watershed protection
- Water Reuse and Desalination
    - Support research to advance reuse and desalination
    - Funding assistance for desalination and water reuse projects.
- State and Federal Program – Water Supply Issues
    - Continued and increased State support for efforts to develop water supplies from Oklahoma.
    - Oversight of Groundwater Conservation District rule making.
    - Revise Federal Section 316(b) regulations on power plant cooling water.
    - Reallocation of storage in and maintenance of Federal reservoirs.
    - Funding of long-range Federal water supply projects.
    - Provide education to State policy makers related to Aquifer Storage and Recovery.

8.2 Recommendations for Ecologically Unique River and Stream Segments

TPWD recommendations for 10 ecologically unique river and stream segments in Region C were published in *Ecologically Significant River and Stream Segments of Region C, April 2002*. These 10 river and stream segments, along with the attributes that qualified them for unique status, are listed in **Table 8.1**. The segments are also depicted in red in **Figure 8.1**. In previous Region C Water Plans, and again in this 2021 Region C Water Plan, the Region C Water Planning Group decided not to recommend any river or stream segments as ecologically unique because of continued unresolved concerns regarding the implications of such a designation by the Texas Legislature. According to Texas Water Code 16.051(f), "This designation solely means that a state agency or political subdivision of the state may not finance the actual construction of a reservoir in a specific river or stream segment designated by the legislature…". However, TWDB regulations governing regional water planning require analysis of the impacts of water management strategies on unique stream segments, which implies a level of protection beyond the mere prevention of reservoir development.

In preparing for the *2011 Region C Water Plan*, the Region C Water Planning Group reviewed the 2006 recommendations of the other regional planning groups and directed its consultants to take the following actions regarding ecologically unique river and stream segments:

- Develop scenarios of concern
- Meet with state agencies
- Review previously identified segments
- Consider additional segments

- Present possible candidate segments to the Region C Water Planning Group
- Receive comments
- Recommend action

The potential scenarios of concern involve the following features which could be located within, upstream, or downstream of a designated segment:

- Dams
- Pipeline crossings
- Water intakes
- New water outfalls
- Treated effluent outfalls
- Constructed wetlands
- Bed and banks transport of reservoir releases

These potential scenarios of concern were addressed by Region C consultants in a meeting with staffs of the Texas Water Development Board, Texas Parks and Wildlife Department, and Texas Commission on Environmental Quality (TCEQ) in August 2009. Ecologically unique river and stream segment legislation (Title 2, Chapter 16 of the Texas Water Code) and agency rules (Title 31, Part 10, Chapter 357 of the Texas Administrative Code) were also reviewed at the meeting. Conclusions from this meeting were as follows:

- TPWD plans no updates to its Ecologically Significant River and Stream Segments of Region C, April 2002. This report was summarized in Appendix W of the *2006 Region C Water Plan*.
- TPWD and TWDB staffs believe that ecologically unique river and stream segment legislation only impacts public financing of reservoirs.
- TCEQ staff position is to use all available information to regulate attributes of river and stream segments without regard to ecologically unique designation.
- Ecologically unique river and stream segment designation may influence public opinion.
- Ecologically unique river and stream segment legislation has not been tested in the courts.
- A statewide TWDB/TPWD/TCEQ/RWPG working group could help address concerns.

The RCWPG continues to recommend the formation of a working group comprised of representatives of TWDB, TPWD, TCEQ, and the sixteen water planning regions to bring clarity, purpose, and direction to the legislative mandate to "identify river and stream segments of unique ecological value." It is expected that the group would:

- Research, verify, and publicize the intent of ecologically unique river and stream segment legislation.
- Research agency rules and recommend changes or clarifications where needed.
- Ensure common understanding of "reservoir" as used in ecologically unique river and stream segment legislation and agency rules.
- Identify the lateral extent of ecologically unique river and stream segment designation.
- Seek clarification of quantitative assessment of impacts on ecologically unique river and stream segments.
- Illustrate the value of ecologically unique river and stream segment designations.

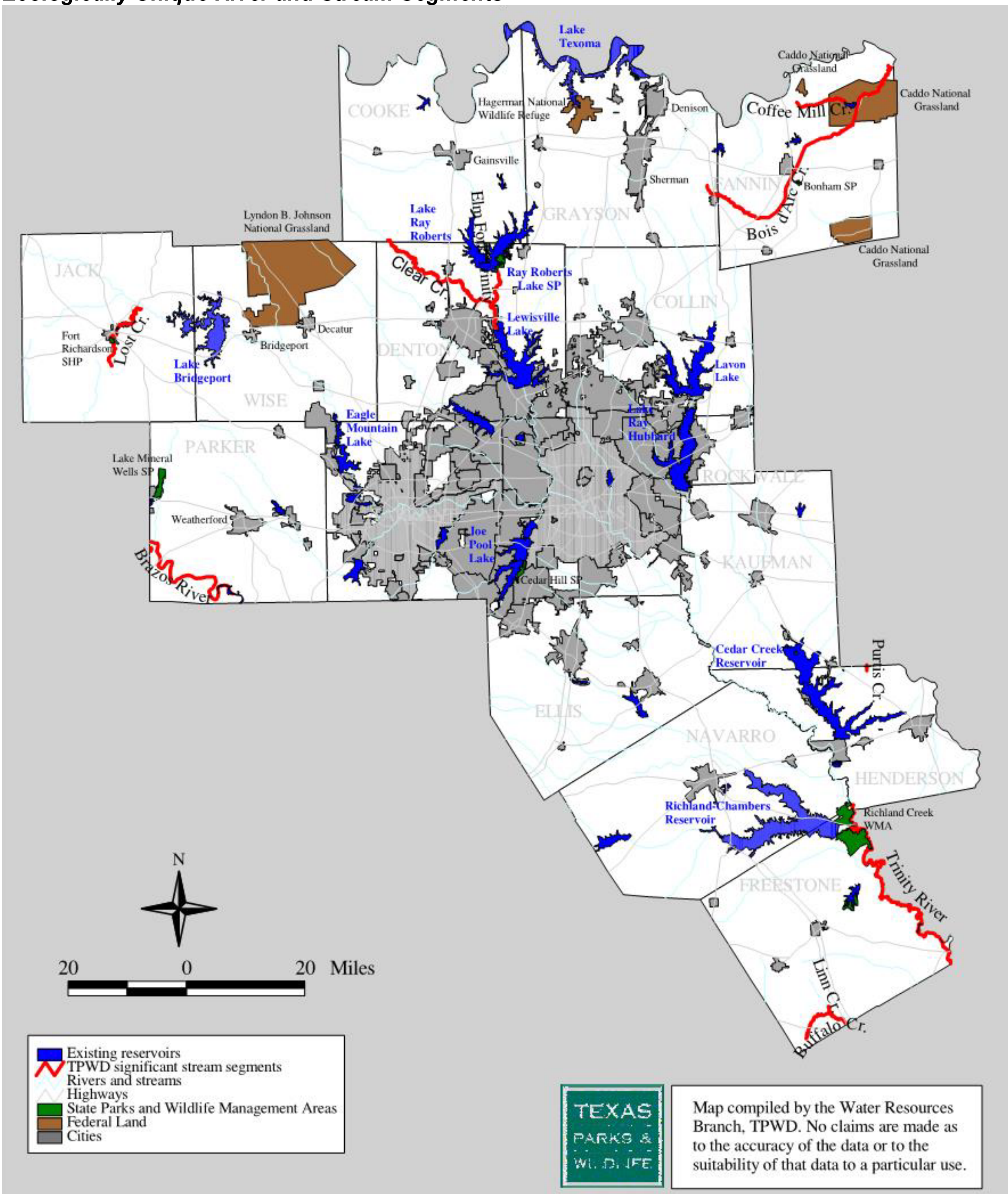
Table 8.1 Texas Parks and Wildlife Department Recommendations for Designation as Ecologically Unique River and Stream Segments

Region C River or Stream Segment	Description	Basin	County	TPWD Reasons for Designation [a]: Biological Function	Hydrologic Function	Riparian Conservation Area	High Water Quality/ Exceptional Aquatic Life/ Aesthetic Value	Endangered Species/ Unique Communities
Bois d'Arc Creek	Entire length	Red	Fannin/ Grayson	X	X	X		
Brazos River	F.M. 2580 to Parker/Palo Pinto County line	Brazos	Parker	X			X	X
Buffalo Creek	Alligator Creek. to S.H. 164	Trinity	Freestone	X	X			
Clear Creek	Elm Fork Trinity River to Denton/Cooke County line	Trinity	Denton				X	
Coffee Mill Creek	Entire length	Red	Fannin			X		
Elm Fork of Trinity River	Lewisville Lake to Lake Ray Roberts Dam	Trinity	Denton			X		
Linn Creek	Buffalo Creek. to C.R. 691	Trinity	Freestone	X	X			
Lost Creek	Entire length	Trinity	Jack			X	X	
Purtis Creek	S. Twin Creek. to Henderson/Van Zandt County line	Trinity	Henderson			X		
Trinity River	Freestone/Anderson/Leon County line to Henderson/Anderson County line	Trinity	Freestone/ Anderson	X		X		X

[a]*Data are from source* (2).

[b]*The criteria listed are from Texas Administration Code, Title 31, Section 358.2. The Texas Parks and Wildlife Department feels that their recommended stream reaches meet those criteria marked with an X.*

Figure 8.1 Texas Parks and Wildlife Department Recommendations for Designation as Ecologically Unique River and Stream Segments



8.3 Recommendations for Unique Sites for Reservoir Construction

In 2007, the 80th Texas Legislature passed Senate Bill 3 (SB3), which designated unique sites for reservoir construction as recommended in the *2007 State Water Plan*, including the following sites previously recommended by the Region C Water Planning Group:

- Muenster site on Brushy Elm Creek in Cooke County
- Ralph Hall site on the North Sulphur River in Fannin County
- Lower Bois d’Arc Creek (currently named Bois d’Arc Lake) site on Bois d’Arc Creek in Fannin County
- Marvin Nichols site on the Sulphur River in Red River, Titus, and Franklin counties
- Fastrill site on the Neches River in Anderson and Cherokee counties
- Tehuacana site on Tehuacana Creek in Freestone County.

SB3 also designated the Columbia site on Mud Creek in Cherokee County as a unique site for reservoir construction. This site was previously recommended by the East Texas Regional Water Planning Group.

According to Section 16.051 of the Texas Water Code, these designations were to terminate on September 1, 2015, unless there was “an affirmative vote by a proposed project sponsor to make expenditures necessary in order to construct or file applications for permits required in connection with the construction of the reservoir under federal or state law.” To date, none of the existing reservoir designations have been terminated.

Finally, a new reservoir located at the George Parkhouse (North) site was added as an alternative water management strategy in the *2016 Region C Water Plan* for the Upper Trinity Regional Water District (UTRWD) and the North Texas Municipal Water District (NTWMD). It was recommended that the Texas Legislature designate the George Parkhouse (North) site as a unique site for reservoir construction. However, the Legislature has not yet approved this additional designation.

With the exception of Muenster Lake, which has been constructed and is currently in operation, brief descriptions of each site follow, along with a summary of actions that the project sponsor has taken to bring the project to fruition.

Lake Ralph Hall would be located on the North Sulphur River in southeast Fannin County, north of Ladonia. The site is located in the Sulphur River Basin in Region C. The reservoir would yield 39,220 acre-feet per year and would flood 7,568 acres. Lake Ralph Hall is a recommended water management strategy for the UTRWD. The proposed lake would provide water to southeast Fannin County residents, as well as to customers of the Upper Trinity Regional Water District in the Denton County area.

To develop Lake Ralph Hall, UTRWD has:

- Secured a water right. Permit 5821, issued in December 2013, allows UTRWD to impound up to 180,000 acre-feet in Lake Ralph Hall and to divert up to 45,000 acre-feet per year for municipal, industrial, irrigation, and recreation purposes. As part of the water right permitting process, UTRWD completed special engineering and cultural resources studies, including:

- Hydrologic and hydraulic studies,
- Biological and in-stream flow assessment,
- Geologic characteristics study,
- Economic impact study, and
- Water conservation implementation plan.

- Received a Clean Water Act Section 404 permit from the U.S. Army Corps of Engineers (USACE) in January 2020. As part of the 404 permitting process, UTRWD has:
  - Completed special engineering and cultural resources studies, including:
  - Hydrologic and hydraulic studies,
  - Preliminary jurisdictional determination of waters of the U.S.,
  - Preliminary habitat assessment,
  - Archaeology & quaternary geology,
  - Biological and in-stream flow assessment,
  - Geologic characteristics,
  - Economic impact study,
  - Geomorphic and sedimentation evaluation, and
  - Draft mitigation plan for impacts to aquatic resources and terrestrial habitats.
- Environmental Impact Statement (EIS) developed and submitted it to the USACE. Final approval of the EIS issued in September 2019.

Bois d'Arc Lake (formerly named Lower Bois d'Arc Creek Reservoir) would be located on Bois d'Arc Creek in Fannin County, immediately upstream from the Caddo National Grassland. The site is located in the Red River Basin in Region C. The proposed reservoir would yield 120,200 acre-feet per year and would flood 16,641 acres. The North Texas Municipal Water District (NTMWD) is the primary developer of Bois d'Arc Lake. The proposed reservoir is a recommended water management strategy to provide water to potential customers in Fannin County in addition to existing customers of the NTMWD.

To develop Bois d'Arc Lake, NTMWD has:

- Secured a water right. Permit 12151, issued in June 2015, allows NTMWD to impound up to 367,609 acre-feet and to divert up to 175,000 acre-feet per year for municipal, industrial, and irrigation purposes. As part of the water right permitting process, NTMWD has:
  - Contracted with conservation experts and enhanced its water conservation plan.
  - Reached settlement agreements with the National Wildlife Federation, the Sierra Club, Texas Parks and Wildlife Department, Bois D'Arc Municipal Utility District, and some landowners.
- Applied for a Clean Water Act Section 404 permit from USACE. As part of the 404 permitting process, NTMWD:
  - Completed a final pipeline alignment, intake

pump station location, and terminal storage analysis study.
    - Completed an archaeological study of reservoir site, pipeline route, and Leonard water treatment plant site and completed Phase 1 archaeological study of mitigation site.
    - Submitted a final proposed mitigation plan to USACE. Completed 30 percent dam design and met with TCEQ to discuss the design.
    - Delivered a draft EIS to the USACE, responded to their comments, and received a final EIS.
    - The USACE approved the 404 permit on February 2, 2018, allowing NTMWD to begin construction of the reservoir.
- Currently, NTMWD is constructing the reservoir and performing environmental and archaeological mitigation work.

Marvin Nichols Reservoir would be located on the Sulphur River upstream from its confluence with White Oak Creek. The dam would be in Titus and Red River counties and would also impound water in Franklin County. The site is located in the Sulphur River Basin in Region D.

The Region C entities that are interested in development of Marvin Nichols Reservoir and other Sulphur Basin Supplies (NTMWD, TRWD, Dallas, UTRWD, and Irving) have formed a Joint Committee on Program Development (JCPD). Since 2001, the JCPD has provided more than $5 million to the Sulphur River Basin Authority (SRBA) to further investigate the development of Marvin Nichols Reservoir and other potential water supply sources in the Sulphur River Basin. Ongoing Sulphur Basin Feasibility studies are being conducted by the U.S. Army Corps of Engineers, SRBA and the JCPD. At the direction of SRBA and the JCPD, these ongoing studies are seeking to address concerns from Region D entities regarding the protection of natural resources, environmental impacts, and the socio-economic impacts of developing water supply within Region D and the Sulphur Basin.

As identified in the 2014 Sulphur River Basin studies [4], this *2021 Region C Water Plan* recommends a Marvin Nichols Reservoir as well as reallocation of flood storage to conservation storage in Wright Patman Lake. The proposed Marvin Nichols and Wright Patman strategy would provide 483,400 acre-feet per year for Region C (using TCEQ WAM models, assuming Lake Ralph Hall is senior and accounting for environmental flows). Both the Marvin Nichols Reservoir and Wright Patman Reallocation are recommended water management strategies for NTMWD, UTRWD, and TRWD. They are also alternative strategies for Dallas and the City of Irving. Approximately 80 percent of the water supplied from the Marvin Nichols Reservoir is expected to serve customers of wholesale water providers in Region C and approximately 20 percent would serve water needs in Region D.

Region C recognizes that there are inherent risks and impacts associated with the reallocation of flood storage in Wright Patman Lake. Reallocation of storage at Wright Patman Lake at the scale envisioned for the strategy will require recommendation by the Corps of Engineers/Department of the Army and approval by the United States Congress. Prior to making a recommendation, the Corps will need to conduct a detailed evaluation of impacts associated with raising the conservation pool elevation. Potentially significant impacts could include inundation of natural resources within the flood pool, loss of flood protection downstream, increased impacts to cultural resources on the reservoir perimeter, effects on the Congressionally-established White Oak Creek Mitigation Area in the upper reaches of the Wright Patman flood pool, and reduced flexibility in International Paper's effluent management operations downstream of the dam. Wright Patman reallocation may also be constrained by Dam Safety considerations. As more detailed studies seek to develop an understanding of the tradeoffs between the environmental impacts at Wright Patman in comparison with the predicted impacts of new storage at the Marvin Nichols site, the risk exists that the Wright Patman reallocation alternative may be constrained by policy issues or environmental issues, or both.

As mentioned above, since 2001, the JCPD has provided more than $5 million to the Sulphur River Basin Authority (SRBA) to further investigate the development of Marvin Nichols Reservoir and other potential water supply sources in the Sulphur River Basin. These investigations have included:

- Land use/land cover classification
- Identification of reservoir sites and conservation pool elevations
- Reconnaissance geology review of potential dam sites
- Mapping
- A site selection study for Marvin Nichols Reservoir
- System operation assessment of Wright Patman Lake and Jim Chapman Lake
- Analysis of Sulphur River instream flows (hydrology, hydraulics, and fish habitat utilization)
- Aerial LIDAR survey
- Hydrologic and hydraulic modeling
- Modification of the TCEQ's Sulphur River Water Availability Model
- Development of a Sulphur River Basin Soil and Water Assessment Tool (SWAT) model
- Wright Patman Lake additional yield modeling
- Socioeconomic Assessment
- Comparative Environmental Assessment
- Studies of
  - Operation issues
  - Institutional issues
  - Water demand/availability

These studies are needed to develop applications for a state water permit and a Section 404 permit for the project. Some of the investigations listed above are part of the Sulphur River Basin Feasibility Study, conducted by the JCPD in partnership with USACE and the SRBA [4]. The combination of reallocation of water in Wright Patman Lake and development of Marvin Nichols Reservoir was the strategy recommended by the Feasibility Study.

Tehuacana Reservoir would be located on Tehuacana Creek in Freestone County, south of the Richland-Chambers Reservoir. The site is located in the Trinity River Basin in Region C. The proposed reservoir would have a safe yield of 21,070 acre-feet per year and would inundate approximately 15,000 acres. Tarrant Regional Water District would be the developer of Tehuacana Reservoir. Tehuacana Reservoir is a recommended water management strategy in the *2021 Region C Water plan* to serve needs in Freestone County in addition to customers of TRWD. Tehuacana Reservoir is also a recommended strategy in TRWD's Integrated Water Supply Plan [5]. In addition, TRWD has completed an evaluation of four alternative dam locations and impact scenarios, reservoir site geology, natural resources, and land and mineral ownership [6].

Lake Columbia would be located on Mud Creek in Cherokee County, southeast of Jacksonville. The site is located in the Neches River Basin in Region I. The proposed reservoir is estimated to have a firm yield of 75,600 acre-feet per year in 2020, reducing to 75,350 acre-feet per year in 2070. Approximately 75% of the firm supply (56,000 acre-feet per year) would be available to Dallas. Lake Columbia would inundate 11,500 acres. The Angelina & Neches River Authority (ANRA) would be the developer of Lake Columbia, and purchasing water from Lake Columbia is a recommended water management strategy for Dallas. To develop Lake Columbia, ANRA has:

- Secured a water right. Permit 4228, issued in June 1985, allows ANRA to impound up to 195,500 acre-feet in Lake Columbia and to divert up to 85,507 acre-feet per year for municipal, industrial, and recreation purposes.
- Applied for a Clean Water Act Section 404 permit from the U.S. Army Corps of Engineers (USACE).
- As part of the 404 permitting process, ANRA has:
    - Completed a downstream impact analysis.
    - Completed an archaeological field survey.
    - Completed a proposed mitigation plan.
    - Worked toward completion of a draft EIS.

Lake Fastrill would be located on the Neches River in Anderson and Cherokee counties downstream of Lake Palestine and upstream of the Weches dam site. The site is located in the Neches River Basin in Region I. The proposed reservoir would yield 148,780 acre-feet per year and flood 24,950 acres. In 2006, the U.S. Fish and Wildlife Service established the Neches River Wildlife Refuge along the Upper Neches River near the same area as the proposed Lake Fastrill. Lake Fastrill was formerly a recommended water management strategy for Dallas. On February 22, 2010, the U.S. Supreme Court declined to hear an appeal of a decision by the 5th Circuit Court of Appeals that ruled against construction of Fastrill Lake and in favor of the wildlife refuge. Since that decision, Dallas has replaced Lake Fastrill with other projects in its long-range water supply planning. However, the Upper Neches River Municipal Water Authority (UNRMWA) has continued to pursue development of Lake Fastrill, and this reservoir could be a potentially feasible water management strategy for Dallas beyond the planning period.

George Parkhouse Reservoir (North) would be located on the North Sulphur River in Lamar and Delta Counties, upstream of Marvin Nichols Reservoir and downstream of Lake Ralph Hall. The site is located in the Sulphur River Basin in Region D. With instream flow releases, the proposed reservoir would yield 106,500 acre-feet per year (with 85,200 acre-feet per year available for Region C), but the yield would be reduced substantially by development of Lake Ralph Hall and/or Marvin Nichols Reservoir. The proposed reservoir would inundate approximately 14,400 acres. George Parkhouse Reservoir (North) is an alternative water management strategy for UTRWD and NTWMD.

In partnership with the USACE and the SRBA, the JCPD (including UTRWD and NTWMD) has studied the proposed George Parkhouse Reservoir (North) as part of the Sulphur River Basin Feasibility Study. The reservoir yield and environmental impacts of the reservoir are documented in the Feasibility Study. These entities are continuing to study water supply options in the Sulphur River Basin, including George Parkhouse Reservoir (North).

Recommendations. The Region C Water Planning Group recommends that:

- The Texas Legislature continue to designate the following sites as unique sites for reservoir construction: Ralph Hall, Bois d'Arc Lake (formerly named Lower Bois d'Arc Creek), Marvin Nichols, Tehuacana, Columbia, and Fastrill.
- The Texas Legislature designate the George Parkhouse (North) site as a unique site for reservoir construction.
- Sponsors of these proposed reservoirs continue to affirmatively vote to make expenditures necessary to construct or apply for required permits for these reservoirs and avoid termination of unique reservoir site designation.

8.4 Policy and Legislative Recommendations

The Region C Water Planning Group discussed legislative and policy issues that impact the planning and development of water resources. The group offers the following policy and legislative recommendations, which are divided by topic.

8.4.1 Regional Water Planning Process

Encourage Formation of a Working Group on Stream Segments of Unique Ecological Value. As in previous planning cycles, the Region C Water Planning Group continues to recommend the formation of a working group comprised of representatives of TWDB, TPWD, TCEQ, and the sixteen water planning regions to bring clarity, purpose, and direction to the legislative mandate to "identify river and stream segments of unique ecological value. " Specifically, it is expected that the working group would:

- Research, verify, and publicize the intent of ecologically unique river and stream segment legislation.
- Research agency rules and recommend changes or clarifications where needed.
- Ensure common understanding of "reservoir" as used in ecologically unique river and stream segment legislation and agency rules.
- Identify the lateral extent of ecologically unique river and stream segment designations.
- Seek clarification of quantitative assessment of impacts on ecologically unique river and stream segments.
- Illustrate the value of ecologically unique river and stream segment designations.

Support Legislative and State Agency Findings Regarding Water Use Evaluation. Per capita water use is unique to each water supplier and each region of the State. A statewide per capita water use value is not appropriate for the State, considering its wide variation in rainfall, economic development, and other factors.

The Texas Legislature has found that:

- "…using a single gallons per capita per day metric to compare the water use of municipalities and water utilities does not produce a reliable comparison because water use is dependent on several variables, including differences in the amount of water used for commercial and industrial sector activities, power production, permanent versus temporary service populations, and agricultural sector production…" and
- "a sector-based water use metric, adjusted for variables in water use by municipalities and water utilities, is necessary in order to provide an accurate comparison of water use and water conservation among municipalities and water utilities (7)."

Similarly, in its *Guidance and Methodology for Reporting on Water Conservation and Water Use*, the TCEQ/TWDB/WCAC recognized that "a simple comparison of total gallons per capita per day among Texas municipal water providers may lead to inaccurate conclusions about comparative water use efficiencies among those municipal water providers. When examining the profiles of municipal water providers individually, significant differences may be found in climate, geography, source water characteristics, and service population profiles. As a metric, total gallons per capita per day has its limitations (8)." The Guidance further recommends use of sector-specific metrics in tracking and comparing water conservation and water.

The Region C Water Planning Group supports these findings and encourages continued development and refinement of sector-specific metrics for tracking water use.

Allow Waivers of Plan Amendments for Entities with Small Strategies. Region C recommends that the Texas Water Development Board allow waivers for consistency issues for plan amendments that involve projects resulting in small amounts of additional supply.

Coordination between TWDB and TCEQ Regarding Use of the WAMs for Planning and Permitting. The TWDB requires that the Water Availability Models (WAMs) developed under the direction of TCEQ be used in determining available surface water supplies. The models were developed for the purpose of evaluating new water rights permit applications and are not appropriate for water supply planning. The assumptions built into the WAM (full use of all existing water rights, full operation of priority calls at all times, full permitted area and capacity, overlapping of environmental flow criteria developed during the Senate Bill 3 process and special conditions for instream flows developed using other statistical approaches) do not match the actual operations of supplies and could prohibit the issuance of water rights permits upon which implementation of the regional plans is dependent. Using these conservative assumptions could result in unnecessary water supply projects to meet projected needs that might otherwise be satisfied through the flexible operation of existing supplies. The TWDB and TCEQ should coordinate their efforts to determine the appropriate data and tools available through the WAM program for use in water planning and permitting. The TWDB should allow the regional water planning groups flexibility in applying the models made available for planning purposes, and TCEQ should exercise flexibility in permitting to allow for optimization of existing or future water supplies.

TWDB's recognition of Region C's designation of the Sulphur River Basin

Authority as a wholesale water provider in the Regional Water Planning Process. According to 31 TAC §357.10(3), a wholesale water provider is:

> "Any person or entity, including river authorities and irrigation districts, that has contracts to sell more than 1,000 acre-feet of water wholesale in any one year during the five years immediately preceding the adoption of the last regional water plan. The regional water planning groups shall include as wholesale water providers other persons and entities that enter or that the regional water planning group expects or recommends to enter contracts to sell more than 1,000 acre-feet of water wholesale during the period covered by the plan."

As described in previous sections, the Marvin Nichols Reservoir and Wright Patman Reallocation strategies are recommended for NTMWD, UTRWD, and TRWD and are alternative strategies for Dallas and the City of Irving. It is expected that SRBA would permit and construct Marvin Nichols Reservoir in the Sulphur Basin and would sell more than 1,000 acre-feet per year of water from the reservoir to these Region C entities. For these reasons, the RCWPG voted to designate SRBA as a WWP at its September 28, 2015 meeting. RCWPG requested TWDB's recognition of this designation in the regional water planning process.

Clear Separation between Regional Water Plans and Regional Flood Plans. The 86th Texas Legislature recently passed Senate Bill 8 (SB8) which requires the TWDB to prepare and adopt a comprehensive state flood plan before September 1, 2024 and every five years thereafter. Region C recommends that the TWDB maintain a clear separation between the Regional Water Plans and the new Regional Flood Plans. Region C also suggests renaming the Regional Water Plans to Regional Water Supply Plans to maintain a clear distinction from the new Regional Flood Plans.

Eliminate Supplemental Requirements Added to the Regional Water Plans after Contracts have been Executed, When Additional Funding is Not Provided. House Bill 807 was passed by the 86th Texas Legislature in 2019 adding five additional requirements to the regional water planning process. These requirements were added without increasing the funding for developing the regional water plans or extending the schedule. Adding additional requirements to the regional water plans without increasing funding or extending the schedule necessarily reduces the overall quality of the regional plan by allowing less time to be spent on the original scope of work. Region C recommends that no additional requirements be added to the regional water plans after the initial development of the scope of work, unless the new requirements are accompanied by appropriate funding and schedule amendments.

8.4.2 TCEQ Policy and Water Rights

Requirements for Interbasin Transfers Introduced in Senate Bill One. In 1997, Senate Bill One introduced a number of new requirements for applications for water rights permits to allow interbasin transfers. The requirements are found in Section 11.085 of the Texas Water Code [9]. The code includes many provisions that are not required of any other water rights, including:

- Public meetings in the basin of origin and the receiving basin.
- Simultaneous (and dual) notices of an interbasin transfer application in

newspapers published in every county located either wholly or partially in both the basin of origin and the receiving basin, without regard to the distance or physical relationship between the proposed interbasin transfer and any such county's boundaries.

- Additional notice to county judges, mayors, and groundwater districts in the basin of origin.
- Additional notice to legislators in the basin of origin and the receiving basin.
- TCEQ request for comments from each county judge in the basin of origin.
- Proposed mitigation to the basin of origin.
- Demonstration that the applicant has prepared plans that will result in the "highest practicable water conservation and efficiency achievable…"

Exceptions to these extra requirements placed on interbasin transfers are made for emergency transfers, small transfers (less than 3,000 acre-feet under one water right), transfers to an adjoining coastal basin, transfers to a county partially within the basin of origin, transfers within a retail service area, and certain imports of water from outside the state.

The effect of these changes is to make obtaining a permit for interbasin transfer significantly more difficult than it was under prior law and thus to discourage the use of interbasin transfers for water supply. This is undesirable for several reasons:

- Interbasin transfers have been used extensively in Texas and are an important part of the Region C's and the state's current water supply.
- Current supplies greatly exceed projected demands in some basins of origin, and the supplies already developed in those basins can only be beneficially used as a result of interbasin transfers.
- Senate Bill One water supply plans for major metropolitan areas in Texas (Dallas-Fort Worth, Houston, and San Antonio) rely on interbasin transfers as a key component of their plans.
- Texas water law regards surface water as "state water" belonging to the people of the state, to be used for the benefit of the state as a whole and not merely that area or region of the state where abundant surface water supplies may exist [(10)].
- The current requirements for permitting interbasin transfers provide unnecessary barriers to the development of the best, most economical, and most environmentally acceptable source of water supplies.

The legislature should revisit the current law on interbasin transfers and remove some of the unnecessary, unduly burdensome, and counterproductive barriers to such transfers that now exist.

Cancellation of Water Rights for Non-Use. Texas Water Code [(11)] allows the Texas Commission on Environmental Quality to cancel certain water rights, in whole or in part, for ten consecutive years of non-use. In 2013 the Texas Legislature provided the following additional exceptions to cancellation for non-use:

- If a significant portion of the water authorized has been used in accordance with a specific recommendation for meeting a water need included in an approved regional water plan;
- If the water right was obtained to meet demonstrated long-term public

water supply or electric generation needs as evidenced by a water management plan developed by the holder and is consistent with projections of future water needs contained in the state water plan; or

- If the water right was obtained as the result of the construction of a reservoir funded, in whole or in part, by the holder of the water right as part of the holder's long-term water planning.

These changes assist with long-term water supply planning and allow construction of reservoirs to meet future needs, even if only part of the supply is used in the first ten years of the reservoir's operation, Region C supports these exceptions to cancellation of water rights for non-use.

8.4.3 State Funding for Water Supply Programs

Continued and Expanded State Funding for Texas Water Development Board Loans and the State Participation Program. The total capital cost of strategies recommended in the 2017 State Water Plan is $63 billion, including $23.6 billion for Region C recommended strategies. Municipal water providers anticipate needing $36.2 billion from state financial assistance programs [12]. The Texas Water Development Board's loan and State Participation Programs have been important tools in the development of existing supplies, but funding for many of these programs has been insufficient to serve all applicants. The SWIFT/SWIRFT funding program began in 2015 and has committed more than $8.2 billion towards water projects through Fiscal Year 2018. Twenty percent of the SWIFT funding is reserved for water conservation and reuse projects. The SWIFT funding program is expected to finance $27 billion in state water plan projects over the next 50 years [13].

These programs should be continued and expanded with additional funding as needed to assist in the development of the water management strategies recommended in the regional water plans to meet the future water needs in Texas. Region C supports the continued expeditious implementation of the SWIFT/SWIRFT funding program and does not support diversion of existing funding for other purposes.

Expand Eligibility for SWIFT Funding to Include Consistency with Adopted Regional Water Plans. The current legislation specifies that a water supply project must be in the adopted State Water Plan to be eligible for SWIFT funding. To allow the TWDB sufficient time to develop the State Water Plan, there is a one-year period between when a regional water plan is adopted and when the TWDB approves the corresponding State Water Plan. During this one-year period, the State Water Plan is based on recommended projects in a superseded regional water plan. Under current law, if a project is included in the current regional water plan but not in the superseded regional water plan, the project sponsor must amend the superseded regional water plan to receive SWIFT funding. This could mean that the regions and project sponsors are expending funds for a process that has already been completed for the current regional water plan. Region C recommends that the consistency requirement with the State Water Plan for eligibility for SWIFT funds be expanded to include the currently adopted regional water plans.

State Funding for Water Conservation Efforts. In 2007, the Texas Legislature formed the Water Conservation Advisory Council to serve as an expert resource to the state government and the public on water conservation in Texas. The Council publishes biennial reports to the Legislature on progress of water conservation in Texas. In its December 2018 report, the Council recommended that “the Texas Legislature appropriate up to $3 million per year to the TWDB to implement a statewide water conservation public awareness program as directed by the Texas Legislature in 2007 with the passage of Senate Bill 3 and House Bill 4[(14)].” A statewide public awareness campaign titled “Do or Dry” is currently being developed by Texas State University in collaboration with TWDB to promote conservation and emphasize the importance of water. It is anticipated that the “Do or Dry” campaign will be launched in the next couple of years. Region C encourages adequate funding for the Water Conservation Advisory Council and for a statewide water conservation awareness campaign.

State Funding for Reservoir Site Acquisition. As described in **Section 8.3**, the State of Texas has designated unique sites for reservoir development. However, the designation of these sites does not fully protect them for development as reservoirs. Region C recommends that TWDB and the Legislature consider assisting with the acquisition of sites to achieve a greater degree of protection for development of the sites as reservoirs. Actions that could be taken include:

- The use of state funds to acquire reservoir sites.
- Changing TWDB regulations so that Water Infrastructure Fund resources can be used for the acquisition of reservoir sites before completion of the permitting process.
- Encouraging voluntary sales of land in these reservoir sites to entities planning to develop the reservoirs.

Consider Alternative Financing Arrangements for Large Projects. The Texas Water Development Board offers low-interest financing for development of projects from the State Water Plan through the Water Infrastructure Fund. TWDB also offers deferred financing with delayed requirements for repayment, but the terms for deferred financing are not as flexible as they could be.

To address this issue, the TWDB has created two flexible financing options in the SWIFT/SWIRFT funding program:

- Deferred loans have maturities of 20 to 30 years and may be used to fund developmental costs, such as planning and design. Principal and interest are deferred up to eight years or until end of construction, whichever is sooner.
- Board participation loans allow entities to reasonably finance the total debt for an optimally sized regional facility through temporary TWDB ownership interest in the facility. The local sponsor repurchases TWDB’s interest on a repayment schedule that defers principal and interest. The typical maturity of a Board participation loan is 34 years.

Region C supports the flexible financing options offered under the SWIFT/SWIRFT funding program and encourages the Texas Water Development Board and the Legislature to continue to consider more flexible deferred financing.

Adequate Funding of Groundwater Conservation Districts. In recent years, the Texas Legislature has created a great number of new groundwater conservation districts across the state. Especially in the early years of their existence, many of these districts struggle to find adequate resources to develop and implement their rules. We recommend that the state fund a grant program to provide financial resources for the development of the initial rules of these districts.

Funding for NRCS Structures as a Form of Watershed Protection. One key element of water supply planning is the protection of the quality and usability of supplies already developed. Over the past 50 to 60 years, the U.S. Natural Resources Conservation Service (NRCS, formerly the Soil Conservation Service) has built numerous small dams for sediment control and flood control in Texas. The NRCS reservoirs improve water quality, prevent erosion in the watershed, provide water for livestock and provide increased streamflows during low flow periods.

The design life for the majority of the NRCS dams is 50 years. Most of the existing projects were built in the 1950s and 1960s and are nearing the end of their design life. Many NRCS structures are in need of maintenance or repair to extend their useful life. Under the PL-566[1] program, the NRCS provides technical assistance and funding for repair and rehabilitation of existing NRCS structures. The rehab program is a 65/35 split of federal funds to the sponsor's funds. In U.S. Congressional Districts located completely or partially within Region C, there are 1,180 existing NRCS dams, of which about 66 percent are located in Region C. In these Congressional Districts, there are 123 dams in need of repairs. The estimated repair cost for these dams is approximately $34.4 million [(15)].

In addition, the NRCS and local sponsors plan to construct new dams in Region C. Under the PL-566 program and the similar PL-534[2] program, the NRCS will provide 100 percent of the construction costs of new dams, and the sponsor provides the land acquisition costs.

The State should develop a program to provide funding for the development and rehabilitation of new and existing NRCS structures, as a form of watershed protection. Elements of such a program could include:

- State grants or matching funding for studies of NRCS structures
- Seminars on watershed protection.

The Region C Water Planning Group recommends that the State seek additional federal funding to improve and maintain NRCS structures. Region C also recommends that the State provide funding to local sponsors to aid them in paying for their required 35 percent of the cost for the dam rehabilitation projects.

8.4.4 Water Reuse and Desalination

Support for Research to Advance Reuse and Desalination. Water reuse and desalination are extremely important sources of water supply for Texas. However, these sources have unique challenges related to water quality and cost-effective implementation. Region C recommends that the Legislature and the TWDB continue to support research to

[1] PL-566, the Watershed Protection and Flood Prevention Act of 1954, provides for cooperation between the Federal government and the States and their political subdivisions in a program to prevent erosion, floodwater, and sediment damage; to further the conservation, development, utilization, and disposal of water; and to further the conservation and proper utilization of land in authorized watersheds.

[2] PL-534, the Flood Control Act of 1944, authorizes the Secretary of Agriculture to install watershed improvement measures in 11 watersheds, also known as pilot watersheds, to reduce flood, sedimentation, and erosion damage; improve the conservation, development, utilization, and disposal of water; and advance the conservation and proper utilization of land.

advance these water supply strategies in the coming years.

Funding Assistance for Desalination Projects. The Red River and Lake Texoma in Region C have high concentrations of salts. The water from these sources must either be blended with a less saline supply or desalinated for direct use. The smaller communities neighboring these water supplies could potentially use this water with help in funding the necessary desalination process. These sources would be more economical for the smaller communities than building small pipelines of great lengths to purchase water from a larger supplier. Region C recommends that the TWDB provide funding assistance for desalination projects for smaller communities. Region C also recommends that federal funds be sought for desalination projects.

Funding Assistance for Water Reuse Projects. The Region C Water Plan includes reuse as a key water management strategy to meet the water needs of the Region between now and 2070. Water reuse projects are rapidly developing in Region C. In the *2016 Region C Water Plan*, the 2070 supply from existing reuse projects was almost 361,000 acre-feet per year (17). In the current plan, newly developed projects have increased the supply available from existing reuse projects to more than 411,000 acre-feet per year by 2070. The current plan also calls for development of an additional 485,000 acre-feet per year in reuse projects by 2070. Statewide, 14 of the 16 regions included reuse as a water management strategy in their most recent water plans (17). In order to achieve implementation of the significant quantities of reuse there is a critical need to develop implementation approaches, funding support, and the technology and science associated with reuse. The Texas Water Development Board developed a research agenda that identified seven research priorities in Texas (18):

- Understanding the role of environmental buffers in surface water indirect potable reuse projects
- Effectiveness of treatment wetlands in improving reclaimed water quality
- Use of managed aquifer recharge systems to facilitate water reclamation in Texas
- Understanding the effectiveness of nutrient removal processes in reduction of constituents of concern relative to indirect potable reuse
- Understanding the potential for utilizing nanofiltration as a beneficial treatment process relative to reclaimed water in Texas
- Organizational, institutional, and public awareness framework to advance water reuse in Texas
- Development of integrated water quality models for the Trinity River System

Region C recommends that the State Legislature provide funding support to perform research in the priority categories identified by the Texas Water Development Board.

8.4.5 State and Federal Programs – Water Supply Issues

Continued and Increased State Support of Efforts to Develop Water Supplies for Oklahoma. In recent years, water suppliers in Region C have been seeking to develop unused water resources in Oklahoma. We encourage the State of Texas to continue and increase its support of efforts to develop unused water resources in Oklahoma.

Oversight of Groundwater Conservation District Rule Making. The Legislature has established groundwater conservation districts across Texas, often without regard for aquifer boundaries. These groundwater conservation districts develop rules and regulations regarding groundwater pumping within their boundaries. Often, the rules that have been developed by these districts are inconsistent from one district to the next, resulting in inconsistent regulation of the same aquifer. Although one-size-fits all regulations are inappropriate, the groundwater conservation districts need state oversight, particularly with regard to their rule-making policies. Region C recommends that the TWDB or TCEQ provide oversight for the current and future groundwater conservation districts.

Revise Federal Section 316(b) Regulations on Power Plant Cooling Water. USEPA regulations adopted in 2017 implementing Section 316(b) of the Clean Water Act place requirements on cooling water intake structures that are intended to reduce fish/shellfish mortality due to impingement on screens/barriers or entrainment into flow entering an industrial facility. Although the regulations do not mandate cooling towers for new or existing power plants, they do generally require equivalent performance in terms of intake flowrates and velocities. Compared to once-through cooling (which was the usual approach in Texas prior to the new regulations), cooling towers reduce the amount of water diverted for a power plant but significantly <u>increase</u> the amount of water consumed. There is also a secondary impact; operation of cooling towers creates a high TDS (total dissolved solids) waste stream known as blowdown, that must be managed and/or treated, often resulting in additional increased water consumption. This higher water consumption is not good for Texas, where water supplies are scarce. We encourage TWDB and TCEQ to work with the Federal government on Section 316(b) regulations to allow the efficient use and conservation of water supplies for power plants and the state.

Support ongoing efforts of state agencies to develop additional data and information related to evaluating the feasibility of ASR projects. House Bill 807 requires that the regional water plan include a specific assessment of the feasibility of aquifer storage and recovery (ASR) projects for any regional water planning area with significant identified water needs. The Region C planning group acknowledges that ASR can be an effective water supply strategy under specific conditions. However, ASR is not a suitable or feasible strategy in all areas. Region C supports efforts to develop data and information regarding the site-specific applicability of ASR and the conditions under which ASR is or isn’t a feasible WMS.

8.5 Chapter 8 List of References

(1) Texas Water Code, Chapter 16 Provisions Generally Applicable to Water Development, Subchapter C, Section 16.053 Amended by Acts 2011, 82nd Leg., ch. 1233, sec. 11, eff. Sept. 1, 2011, Austin, [Online], Available URL: http://www.statutes.legis.state.tx.us/Docs/WA/htm/WA.16.htm#16.053, accessed Sept. 2019.

(2) Texas Parks and Wildlife Department: *Water Planning Data for Region C*, Austin, [Online] Available URL: https://tpwd.texas.gov/landwater/water/conservation/water_resources/water_quantity/sigsegs/regionc.phtml, accessed Sept. 2019.

(3) Texas Parks and Wildlife Department: *Ecologically Significant River and Stream Segments for Region C*, April 2002, Austin, [Online] Available URL: http://www.tpwd.texas.gov/landwater/water/conservation/water_resources/water_quantity/sigsegs/media/region_c_map.pdf, accessed Sept. 2019.

(4) Sulphur River Basin Authority: *Sulphur River Basin Feasibility Study*, [Online], Available URL: http://srbatx.org/sulphur-basin-feasibility-study, accessed Sept. 2019.

(5) Buhman Associates, LLC, in cooperation with CDM Smith, Inc. and Freese and Nichols, Inc.: *Tarrant Regional Water District Integrated Water Supply Plan*, prepared for Tarrant Regional Water District, 2013.

(6) Fugro Consultants, Inc.: *Evaluation of Alternative Dam Locations Based Upon Impact to Natural Resources Proposed Tehuacana Reservoir Site Freestone County, Texas*, prepared for Tarrant Regional Water District, August 2012.

(7) Texas Water Code, Chapter 16 Provisions Generally Applicable to Water Development, Subchapter C, Section 16.403(a) Added by Acts 2011, 82nd Leg., ch. 595, sec. 2, eff. June 17, 2011, Austin, [Online], Available URL: http://www.statutes.legis.state.tx.us/Docs/WA/htm/WA.16.htm#16.403, accessed Sept. 2019.

(8) Texas Commission on Environmental Quality, Texas Water Development Board, and Water Conservation Advisory Council: *Guidance and Methodology for Reporting on Water Conservation and Water Use*, December 2012.

(9) Texas Water Code, Chapter 11 Water Rights, Subchapter C, Section 11.085 Amended by Acts 2013, 83rd Leg., ch. 1065, sec. 1, eff. Sept. 1, 2013, Austin, [Online], Available URL: http://www.statutes.legis.state.tx.us/Docs/WA/htm/WA.11.htm#11.085, accessed Sept. 2019.

(10) Texas Water Code, Chapter 11 Water Rights, Subchapter B, Section 11.021 Amended by Acts 1977, 65th Leg., ch. 870, sec. 1, eff. Sept. 1, 1977, Austin, [Online], Available

URL: http://www.statutes.legis.state.tx.us/Docs/WA/htm/WA.11.htm#11.021, accessed Sept. 2019.

(11) Texas Water Code, Chapter 11 Water Rights, Subchapter E, Section 11.173, Amended by Acts 2001, 77th Leg., ch. 966, § 2.12, eff. Sept. 1, 2001, Austin, [Online], Available URL: https://statutes.capitol.texas.gov/Docs/WA/htm/WA.11.htm#11.173 , accessed Sept. 2019.

(12) Texas Water Development Board: *2017 Water for Texas*, Austin, [Online], Available URL: http://www.twdb.texas.gov/waterplanning/swp/2017/index.asp, January 2017.

(13) Texas Water Development Board: *State Water Implementation Fund for Texas (SWIFT)*, [Online], Available URL: http://www.twdb.texas.gov/swift/index.asp, accessed Sept. 2019.

(14) Water Conservation Advisory Council: *A Report on Progress of Water Conservation in Texas Report to 86th Legislature*, December 2018, [Online], Available URL: https://savetexaswater.org/resources/doc/2018_WCAC_Lege_Report.pdf, accessed Sept. 2019.

(15) U. S. Department of Agriculture Natural Resources Conservation Service: *Fact Sheets by US Congressional Districts*, [Online], Available URL: http://www.nrcs.usda.gov/wps/portal/nrcs/detail/tx/programs/planning/wpfp/?cid=nrcs144p2_002892, accessed September 2019.

(16) U. S. Department of Agriculture Natural Resources Conservation Service: *Watershed Rehabilitation Status Summary Report*, [Online], Available URL: http://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb1082547.pdf, September 2019.

(17) Freese and Nichols, Inc., Alan Plummer Associates, Inc., CP&Y, Inc., and Cooksey Communications, Inc.: *2016 Region C Water Plan*, prepared for the Region C Water Planning Group, Fort Worth, December 2015.

(18) Alan Plummer Associates, Inc.: *Water Reuse Research Agenda*, prepared for the Texas Water Development Board, February 2011, [Online], Available URL: https://www.twdb.texas.gov/publications/reports/contracted_reports/doc/0904830937CWaterReuseResearch.pdf, accessed Sept. 2019.

9 Infrastructure Funding Recommendations

This plan has identified approximately $30 billion in recommended projects sponsored by water providers in Region C. These projects include a wide variety of infrastructure improvements, ranging from water loss control at the local level to large-scale regional transmission systems. An infrastructure financing survey was conducted as part of the regional water planning process to better assess the state's role in financing the identified water projects. Many of the sponsors of these projects will seek funding assistance through programs administered by the TWDB. TWDB funding programs that may be sources of funding for projects in the regional water plans are discussed in **Section 9.2** of this plan.

For this planning cycle, the TWDB developed the infrastructure financing survey to evaluate the amount of state funding that water users are likely to request. Using the results of this survey, this chapter identifies the portion of capital improvements recommended for Region C that may require TWDB financial assistance and identifies the potential TWDB financial categories that will be used. The survey developed by the TWDB included the following three financial categories:

- **Planning, Design, Permitting & Acquisition Funding**
- **Construction Funding**
- **State Participation Funding**

It should be noted that the capital costs contained in the surveys were from the Initially Prepared Plan (IPP) published in March 2020. Between the IPP and this Final Plan some cost estimates were updated, resulting in a total capital cost of strategies in this final plan that is slightly different than the total capital cost of projects surveyed.

Section Outline

Section 9.1 – Infrastructure Financing Questionnaires for Recommended Water Management Strategies

Section 9.2 – TWDB Funding Mechanisms

Related Appendices

Appendix N – Infrastructure Financing Information

RWPGs shall assess and quantitatively report on how individual local governments, regional authorities, and other Political Subdivisions in their RWPA propose to finance recommended WMSs and associated WMSPs. The assessment shall also describe what role the RWPG proposes for the state in financing recommended WMSs and associated WMSPs, including proposed increases in the level of state participation in funding for regional projects to meet needs beyond the reasonable financing capability of local governments, regional authorities, and other political subdivisions involved in building water infrastructure. [31 TAC §357.44]

9.1 Infrastructure Financing Surveys for Recommended Water Management Strategies

Infrastructure Financing Surveys were distributed via e-mail to each Region C wholesale water provider or municipal water user group with one or multiple recommended projects in the 2021 Regional Water Plan that might be eligible for state financial assistance. Each survey was prefaced with an explanation of its purpose in identifying the need for financial assistance programs offered by the State of Texas and administered by the TWDB. The surveys listed each recommended project and its total capital cost. Following this basic data, the wholesale water provider or water provider was asked: 1) to enter the portion of the total costs associated with the planning and acquisition phase of the project and the year needed; 2) to enter the portion of the total costs associated with the construction phase of the project and the year needed; and 3) to enter the percent share of the total project capacity that will not be needed within the first 10 years of the project life.

Water providers whose water supply strategies were noted in the regional plan as having zero capital costs were not surveyed. Only water user groups with strategies with a capital cost were surveyed. Non-municipal and municipal county-other water user groups with water supply strategies included in the regional plan were not surveyed, unless there was a specific project sponsor. Surveys were delivered the first week of May 2020 and received until the end of August 2020.

Several entities that were surveyed did not respond. The results of this survey represent the best effort of the group to complete the survey. To help encourage additional input, a follow-up email and phone call was attempted for water providers who had not responded to the initial survey.

A total of 252 surveys were sent - 222 to water user groups, and 30 to wholesale water providers. Many of the proposed capital improvements recommended in this plan involve one or more of the major water providers. As a result, more than 85 percent of the total Region C plan costs are borne by the major water providers.

9.1.1 Water User Groups (WUGs)

Of the 222 water user groups surveyed, 88 submitted responses, resulting in a 40 percent participation rate in this survey. This is a lower response rate than desired; however, it is similar to previous planning cycles.

Summaries of the water user group responses are included in **Appendix N**.

9.1.2 Wholesale, Major and Regional Water Providers

Of the 30 wholesale water providers surveyed, 18 submitted responses (6 of which were major and/or regional water providers) resulting in a 60 percent response rate. This is a lower response rate than desired; however, it is similar to previous planning cycles.

Summaries of the wholesale water provider responses are included in **Appendix N**.

9.1.3 Summary

Overall, the TWDB IFR survey received a 42 percent response rate (40 percent of WUGs and 60 percent of WWPs). However, on a monetary basis, the survey respondents accounted for a large percent of the total capital costs in Region C. Based on the survey responses, from both WUGs and WWPs, the water users in Region C are likely to request financial assistance from the TWDB to pay for over $24.7 billion (83 percent) of the capital costs identified for those entities' water supply infrastructure.

Table 9.1 provides a summary of the financing needs for the Region based on the survey results. More detailed information on individual responses can be found in **Appendix N**.

Table 9.1 Summary of Financing Needs in Region [a]

	TOTAL
Total Costs of Strategies - All Entities Surveyed	**$29,931,548,000**
Amount Respondents Requested from TWDB Programs	**$24,716,486,000**
Amount Likely to be Funded by Planning, Design, Permitting & Acquisitions Funding	$5,042,123,000
Amount Likely to be Funded by Construction Funding	$19,674,363,000
Remaining Costs [a]	**$5,215,062,000**

[a] *The remaining costs likely would be funded either by cash reserves, bonds, loans, or other programs.*

9.2 TWDB Funding Mechanisms

To help implement water management strategies, there are numerous funding programs available through Texas Water Development Board (TWDB). **Table 9.2** shows the potential TWDB funding sources. The primary means of funding for projects in the regional and state water plan is expected to be TWDB's new SWIFT program (State Water Implementation Fund for Texas).

In the 83rd Regular Session, the Texas Legislature (2013), via the passage of House Bill 4, outlined the structure and administration of SWIFT, including a prioritization process for projects and the creation of a legislative advisory committee. SWIFT supports low-cost financing of water projects in the State Water Plan through the issuance of bonds with subsidized interest rates, longer repayment terms, incremental repayment terms, and deferral periods. The TWDB will solicit abridged applications for SWIFT assistance up to twice a year. The abridged applications will then be prioritized for funding consideration. The TWDB anticipates selling bonds for each round of funding through the SWIFT.

Detailed information on funding programs offered by the TWDB can be found here: *https://www.twdb.texas.gov/financial/programs/*

Table 9.2 Summary of Texas Water Development Board Funding Programs

Program	Type	Eligible Water Supply Projects
State Water Implementation Fund for Texas	Loans	Projects must be in the state water plan.
Drinking Water State Revolving Fund	Loans	Water supply and source water protection
Water Development Fund Program	Loans	Planning, acquisition and construction of water related infrastructure
Clean Water State Revolving Fund Program	Loans	Wastewater recycling and reuse facilities
State Participation Program	Loans	Regional water, wastewater recycling and reuse facilities. Projects must be in water plan.
Agriculture Water Conservation Loan	Loans	Install efficient irrigation equipment on private property
Water Infrastructure Fund	Loans	Water management strategies recommended in state or regional water plans
Rural Water Assistance Fund	Loans	Development or regionalization of rural water supplies
Economically Distressed Area Program	Grants, Loans	Water and sewer service to economically distressed areas. Projects must be in water plan.
Regional Facility Planning Grant Program	Grant	Studies and analyses of regional water supply and wastewater facility needs

10 Plan Approval Process and Public Participation

This section describes the plan approval process for the Region C Water Plan and the efforts made to inform the public and encourage public participation in the planning process. Special efforts were made to inform the general public, water suppliers, and others with special interest in the regional water plan and to seek their input.

Chapter Outline

Section 10.1 – Regional Water Planning Group

Section 10.2 – Outreach to Water Suppliers, Water User Groups, and Regional Planning Groups

Section 10.3 – Outreach to the Public

Section 10.4 – Public Meetings and Public Hearings

Section 10.5 – Region C and the Region D Interregional Conflict in the 2011 Regional Plans

Section 10.6 – Region C and the Region D Interregional Conflict in the 2016 IPPs

Section 10.7 – Region C and the Region D Interregional Coordination in the Fifth Cycle of Planning

Related Appendices

Appendix C – Adjustments to Projections

Appendix F – Potentially Feasible Water Management Strategies

10.1 Regional Water Planning Group

The legislation for Senate Bill One and TWDB planning guidelines establish regional water planning groups to control the planning process [1]. Each regional water planning group includes representatives of twelve designated interest groups: General public, counties, municipalities, industrial, agricultural, environmental, small businesses, electric generating utilities, river authorities, water districts, water utilities and groundwater management areas.

Table 10.1 lists the members of the Region C Water Planning Group as of February 2020 and the interests they represent. For the first half of the fifth round of planning, Jody Puckett (Dallas Water Utilities) was the Chair of the Region C Water Planning Group, Russell Laughlin was Vice-Chair, and Kevin Ward was Secretary. Upon the retirement of Ms. Puckett, the RCWPG elected Kevin Ward as Chair, and elected Tom Kula to replace Mr. Ward as Secretary. A number of planning group members either retired from the group or did not seek reelection as their terms expired during this planning cycle.

Table 10.1 Current Members of the Region C Water Planning Group (September 2020)

Interest	Member
River Authorities	Kevin Ward, Chair
Industry	Russell Laughlin, Vice Chair
Water Districts	Tom Kula, Secretary (retired)
Groundwater Management Areas (GMA12)	David Bailey
Municipalities	Kenneth Banks (replaced Tim Fisher who replaced Howard Martin)
Public	Jay Barksdale (replaced Bill Ceverha)
Water Utilities	Chris Boyd (replaced Jim McCarter)
Environment	Grace Darling (replaced Robert Scott)
Agriculture	John Paul Dineen III (replaced Tom Woodward)
Groundwater Management Areas (GMA11)	Gary Douglas
Municipalities	Chris Harder (replaced Ken Morgan who replaced John Carman)
Groundwater Management Areas (GMA8)	Harold Latham
Public	John Lingenfelder
Counties	G.K. Maenius
Small Business	Steve Mundt
Environment	Bob Riley
Water Districts	Drew Satterwhite
Municipalities	Rick Shaffer (replaced James Hotopp)
Electric Generating Utilities	Gary Spicer
Water Utilities	Connie Standridge
Water Districts	Jack Stevens
Municipalities	Richard Wagner (replaced Jody Puckett)

10.2 Outreach to Water Suppliers, Water User Groups, and Regional Planning Groups

The Region C Water Planning Group made special efforts to contact water suppliers and water user groups in the region and neighboring regional water planning groups to obtain their input in the planning process. Water suppliers and water user groups were surveyed and contacted on a number of occasions to solicit information on their current situation and their future water plans. Region C coordinated with Regions D, G, H, and I regarding shared resources and water user groups that were located in multiple regions.

Five of the six major water providers in the region (Dallas Water Utilities, Tarrant Regional Water District, North Texas Municipal Water District, Fort Worth, and Trinity River Authority) were represented on the water planning group. In addition, the planning group encouraged the Region C consultants to keep in touch with wholesale water providers and other water suppliers as planning proceeded. Other specific measures to obtain input from water suppliers and from other regional water planning groups are discussed below.

10.2.1 Questionnaires

A number of questionnaires have been sent to the Region C water user groups and wholesale water providers. **Appendix C** includes a sample copy of the population and demand questionnaire that was emailed to named municipal WUGs (did not send to County Other WUGs) located in Region C in August 2017. Over 100 WUGs responded that they agreed with the projections, while 32 WUGs requested revisions. The overall response rate for this survey was about 50 percent. **Appendix F** includes a sample copy of the water management strategy (WMS) questionnaire that was emailed to these Region C WUGs in November 2017. This survey also inquired about implementation of any WMSs from the *2016 Region C Water Plan* (results of which are summarized in **Chapter 11** of this report), any current contracts, existing water supply and delivery infrastructure, and any emergency interconnections with other water suppliers. Over 50 water suppliers responded to this survey with updated information.

A questionnaire was sent to all major water providers and wholesale water providers via email prior to the publication of this Initially Prepared Plan (IPP). This questionnaire asked for either agreement or further input on the entities' recommended water management strategies.

Lastly, a questionnaire was mailed to water user groups and wholesale water providers after the publication of the IPP. This questionnaire was developed by TWDB and sought input regarding how much, if any, TWDB funding each entity will likely pursue to develop the strategies outlined in this plan and when that funding would be needed. The results of this survey are compiled and discussed in Chapter 9 and in Appendix N of this report.

10.2.2 Meetings with Wholesale Water Providers and Other Suppliers

The consultants met in person with all the major water providers, many of the wholesale water providers, and with water user groups that were interested in meeting. The consultants spoke with wholesale water providers by phone when the provider thought that an in-person meeting was not necessary.

During the planning process, the consultants met with or held conference calls with the following water suppliers on one or more occasions. Discussion topics included current water supplies, current customers, population and demand projections, recommendations from the 2016 Plan, future water supplies, water treatment plant capacity and planned expansions, and additional wholesale customers. The consultants held meetings with major, regional and wholesale water providers.

The meetings with the providers listed above provided a better understanding of the current water supplies and the manner in which they are used, current customers, current infrastructure limitations, potential future customers, and planned water supply and infrastructure improvement projects. These meetings were useful in determining recommended strategies for the Region C Water Plan.

10.3 Outreach to the Public

The media outreach plan for Region C called for using a number of communication vehicles to keep the media, and hence the public, informed of the progress and activities of the Region C Water Planning Group.

10.3.1 Public Hearings

The media were invited through printed public meeting notices and press releases to attend the public hearings regarding the approval of the scope of work and the Initially Prepared Plan.

10.3.2 Informational Materials

Updated materials, for the press and other public audiences, on Region C's water planning effort were developed during the fifth round of Regional Water Planning and provided to media and the public throughout the planning period. Updated materials, which were added to the website, included a new FAQs list (frequently asked questions and answers), a summary of the planning process and timeline of key planning milestones, list of key water management strategies under consideration, overview brochure (see details below), roster of RCWPG members and consultants plus their respective contact information, water conservation tips for indoor and outdoor water use, links to third-party resources and a glossary of key water planning terms.

10.3.3 Brochure

Developed a single-fold, four-panel brochure for on-demand printing by RCWPG members and members of the public, as needed. The new brochure, entitled "Region C Water Planning: A Critical Process for North Central Texas' Future Prosperity and Quality of Life," provides an overview of the current, five-year planning cycle and answers basic questions about regional water planning, including:

- What is the Region C Water Planning Group?
- What is Region C's geographic area?
- How does regional water planning work?
- Why is this planning effort so important to North Central Texas residents and businesses?
- What are the recommended water management strategies for Region C in the current (2016) plan?
- Where are we in the current regional water planning process, and what are the upcoming opportunities for public participation?
- What are some key facts and figures about Region C water planning?
- Who are the current Planning Group members?
- Where can I find more information?

10.3.4 Press Releases and Media Advisories

Press releases and/or media advisories were issued prior to every meeting of the RCWPG during the fifth round of regional water planning. These notices alerted the media of the opportunity to attend and cover these public meetings, as well as requested the media to include meeting notices in their public calendars to encourage public attendance and participation.

10.3.5 Ongoing Media Relations

Among other key media outlets, reporters from key print and broadcast media across the Dallas/Fort Worth Metroplex have been proactive in attending the public meetings and have diligently covered the issues and activities surrounding the Region's water planning efforts. Significant coverage of Region C water planning efforts has also appeared in countless other community newspapers, magazines, websites and blogs across the entire 16-county region.

The Region C Water Planning Group and its efforts have netted a significant amount of press coverage since the fifth round of water planning began. The following are some of the media outlets that have produced stories on the Region C planning process in the last few years:

- Allen American
- Athens Daily Review
- Azle News
- Beaumont Enterprise
- Bridgeport Index
- Carrollton Reader
- Celina Record
- Cleburne Eagle News
- Collin County Business Press
- Community Impact News (various local editions across Dallas/Fort Worth)
- Coppell Gazette
- Corsicana Daily Sun
- D Magazine
- Dallas Business Journal
- Dallas Morning News
- Denton Record-Chronicle
- Flower Mound Leader
- Forney Messenger
- Fort Worth Business Press
- Fort Worth Star-Telegram
- Fort Worth Weekly
- Frisco Enterprise
- Gainesville Daily Register
- Greenville Herald Banner
- Henderson Daily News
- KDFW Fox 4 TV
- KERA TV and Radio
- KRLD News Radio 1080 AM
- KTVT CBS-11 TV
- KXAS NBC-5 TV
- Lewisville Leader
- Little Elm Journal
- Longview News Journal
- Lufkin Daily News
- McKinney Courier-Gazette
- Mesquite News
- Mount Pleasant Daily Tribune
- Nacogdoches Daily Sentinel
- North Texas e-News
- Oak Cliff Tribune
- Plano Star-Courier
- Rockwall County Herald Banner
- Rowlett Lakeshore Times
- Sanger Courier
- Sherman Herald-Democrat
- Texarkana Gazette
- Texas Tribune
- Tyler Morning Telegraph
- WBAP 820 AM
- WFAA Channel 8
- Wise County Messenger
- Wylie News

10.3.6 Region C Web Site

In order to make the *2021 Initially Prepared Region C Water Plan* more accessible to the public, the draft plan was be made available on the Region C web site, www.regioncwater.org, in February 2020. The web site has been used extensively throughout the fifth round of regional water planning, with all key documents uploaded to the site for public review. The site has also provided updates on upcoming meetings (including agenda and meeting materials) and key dates in the water planning process, as well as contact information for RCWPG members and consultants. Members of the press have also been able to access information and submit requests for interviews via the web site.

The site was also converted and rebuilt during this planning round to a more contemporary WordPress platform, making it easier to upload and update documents by the Region C consultants and simultaneously more accessible, visually appealing, intuitive to navigate and user-friendly for members of the public. The updated site is fully responsive and adaptive for optimal functionality and legibility on a wide variety of devices and browsers, ensuring that the public can access its critical information whether on a desktop computer, laptop, tablet device or cell phone. The updated site also allows for use of Google Analytics, enabling the RCWPG to count unique visitors that use the site.

The Final *2021 Region C Water Plan* was made publicly available on the Region C web site as required.

10.4 Public Meetings and Public Hearings

All regular, committee, and subcommittee meetings of the regional water planning group were posted and held in accordance with the Texas Open Meetings Act, the Texas Public Information Act, statute, and regional water planning rules.

10.4.1 Initial Public Hearing

As required by Senate Bill One rules, the Region C Water Planning Group held an initial public meeting to discuss the planning process and the scope of work for the region on April 20, 2016. The scope of work was approved by the Region C Water Planning Group. The public were notified by the notice that was published in accordance with Texas Water Development Board (TWDB) guidelines [(1)].

10.4.2 Regular Public Meetings

The Region C Water Planning Group held regular meetings during the development of the plan, receiving information from the region's consultants and making decisions on planning efforts. These meetings were open to the public, proper notice was made under Senate Bill One guidelines [(1)], and these meetings met all requirements of the Texas Open Meetings Act. All of the Region C Water Planning Group meetings were held at the North Central Texas Council of Governments offices in Arlington, a central location in the region. The water planning group met regularly, approximately two to three times per year. The following is a list of the dates of the Region C Water Planning Group meetings during this round of planning:

- December 5, 2016
- May 22, 2017
- December 18, 2017
- April 9, 2018
- August 20, 2018
- February 25, 2019
- June 24, 2019
- October 7, 2019
- December 16, 2019
- February 10, 2020
- September 21, 2020 (virtual due to coronavirus pandemic)

10.4.3 Public Hearing on Initially Prepared Plan

A public hearing teleconference on the *2021 Initially Prepared Region C Water Plan* was held May 26, 2020. Official public notice was posted in accordance with the TWDB requirements [(1)] and the public meeting met all requirements of the Texas Open Meetings Act. Unlike other rounds, this public hearing was conducted by telephone pursuant to the authority of Texas Government Code Section 551.125, and the orders of the Texas Governor regarding public gatherings due to the coronavirus pandemic.

10.4.4 Public Input

The Region C Water Planning Group encouraged the public to participate in the planning process by providing an opportunity for the public to speak to the Group at each public meeting during the planning cycle. The public was allowed to address the planning group on each action item prior to the Group taking action. The public was also invited to speak on any topic prior to the conclusion of each meeting.

After the submittal of the Initially Prepared Plan (IPP) to TWDB, Region C distributed copies of the IPP to the required locations, including county clerks offices in all 16 Region C Counties and at least one public library in each of the 16 Region C Counties. These copies were made available to the public at these locations at least 30 days prior to the May 26, 2020 Public Hearing. Public notice for this hearing was conducted as required by TWDB (TAC 357.21), including notices in both the Dallas Morning News and the Fort Worth Star Telegram. In this public notice, the public was made aware of where to access the IPP, given the opportunity to comment on the IPP at the public hearing, and given the opportunity to submit written comments up to 60 days after the public hearing. Oral comments at the public hearing regarding the IPP were recorded and are included in **Appendix Q** of this report. Written comments were also accepted by the planning group and are included in **Appendix Q** as well as responses to the written comments.

10.5 Region C and the Region D Interregional Conflict in the 2011 Regional Plans

The following text is an excerpt from the May 19, 2014 TWDB Executive Administrator (EA) final recommendation on Conflict, Background Section [(2)].

Senate Bill I (SB 1) in 1997 created the current state water planning process. Before the implementation of SB 1, Marvin Nichols was recommended as a water management strategy in the 1968 State Water Plan, the 1984 State Water Plan, and the 1997 State Water Plan. Under SB 1, the first Region D Regional Water Plan in 2001 recommended that Marvin Nichols be developed to provide a source of future water supply for water users both within Region D and in Region C. The 2001 Plan was later amended to remove support for the development of Marvin Nichols, however. The 2006 Region D Regional Water Planning Group took the position that Marvin Nichols should not be included in any regional plan or in the State Water Plan as a water management strategy. Further, the Region D Regional Water Planning Group expressed the opinion that the inclusion of Marvin Nichols in the Region C Regional Water Plan constituted an interregional conflict. Following the policy established with the first series of water plans, the Texas Water Development Board (TWDB) approved both the Region C and Region D 2006 Regional Water Plans because it did not find an over-

allocation of a source of supply--the TWDB's definition of an interregional conflict.

In 2007, the 80th Legislature established a study commission on Region C Water Supply that consisted of members appointed by the regional water planning groups of Regions C and D. The Study Commission was charged with reviewing the water supply alternatives available to the Region C Regional Water Planning Area. But the Study Commission was unable to reach a consensus on its findings and recommendations, so a final report was not delivered to the 82nd Legislature.

In 2011, the Region C Regional Water Planning Group again adopted Marvin Nichols as a recommended strategy and Region D reiterated concerns it had raised previously. Region D again expressed the opinion that including Marvin Nichols in the Region C Regional Water Plan constituted an interregional conflict. The TWDB approved the Region D Regional Water Plan in October 2010, and the Region C Regional Water Plan in December 2010, finding again that there was no over-allocation of supply sources. To date, Marvin Nichols has not been constructed and no permits for its development have been sought from the Texas Commission on Environmental Quality (TCEQ) or the U.S. Corps of Engineers.

Private parties in Region D (Ward Timber et al) filed suit in District Court in Travis County in January 2012, seeking judicial review of the TWDB's decision approving the Region C Regional Water Plan. In its order issued on December 5, 2011, the District Court declared that an interregional conflict existed, reversed the TWDB's decisions approving the two regional plans, and remanded the case to the TWDB for resolution. The TWDB appealed. The 11th Court of Appeals heard the case and affirmed the district court's ruling on May 23, 2013. No further motions were filed.

The TWDB contracted for a mediator and arranged for a mediation between Region C and Region D members appointed by their respective regional planning groups. The mediator reported on December 17, 2013 that the parties did not reach agreement in the mediation. Thus, under the statute and the Court's Order, the TWDB is to resolve the conflict.

The core dispute between Region C and Region D is whether Marvin Nichols should be developed in the north-central part of Region D to serve the water needs in Region C.

10.5.1 Timeline of Conflict and Resolution

The following text is from the TWDB web site [3].

***March 4, 2014** - The preliminary recommendation from TWDB EA (Kevin Patteson) is posted on the agency website and provided to the chairs of the C and D regional water planning groups and the parties to the Ward Timber litigation through their attorney. The TWDB begins receiving comments.*

***April 29 and 30, 2014** - public hearings for Region D and Region C on the preliminary recommendation.*

***May 2, 2014** - Comment period on Preliminary Recommendation closed.*

***May 19, 2014** - The Executive Administrator submits a final recommendation to the Board and issues a letter soliciting briefs.*

***August 7, 2014** - Board considered TWDB Executive Administrator's final recommendation.*

On August 7, 2014, the Board considered TWDB Executive Administrator's final recommendation regarding the interregional conflict between the Region C and Region D Regional Water Plans. The Board determined that there was inadequate analysis and quantification of the impact of the Marvin Nichols Reservoir Water Management Strategy on the agricultural and natural resources of Region D and the State.

***August 8, 2014** - Board Interim Order issued.*

On August 8, 2104 it was ordered that Region C conduct such analysis and quantification and submit same to the Board by November 3, 2014. It was further ordered that upon receipt of the analysis and quantification, the Executive Administrator and Region D would be given the opportunity to submit a written response to the submission, and the matter would be scheduled for Board consideration.

***November 3, 2014** - Additional quantitative analysis of agricultural and natural resource impacts of the Marvin Nichols Water Management Strategy by Region C due to TWDB.*

Region C submitted its analysis and quantification to the Board on October 29, 2014

***December 17, 2014** - Region D and the Executive Administrator responded to Region C's quantitative analysis.*

***January 8, 2015** – Order issued by the Texas Water Development Board. The Board found that Region C's 2011 Regional Water Plan together with the analysis and quantification submitted on October 29, 2014, meets the applicable statutory and regulatory criteria. Further, the Board found that in accordance with Texas Water Code (TWC) §§ 16.051 and 16.053, the interregional conflict as asserted by Region D is hereby resolved with the inclusion of the Marvin Nichols Reservoir Project as a recommended water management strategy in the 2011 Region C Regional Water Plan.*

Pursuant to the January 8, 2015, TWDB Order, Region C revised the *2011 Region C Water Plan* to reflect the conflict resolution. In addition, a public hearing was held on February 27, 2015 at the Bob Duncan Community Center in Arlington to solicit public comment on the proposed revisions to the 2011 Region C Water Plan based on the Board's January 8, 2015 order. There was one individual in attendance and there were no public comments. One written comment was received.

A Region C Water Planning Group meeting was held on March 2, 2015 to consider approval and adoption of the revisions to the *2011 Region C Water Plan*, related to TWDB's final resolution of the interregional conflict between Region C and Region D regarding the Marvin Nichols Reservoir Water Management Strategy. The group unanimously adopted the revisions to the 2011 Plan. The proposed revisions and the transcript from the public hearing were submitted to the TWDB on March 11, 2015. All of the items related to the interregional conflict can be found on the Region C web site (regioncwater.org), as well as the TWDB's web site (http://www.twdb.texas.gov/home/tabs/doc/hot/RegionCandDConflict.asp).

10.6 Region C and the Region D Interregional Conflict in the 2016 IPPs

Key documents pertaining to the 2016 Interregional Conflict Resolution were included in Appendix Z [4] of the *2016 Region C Water Plan*. Underlined items in the text below indicate a document that was included in that appendix.

The *2016 Initially Prepared Region C Water Plan* (IPP) contained a strategy called "Sulphur Basin Supplies" which consisted of the combination of supply from raising the conservation pool at Lake Wright Patman (to elevation 232.5 msl) and from a proposed Marvin Nichols Reservoir at elevation 313.5 msl (41,722-acre footprint). In the IPP, Sulphur Basin Supplies was a recommended strategy for Tarrant Regional Water District, North Texas Municipal Water District, and Upper Trinity Regional Water District, and was an alternative strategy for the cities of Dallas and Irving. This strategy was shown to be online by 2050.

On **July 21, 2015**, the Region D (North East Texas) Water Planning Group notified TWDB (by letter) of their objection to the inclusion of the Marvin Nichols Reservoir in the 2016 Region C Initially Prepared Plan.

On **August 6, 2015** TWDB responded with a memorandum to Regions C and D regarding a Potential Interregional Conflict between Regional Water Plans for Regions C and D.

In this memo, TWDB invited Regions C and D to submit briefs on the issue of whether an interregional conflict exists and notified the Regions that Texas Water Development Board would consider the matter of whether an interregional conflict did exist at its Board Meeting on **September 9, 2015**. Each Region was invited to give a 15 minute oral presentation to the TWDB Board at that meeting.

On **August 24, 2015** Region C submitted a letter brief to TWDB asserting that an interregional conflict did not exist on the basis that the Board had previously reviewed and resolved the interregional conflict in the 2011 Regional Plan ruling in favor of keeping the Marvin Nichols strategy in the regional plan (See **Section 10.5**).

On **September 1, 2015** the Sulphur River Basin Authority (SRBA) submitted a letter to TWDB regarding the Potential Interregional Conflict between Regional Water Plans for Region C and D. In this letter, SRBA added its support of the Marvin Nichols Reservoir being included in the regional plans, stating that "it is crucial that all the water supply strategies in the Sulphur River Basin Feasibility Study that are listed in the Texas State Water Plan remain in the plan".

On **September 9, 2015** TWDB held a Board meeting at which the Board heard presentations from both Region C and D. The minutes from this meeting reflect that TWDB found that an interregional conflict did exist between the 2016 Region C and Region D Initially Prepared Plans and set forth a path by which Regions C and D would participate in mediation to resolve the conflict. TWDB directed each region and TWDB to designate representatives to participate in this mediation.

At its **September 28, 2015** public meeting, the Region C Planning Group designated four representatives to participate in this mediation.

Mediation took place on **October 5, 2015** resulting in an agreement to resolve the conflict. The terms of the agreement are as follows:

- Region C will move the Marvin Nichols Reservoir as a designated strategy to the year 2070 in its 2016 regional water plan;
- Region C will support Region D's effort to obtain Texas Water Development Board funding to study alternative water supplies to Marvin Nichols Reservoir for the process of the 5th cycle of regional water planning for Regions C and D, resulting in the development of the 2021 regional water plans;
- Region C will adopt a resolution to recommend that water suppliers in

Region C not submit any water rights applications for new reservoirs that would be located in Region D through the end of the 5th cycle of regional water planning; and

- Region D agrees that it will not challenge Marvin Nichols Reservoir as a unique reservoir site through the end of the 5th cycle of regional planning.

Both Regions C and D were to seek ratification of the agreement by their respective regional water planning groups and to seek inclusion of the language relating to the terms of the agreement in their region's adopted 2016 regional water plans.

At their **November 9, 2015** public meeting the Region C Water Planning Group adopted two resolutions, one ratifying the mediation agreement and the other recommending that water suppliers in Region C not submit any water rights applications for new reservoirs that would be located in Region D through the end of the 5th cycle of regional water planning. Revisions were made to the final *2016 Region C Water Plan* to reflect the terms of the agreement, particularly that the Marvin Nichols Reservoir portion of the Sulphur Basin Supplies strategy was moved to begin in 2070 rather than 2050. The Wright Patman portion of the Sulphur Basin Supplies strategy is still shown beginning in 2050.

10.7 Region C and Region D Interregional Coordination in the Fifth Cycle of Planning

In anticipation of a potential conflict in the 2021 Initially Prepared Plans for Region C and D, the Texas Water Development Board has offered to facilitate meetings between the two regions.

In a letter dated **April 3, 2019**, TWDB made clear their interest in supporting all regions' efforts to work through any relevant issues. Toward that coordination effort, both the Region C and Region D Water Planning Groups selected a subcommittee from their membership that would participate in the coordination meetings.

The subcommittee members from each Regional Water Planning Area are:

- **Region C Members:**
  - Kevin Ward
  - Russell Laughlin
  - Tom Kula (retired)
  - Denis Qualls
  - Jay Barksdale
  - Steve Mundt
  - Jack Stevens
  - John Lingenfelder
- **Region D Members:**
  - David Nabors
  - Kelly Mitchell
  - Cindy Gwinn
  - Fred Milton (former Region D member)
  - David Montagne
  - Richard LeTourneau
  - Jim Thompson

The initial Coordination meeting was held on **November 4, 2019** in Tyler, Texas, and was open to the public. TWDB staff opened the meeting by making introductions of the participants and discussing the goal and purpose of the coordination meeting. The purpose of the meeting was to share information about where the two RCPGs were in the planning process and to focus on fact-finding and fact-sharing. The goals of the meeting were to identify a list of issues of concern requiring additional information and/or discussion and to decide next steps for the group. The public was given opportunity to comment but no comments were made. Each region's consultants made an informational presentation, showing the overall demands and needs of the regions and the strategies being considered and potentially recommended. The group identified three main issues: the proposed Marvin Nichols Reservoir, the proposed reallocation of flood storage in Lake Wright Patman, and the proposed Parkhouse Reservoirs (North and South). Three sub-issues were identified: mitigation, economic impact, and timing of permitting. The next steps identified by the group were to meet again in December 2019 and for the subcommittee members to develop potential solutions to the issues identified.

Two additional Region C-D coordination meetings were held at which a TWDB-appointed mediator was in attendance. These meetings were open to the public. One meeting was on **December 9, 2019** in Tyler, Texas, and another was on **January 14, 2020** in Sulphur Springs, Texas. Both meetings were similar to the first meeting. Each region presented a proposed resolution to the conflict, but neither resolution was accepted by both regions.

The Initially Prepared Plans were submitted on March 3, 2020 to the TWDB. Regional water planning groups were given an initial deadline of 60 days following (May 2, 2020) to assert a potential interregional conflict. Due to the allowance by the Governor for remote public meetings, the deadline was extended by the TWDB to May 11, 2020. No potential interregional conflict was declared.

10.8 Chapter 10 List of References

(1) Texas Water Development Board, *Exhibit C Second Amended General Guidelines for Fifth Cycle of Regional Water Plan Development* (April 2018), Austin, [Online] Available URL: http://www.twdb.texas.gov/waterplanning/rwp/planningdocu/2021/doc/current_docs/contract_docs/2ndAmendedExhibitC.pdf?d=1571062426136

(2) Patteson, K. *Resolution of the Interregional Conflict between the 2011 Region C and the Region D Regional Water Plans* [Memorandum]. Austin: Texas Water Development Board. [Online] Available URL: http://www.twdb.state.tx.us/board/2014/08/Board/Brd01.pdf, December 19, 2014.

(3) Texas Water Development Board, *Region C and Region D Interregional Conflict* (January 2015), Austin, [Online] Available URL: http://www.twdb.texas.gov/home/tabs/doc/hot/RegionCandDConflict.asp, February 3, 2015.

(4) Freese and Nichols, Inc., Alan Plummer Associates, Inc., CP&Y, Inc., and Cooksey Communications, Inc.: *2016 Region C Water Plan, Appendix Z*, prepared for the Region C Water Planning Group, Fort Worth, December 2015, Available URL: http://www.regioncwater.org/Documents/Final%202016%20Region%20C%20Water%20Plan/Appendix%20Z%20B&W.pdf

11 Implementation and Comparison to Previous Regional Water Plan

This chapter includes a description of the water management strategies (WMSs) and projects that were included in the previous plan (*2016 Region C Water Plan)* [(1)] and have been implemented since the previous plan was published, as well as strategies and projects that are no longer recommended.

It also includes a discussion of the differences between the two plans, specifically regarding:

- Water demand projections
- Drought of record and hydrologic modeling and assumptions used in planning for the region
- Groundwater and surface water availability, existing water supplies, and identified water needs
- Changes to recommended and alternative water management strategies and projects
- Cost of the proposed plan

Chapter Outline

Section 11.1–Implemented and No Longer Included Water Management Strategies and Projects

Section 11.2– Differences Between the Previous and Current Regional Water Plan

Section 11.3– House Bill 807 Requirements

Section 11.4– Conclusion

Related Appendices

Appendix C – Adjustments to Projections

Appendix E –Water Supply Available to Region C

Appendix J – Updated Quantitative Analysis of the Proposed Marvin Nichols Reservoir

Appendix P – Water Management Strategy Implementation Survey

New Designation - Major Water Providers

- Dallas Water Utilities
- City of Fort Worth
- North Texas Municipal Water District
- Tarrant Regional Water District
- Trinity River Authority
- Upper Trinity Regional Water District

Previous WWPs designated as WUGs

- Argyle WSC
- Cross Timbers WSC
- Lake Cities MUA
- East Cedar Creek FWSD
- West Cedar Creek MUD

New Service Area Methodology

- 47 Removed WUGs
- 52 New WUGs

Minimal Changes

- Population +2.5%
- Demand +/- 1.5%
- Supplies +/- 2.5%

New Drought of Record for Eastern Reservoirs

- Chapman Lake
- Proposed Marvin Nichols

11.1 Implemented and No Longer Included Water Management Strategies and Projects

The following sections discuss the water management strategies and projects that were recommended in the *2016 Region C Water Plan* (2016 Plan) and have been partially or completely implemented since that plan was published, as well as WMSs and projects that are no longer being recommended and are not included in the 2021 Plan.

Appendix P includes the updated Water Management Strategy Implementation Survey provided by TWDB. Changes to WMSs since the 2016 Plan are discussed in **Section 11.2**.

11.1.1 Implementation of Previously Recommended Water Management Strategies and Projects

Table 11.1 lists the WMSs and projects that have been fully or partially implemented since the 2016 Plan. Because conservation was a recommended strategy for a large number of WUGs in the 2016 Plan, it is discussed separately and is not listed by WUG in **Table 11.1**. Additional information on conservation as a WMS and project is included in **Section 11.2.6**.

Region C did not consider drought management as a feasible strategy to meet long-term growth in demands or currently identified needs in any of the last three regional plans, so the implementation of this strategy is not relevant to the discussion in this chapter.

Table 11.1 Water Management Strategies/Projects Fully or Partially Implemented Since the 2016 Region C Water Plan[a]

Sponsor	WMS/Project Name	Source of Supply
Upper Trinity River Water District	Contract Renewal with Commerce	Chapman Lake
North Texas Municipal Water District	Main Stem Pump Station	Indirect Reuse
North Texas Municipal Water District	Dredge Lavon Lake	Lavon Lake
Tarrant Regional Water District	Integrated Pipeline	TRWD Sources (Cedar Creek and Richland Chambers Reservoir)
North Texas Municipal Water District/Trinity River Authority	Central Reuse for East Fork Wetland	TRA Central WWTP
Irving/Trinity River Authority	Irving Indirect Reuse Use (Twin Wells Golf Course Reuse)	TRA Central WWTP
North Texas Municipal Water District /Irving	Removal of Silt Barrier	Chapman Lake
Westlake/Trophy Club MUD #1	Joint Project to increase delivery infrastructure from Fort Worth	TRWD Sources (through Fort Worth)
Keller	Increase Delivery Infrastructure to Purchase Additional Water from Fort Worth	TRWD Sources (through Fort Worth)
Bethesda WSC	Connection to Arlington	TRWD Sources
Sardis-Lone Elm WSC	Connection to Midlothian	TRWD Sources (through Midlothian)

[a]*Not considering conservation strategies*

11.1.2 **Water Management Strategies and Projects No Longer Included**

Table 11.2 lists water management strategies and projects that were recommended or alternative in the 2016 Plan but are not recommended or alternative WMSs and projects in the 2021 Plan. Overdrafting of aquifers and supplemental wells has been recommended in plans previous to the 2016 Plan but according to regional planning rules [(2)] are no longer eligible as WMSs. Although supplemental wells are no longer permitted to be included in the Regional Water Plans, the planning group believes that the replacement of aging infrastructure, like wells, is an important part of maintaining an adequate water supply. Such projects should be considered consistent with this plan and supported by adequate state funding, where needed.

Table 11.2: Water Management Strategies No Longer Included in the 2021 Region C Water Plan

Sponsor	WMS/Project Name	Comments
TRA	SEP, Multiple Counties Reuse (Ellis, Freestone, Kaufman)	TRA reuse providing supply to other users
TRA	Additional Las Colinas Direct Reuse for Irrigation	TRA reuse providing supply to other users
TRWD	Interim Purchase from DWU	No longer needed
TRWD	Western Oklahoma	Was alternative WMS; removed for 2021 Plan
TRWD	Sale to Navarro County SEP	No longer SEP Demand in Navarro County
NTMWD	Sale to Denton County Other	NTMWD no longer serves Denton County Other through Little Elm.
GTUA	Lake Texoma for Fannin County SEP	No longer SEP Demand in Fannin County
GTUA	Lake Texoma for Grayson County SEP	No longer a need for Grayson County SEP
GTUA	CGMA East West Pipeline	No longer needed; CGMA Parallel Line is still recommended as a WMS.
Corsicana	Sale to Navarro County SEP	No longer SEP Demand in Navarro County
Manufacturing, Multiple Counties	Conservation	Demand projections do not increase after 2030 due to uncertainty in future demands
SEP, Multiple Counties	Conservation	Demand projections do not increase after 2030 due to uncertainty in future demands
Blooming Grove	New Wells	No longer needed
Corinth	New Wells	Increase purchase from current provider instead of new wells
Gastonia-Scurry SUD	Connect to Seagoville	Removed at request of DWU
Johnson County SUD	Connect to Grand Prairie	Grand Prairie supply not needed to meet need
Manufacturing, Denton County	New Wells	Increase purchase from current providers instead of new wells
Mountain Peak SUD	New Wells	Increase purchase from current provider instead of new wells
Southmayd	New Wells	Participating in GTUA Regional Water System instead of new wells
Springtown	New Wells	Pursuing expanded use of existing surface supply instead of new wells
Waxahachie	Sale to Ellis County SEP	Meeting needs through another supplier.
Willow Park	Connect to Weatherford	Pursuing direct connection to Fort Worth instead

11.2 Differences Between the Previous and Current Regional Water Plan

The following sections provide a discussion of changes from the 2016 Plan to the 2021 Plan.

11.2.1 Water Demand Projections

Chapter 2 of this report details the projected water demands for Region C for the 2021 regional plan. **Figure 11.1** compares the total demand projections from the 2016 and 2021 Plans. This figure shows that the water demand projections in the two plans are very similar. **Table 11.3** shows the difference in demands by county, and **Table 11.4** shows the difference by use category. The municipal projections are slightly higher due to a slight increase in projected population from the 2016 Plan (up to 2.4 percent population increase by 2070).

The largest change in demand projections from the 2016 plan to the 2021 Plan is the decrease in non-municipal demands, particularly Manufacturing and Steam Electric Power. For this fifth cycle of planning, TWDB changed the methodology for projecting these demand categories due to uncertainty in forecasting demand for these categories. For the 2021 Plans, TWDB required that demands for 2030 to 2070 be held constant rather than increasing over time as in past plans. Since the Region C population is projected to increase by 66 percent from 2030 to 2070, it appears unlikely that there would be no increase in manufacturing or steam electric power water demands after 2030. For this reason, Region C has serious concerns regarding the manufacturing and steam electric power demand projections for 2040 through 2070.

Figure 11.1: Comparison of Projected Dry Year Demands from 2016 Plan to 2021 Plan

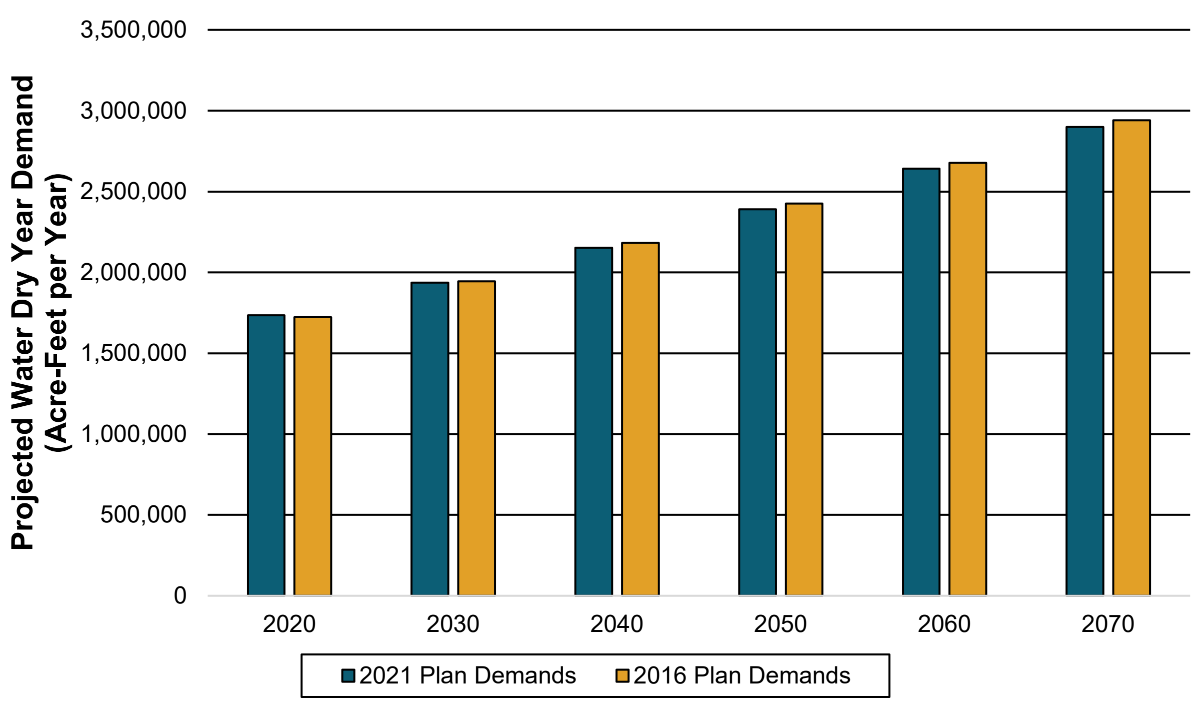


Table 11.3 Changes in Projected Dry Year Demands from 2016 Plan to 2021 Plan for Region C by County

County	Change in Projected Water Dry Year Demand (Ac-Ft/Yr)					
	2020	2030	2040	2050	2060	2070
Collin	18,483	17,403	10,258	18,689	40,053	55,975
Cooke	501	521	510	497	473	471
Dallas	-14,562	-11,871	-17,006	-19,672	-20,425	-20,891
Denton	-1,955	-4,673	-4,844	-1,036	472	1,624
Ellis	5,086	7,263	2,087	-460	-3,670	-7,700
Fannin	-2,809	-8,156	-8,842	-9,367	-9,903	-10,526
Freestone	9,479	9,466	9,562	6,013	939	-5,012
Grayson	-1,431	-8,488	-10,735	-11,986	-13,139	-12,859
Henderson	864	-1,870	-2,924	-3,934	-5,481	-7,555
Jack	2,781	802	513	299	85	-140
Kaufman	3,228	4,126	4,652	4,620	5,324	6,870
Navarro	-7,656	-12,922	-13,028	-13,310	-14,108	-14,740
Parker	1,496	2,270	-482	359	170	-3,731
Rockwall	2,611	3,197	9,314	8,611	7,691	4,532
Tarrant	-4,868	-4,650	-8,152	-10,830	-17,636	-21,750
Wise	-680	-804	-1,906	-3,707	-6,205	-5,908
Region C Total	**10,568**	**-8,386**	**-31,023**	**-35,214**	**-35,360**	**-41,340**
% Change	**0.6%**	**-0.4%**	**-1.4%**	**-1.5%**	**-1.3%**	**-1.4%**

Table 11.4 Change in Projected Water Dry Year Demands from 2016 Plan to 2021 Plan by Type of Use

Use	Change in Projected Water Demand (Ac-Ft/Yr)					
	2020	2030	2040	2050	2060	2070
Municipal	33,125	41,901	42,557	53,340	68,368	78,996
Manufacturing	-31,158	-35,028	-43,224	-50,377	-54,969	-59,909
Steam Electric Power	-8,520	-27,453	-39,310	-46,918	-57,278	-68,720
Irrigation	10,743	10,527	10,311	10,095	9,878	9,662
Mining	7,609	2,898	-126	-123	-128	-138
Livestock	-1,231	-1,231	-1,231	-1,231	-1,231	-1,231
Region C Total	**10,568**	**-8,386**	**-31,023**	**-35,214**	**-35,360**	**-41,340**
% Change	**0.6%**	**-0.4%**	**-1.4%**	**-1.5%**	**-1.3%**	**-1.4%**

11.2.2 **Drought of Record and Hydrologic Modeling Assumptions Used in Planning for the Region**

The drought of record for most water supplies used in Region C occurred from 1950 through 1957. More recent droughts (2003 through 2006 and 2011 through 2015) caused low inflows and low water levels for many Region C lakes. Analysis using hydrologic data from recent years has indicated that Jim Chapman (Cooper) Lake in the Sulphur River Basin has recently experienced a new drought of record (2011 through 2015), reducing the yield by approximately 7 percent from what was in the *2016 Region C Plan* due to the 2010-2015 drought. Yields of proposed projects in the Sulphur Basin show as much as a 24 percent reduction in yield. For other Region C supplies, based on the current hydrology in the Texas Commission on Environmental Quality (TCEQ) Water Availability Models (WAMs), the drought of the 1950s remains the drought of record.

Unless there are changed conditions (new water rights, WAM modification, new area/capacity relationships, new drought of record, other), the firm yields from the 2016 Plan were used. The Region C reservoirs for which new firm yields were calculated include the Elm Fork of the Trinity River System, Lake Lavon, Richland-Chambers Reservoir, the West Fork of the Trinity River System, Cedar Creek Reservoir, Benbrook Lake, Lake Ray Hubbard, White Rock Lake, and Chapman Lake. Additional information on the hydrologic modeling assumptions can be found in **Appendix E**.

11.2.3 **Available Water Supplies**

Chapter 3 and **Appendix E** of this report detail the available supplies for Region C for the 2021 regional plan. **Figure 11.2** compares the total available supplies (not considering infrastructure or permit constraints) from the 2016 and 2021 Plans. **Table 11.5** shows the changes by source of supply. As the figure and table show, the total available supplies in the 2021 Plan are similar to the supplies presented in the 2016 Plan. The following is a summary of the changes:

- The slight decrease in reservoir supply is due to refinements of the modeling methodology to better reflect actual conditions.
- The small decrease in imports is due to reduced yields from Chapman Lake due to the new drought of record and lower yield of Lake Palestine.
- The overall groundwater availability is about 16,000 acre-feet per year more than the availability in the 2016 Plan, based on the Modeled Available Groundwater (MAG) values provided by TWDB. The two largest changes were an increase of about 10,000 acre-feet per year in the Trinity aquifer in Denton County and an increase of about 4,000 acre-feet per year in the Carrizo-Wilcox aquifer in Freestone County. Multiple other changes made up the remaining difference in groundwater availability.
- Reuse has increased in the early decades due to use of additional return flows in Region C primarily attributed to implementation of TRA return flow. Long-term reuse, however, has decreased due to lower return flow projections.

Figure 11.2: Comparison of Total Available Supplies from the 2016 Plan to the 2021 Plan

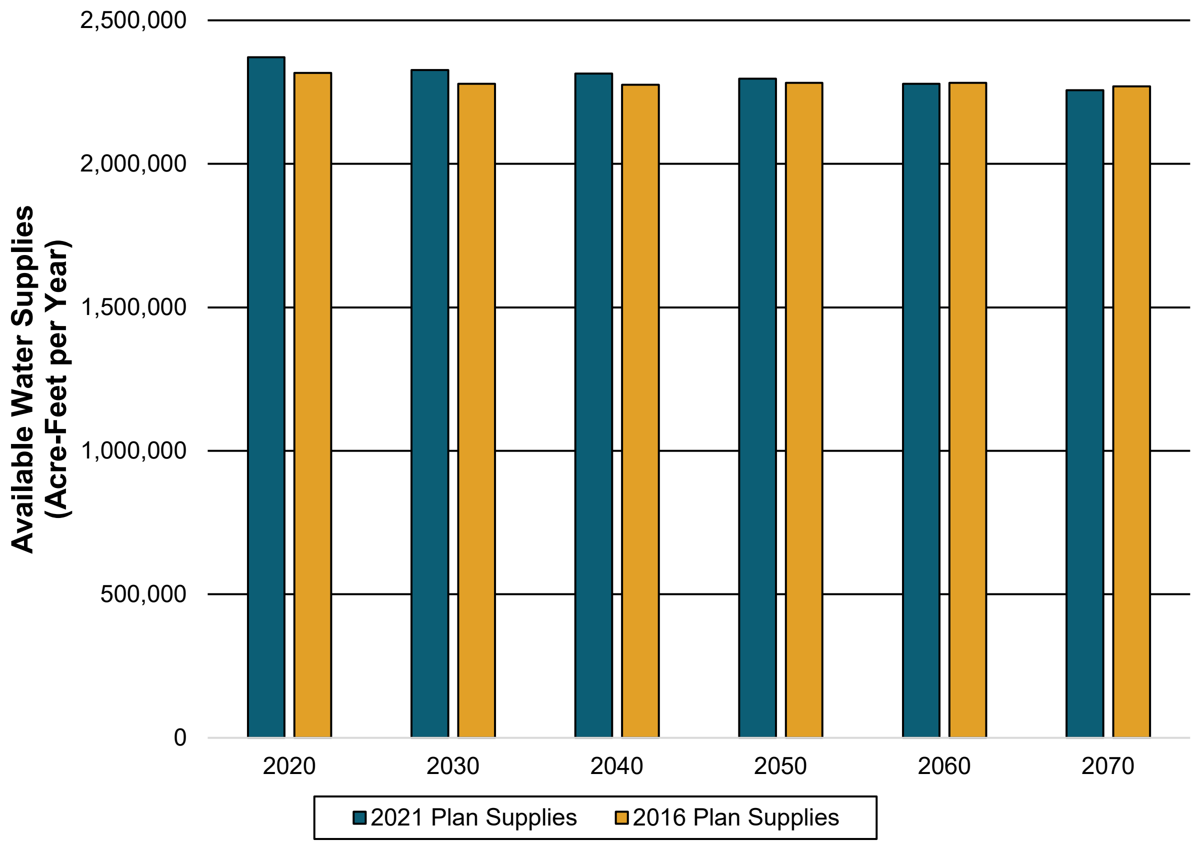


Table 11.5: Change in Total Available Supplies from the 2016 Plan to the 2021 Plan

Source of Supply	2020	2030	2040	2050	2060	2070
Reservoirs in Region C	-6,930	-6,699	-6,687	-6,978	-7,411	-8,235
Local Irrigation	1	1	1	1	1	1
Other Local Supplies	1,317	1,317	1,317	1,317	1,317	1,317
Imports	-10,821	-10,487	-10,148	-9,863	-9,697	-9,527
Groundwater	15,770	15,610	16,198	15,965	16,416	16,054
Reuse	53,174	44,237	35,628	11,122	-5,641	-15,524
Total	**52,511**	**43,979**	**36,309**	**11,563**	**-5,015**	**-15,914**
% Change	2.3%	1.9%	1.6%	0.5%	-0.2%	-0.7%

11.2.4 **Existing Water Supplies of WUGs**

Changes to the existing water supplies for WUGs are summarized in **Table 11.6**.

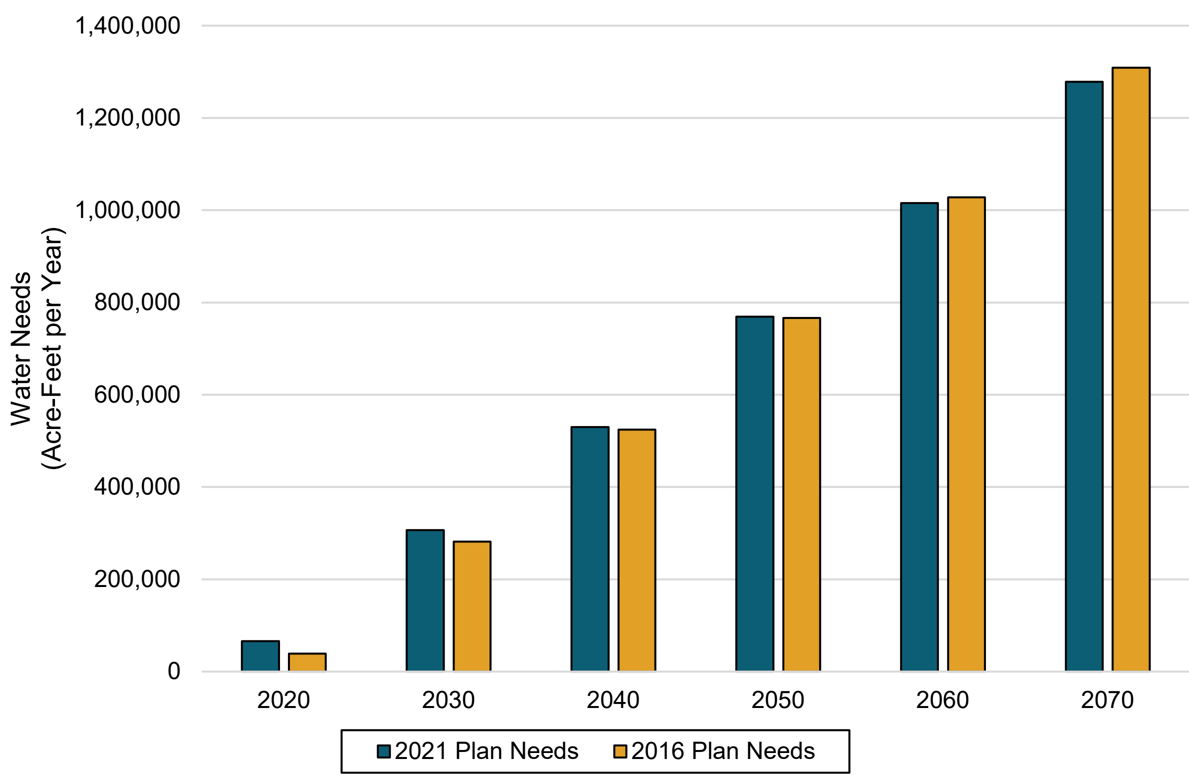
Table 11.6: Changes in Existing WUG Supplies since the 2016 Plan

WUG	Source	Comment
Country Club WSC	Country Club WSC Reuse	No longer a supply
Collin County Irrigation	NTMWD Wilson Creek WWTP (Reuse)	New existing supply

11.2.5 **Identified Water Needs**

Chapter 4 of this report details the identified water needs for Region C for the *2021 Regional Water Plan.* The identified needs are the sum of all the needs of each WUG, not considering any surpluses of other WUGs. **Figure 11.3** is a comparison of those needs in the 2016 Plan and 2021 Plan. The total 2070 need in the 2021 Plan is 1,278,427 acre-feet per year. The total 2070 need in the 2016 Plan was 1,308,539 acre-feet per year.

Figure 11.3: Comparison of Identified Water Needs from the 2016 Plan to the 2021 Plan



11.2.6 **Changes to Recommended and Alternative Water Management Strategies and Projects**

In addition to the implemented and no longer recommended WMSs and projects discussed in **Section 11.1**, there have been numerous changes to the recommended and alternative water management strategies and projects presented in the 2016 Plan. These changes are summarized in **Table 11.8**.

Table 11.8 does not include the 52 new WUGs added since the 2016 Plan. In addition, the table does not include the 47 entities that are no longer considered WUGs. For reference, these new or removed WUGs are listed in **Table 11.9**.

Any strategies or projects associated with these new and removed WUGs are considered changes since the 2016 Plan even though they are not listed in the table of changes. (**Table 11.10** shows any WUGs that have had name changes since the 2016 Plan. Any changes to WMSs for these WUGs will be shown in **Table 11.8**).

It is important to note that the changes to the WMSs and projects listed in **Table 11.8** are only changes to the base WMS and project. For example, if a WUG had a strategy in the 2016 Plan to purchase additional water from DWU and if in the 2021 Plan new infrastructure is required to purchase that water, that is not considered a change to the WMS because there was no change to the source of supply. It is however considered a new project. Because conservation strategies were included for a large number of WUGs, changes to conservation strategies are discussed below and are not listed by WUG in **Table 11.8**.

Conservation. The currently recommended Water Conservation Package for municipal WUGs (described in **Chapter 5B**) is generally consistent with the Water Conservation Package recommended in the 2016 Plan, with the additional recommendations of having a Water Conservation Coordinator and Twice Weekly Irrigation Restrictions. The RCWPG also recommends that municipal WUGs be able to substitute any other appropriate, service-area specific water conservation strategies and projects for those specifically listed in the Water Conservation Package.

This recommendation is presented in greater detail in **Chapter 5B**. For non-municipal WUGs, the RCWPG has renewed the 2016 recommendation for irrigation rebate programs but has removed the manufacturing rebate from the recommendation due to the change in manufacturing demand projection methodology used in this round of planning. With the addition of the two new conservation items (conservation coordinator and twice weekly watering restrictions), the recommended municipal conservation savings for 2070 has increased from 131,108 acre-feet per year in the 2016 plan to 192,405 acre-feet per year. Based on review of water conservation plans submitted to Region C, the most widely implemented municipal water conservation strategies are public and school education, water loss control, conservation rates, and water waste prohibition.

In addition to the information summarized in **Table 11.8**, detailed information regarding significant changes to WMSs for the MWPs is provided below. The information below is intended to highlight the changes to several of the major water provider WMSs and projects since the 2016 Plan, not to provide detailed information on the WMS or project itself. That information can be found in **Chapter 5C** and **5D** of this report.

Sulphur Basin Supplies. In the 2016 Plan, Sulphur Basins Supplies was a recommended strategy/project. This strategy/project was the combination of the reallocation of flood storage at Wright Patman Lake to 232.5 MSL and the proposed Marvin Nichols Reservoir at a conservation pool elevation of 313.5. MSL. The total yield available to Region C from this combined strategy was 489,800 acre-feet per year.

Since the 2016 Plan, updated yield analyses have been performed for the Sulphur Basin to include the new drought of record which spanned from 2011 to 2015. This new drought of record substantially reduced the firm yield of the Sulphur Basin Reservoirs. For the purpose of the 2021 Region C Water Plan, the Sulphur Basin Supplies Strategy has been separated into two distinct strategies and projects. The Wright Patman strategy/project assumes the reallocation of flood storage to elevation 235 MSL. The other strategy/project involves a larger footprint of the Marvin Nichols site with a conservation pool elevation of 328.0 MSL. The yield available to Region C from these two strategies located in the Sulphur Basin would be 483,400 acre-feet per year (122,200 acre-feet per year from Wright Patman and 361,200 acre-feet per year from Marvin Nichols). Even with the larger footprint of Marvin Nichols, the combined yield of these two strategies is 6,400 acre-feet per year less than the Sulphur Basin Supplies strategy from the 2016 Plan.

In the 2016 Plan, the stand-alone Marvin Nichols at 328.0 MSL had a yield available to Region C of 489,800 acre-feet per year. The new drought of record reduced the firm yield of the stand-alone Marvin Nichols (at 328.0 MSL) by 26.3%.

In TWDB's January 8, 2015 Order [(3)] resolving the interregional conflict between the 2011 Region C and D Plans related to the proposed Marvin Nichols Reservoir, TWDB encouraged Region C and D to continue to participate in the ongoing Sulphur River Basin Studies. Region C entities have been and plan to continue participating in these ongoing studies. The Region C entities that are interested in development of Marvin Nichols Reservoir and other Sulphur Basin Supplies (NTMWD, TRWD, Dallas, UTRWD, and Irving) have formed a Joint Committee on Program Development (JCPD). Since 2001, the JCPD has provided more than $8 million to the Sulphur River Basin Authority (SRBA) to further investigate the development of Marvin Nichols Reservoir and other potential water supply sources in the Sulphur River Basin.

Since 2011, ongoing Sulphur Basin Feasibility studies have been conducted by the U.S. Army Corps of Engineers (USACE), SRBA and the JCPD. In 2014, USACE recently completed a significant phase of the Sulphur Basin Feasibility Study [(3)]. This study sought to address concerns from Region D entities regarding the protection of natural resources, environmental impacts, and the socio-economic impacts of developing water supply within Region D and the Sulphur Basin. Socio-economic impacts and environmental mitigation Information from this study has been incorporated into the Quantitative Analysis of the proposed Marvin Nichols Reservoir which is included in this plan as **Appendix J**.

Main Stem Trinity River Pump Station. This was a recommended strategy and project for Dallas Water Utilities (DWU) and North Texas Municipal Water District (NTMWD) in the 2016 Plan. Since the publication of that plan, NTMWD has completed the construction of the pump station and is using it in conjunction with the NTWMD East Fork Reuse. Supplemental supplies for the implemented WMS are purchased from TRA instead of DWU. DWU and NTMWD are in discussions to swap reuse water from several wastewater treatment plants (Elm Fork Swap and Ray Hubbard Exchange WMS). DWU will receive NTMWD treated wastewater discharges into the Lewisville watershed and in return DWU will provide discharges from their WWTPs on the Main Stem of the Trinity River to NTMWD. (The amount provided to NTMWD from Dallas will equal the increase in discharges from NTMWD's Lewisville watershed above historical levels.) NTMWD will divert the water provided DWU to Lake Lavon using the Main Stem Pump Station. The projected supply from the Elm Fork Swap is based on wastewater flow projections for the purposes of regional and state planning – actual supplies are contingent on what is actually discharged. Capital costs are to be determined.

Integrated Pipeline. Tarrant Regional Water District (TRWD) and Dallas Water Utilities (DWU) have partnered to construct and operate the Integrated Pipeline (IPL) Project. Since the 2016 Plan, a portion of the IPL has been constructed and is currently delivering raw water to TRWD customers from the Richland-Chambers Reservoir. However, there is no infrastructure currently in place to transport DWU's supplies from Lake Palestine. Similarly, the TRWD Cedar Creek wetland has not yet been constructed although supplies from the wetland will eventually be transported via the IPL as well. The Dallas portion of the IPL and the supplies from TRWD's Cedar Creek Wetland remain WMSs and projects in the 2021 Plan.

11.2.7 Total Cost of Recommended Strategies

Most of the new supplies for Region C will be developed by the major wholesale water providers in the region. The total cost of implementing all of the recommended water management strategies in the 2021 Region C Plan is approximately $30 billion. The total cost from the 2016 Region C Plan was $23.5 billion. The main changes related to the increase in the cost to develop all of the WMSs are due to changes to several of the large WMSs, inflation, and increased material and equipment costs for pump stations and pipelines.

11.3 House Bill 807 Requirements

House Bill 807 was passed by the 86th Texas Legislature and signed by the Governor on June 10, 2019 and became effective immediately, meaning that the requirements of the Bill would apply to the current round of planning and must be included in the 2021 Regional Water Plans. The Bill amended Section 16.053 of the Texas Water Code to include, among others, the requirement that RWPGs "assess the progress of the Regional Water Planning Area (RWPA) in encouraging cooperation between water user groups for the purpose of achieving economies of scale and otherwise incentivizing strategies that benefit the entire regions" (TWC §16.053(e)(12)).

TWDB provided the following guidance to meet this requirement: "RWPGs shall include documentation of the RWPG's general assessment of progress of the RWPA in encouraging cooperation between WUGs for the purpose of achieving economies of scale and otherwise incentivizing strategies that benefit the entire region" and "to be included in

Chapter 11 of the RWP." Below is the documentation for this requirement.

The RCWPG has continued to encourage joint water management strategies that benefit multiple water providers and provide economies of scale. Examples of these joint projects include:

- **Integrated Pipeline WMS** - a joint delivery strategy recommended for Tarrant Regional Water District and Dallas Water Utilities.
- **Marvin Nichols and Wright Patman WMSs** – a joint reservoir development and delivery strategy recommended for Tarrant Regional Water District, North Texas Municipal Water District, and Upper Trinity Regional Water District; alternative strategy for Dallas Water Utilities and Irving.
- **GTUA Regional Water System** – recommended strategies in Grayson and Cooke counties.

11.4 Conclusion

The total 2070 demand for the region has decreased by about 40,000 acre-feet per year since the 2016 Plan (from 2,939,880 acre-feet per year to 2,898,540 acre-feet per year).

Since the 2016 Plan, the 2070 total available supplies have decreased by 13,000 acre-feet per year.

Sunrise over Benbrook Lake

Table 11.7: New Water Management Strategies/Projects Since the 2016 Region C Water Plan

Sponsor	WMS/Project Name	WMS	Comment
Irving	Main Stem Balancing Reservoir	Indirect Reuse	Alternative Strategy
Irving	Purchase return flow from TRA Central WWTP	Direct Reuse	
TRWD	Purchase return flow from TRA Central WWTP	Indirect Reuse	
TRWD	Carrizo-Wilcox Groundwater	Groundwater	
TRWD	Aquifer Storage and Recovery	ASR Pilot Project	
Corsicana	Additional Treatment Plant Expansion	Expanded use of Halbert/Richland-Chambers	
Athens	New Well(s)	Groundwater	Moved from Alternative to Recommended
Arlington	Sale to Cleburne	Sale of TRWD supply	
Gainesville	GTUA Regional Water System	Lake Texoma	
Sherman/GTUA	Connect to CGMA	NTWMD	
Flower Mound	Direct Reuse	Direct Reuse	
Pilot Point	GTUA Regional Water System	Lake Texoma	
Hudson Oaks	Connect to Fort Worth	TRWD through Ft Worth	
Willow Park	Connect to Fort Worth	TRWD through Ft Worth	
Springtown	Surface Water Treatment Plant & Supply Project	TRWD	Was an Amendment to the 2016 Plan, but not in original 2016 Plan
Anna	New well(s)	Groundwater, Woodbine aquifer	
Bolivar WSC	New well(s)	Groundwater, Trinity aquifer	
Dorchester	New well(s)	Groundwater, Woodbine aquifer	
Lakeside	New well(s)	Groundwater, Trinity aquifer	
Irrigation, Fannin	New well(s)	Groundwater, Trinity aquifer	
Livestock, Henderson	New well(s)	Groundwater, Carrizo-Wilcox aquifer	
Mining, Parker	New well(s)	Groundwater, Trinity aquifer	
Livestock, Tarrant	New well(s)	Groundwater, Trinity aquifer	
County Other, Tarrant	Purchase water from Euless for DFW Airport	TRWD	Alternative Strategy
Mining, Collin	GTUA Regional Water System	Lake Texoma	
Mining, Grayson	Reuse from Sherman	Direct Reuse	

Table 11.8: Changes to Water Management Strategies/Projects Since the 2016 Region C Water Plan

Sponsor	WMS/Project Name	WMS	Change from 2016 Plan
DWU	Additional Indirect Reuse Lewisville Lake	Additional Indirect Reuse Lewisville Lake	Added to account for DWU share of future UTRWD return flows to Lewisville Lake
NTMWD	Ray Hubbard Exchange	Ray Hubbard Exchange	Revised the Main Stem Pump Station strategy to make it clear that this is the water that Dallas captures in Lake Ray Hubbard.
DWU	Elm Fork Swap to NTMWD	Elm Fork Swap to NTMWD	Revised the Main Stem Pump Station strategy to make it clear that this is the water that Dallas captures in Lewisville Lake.
Flower Mound	Long Prairie/Lakeside Business District Service Areas	Long Prairie Direct Reuse	New recommended WMS
Fort Worth	Village Creek WRF Future Direct Reuse	Village Creek WRF Future Direct Reuse	Modified supply quantities in “Fort Worth Future Direct Reuse” WMS to include only projects supplied from the Village Creek WRF
Fort Worth	Mary’s Creek WRF Future Direct Reuse	Mary’s Creek WRF Future Direct Reuse	Added separate project for Mary’s Creek WRF. Supply was included in “Fort Worth Future Direct Reuse” WMS in 2016 plan.
TRA	Irving Indirect for Municipal Use	Irving Indirect for Municipal Use	Strategy start moved to 2030 and project name change from “direct” to “indirect”
NTMWD	Lewisville Lake/Main Stem Pump Station Exchange	Lewisville Lake/Main Stem Pump Station Exchange	New WMS- assumes that NTMWD will divert and treat these flows with an expanded Main Stem Pump Station and new or expanded treatment wetland
NTMWD	Additional Lavon Watershed Reuse	Additional Lavon Watershed Reuse	New WMS- additional projected return flows in Lavon watershed above capacity of Wilson Creek WWTP
NTMWD	Additional East Fork Reuse	Additional East Fork Reuse	New WMS that uses additional available return flows from TRA Central contract. Assumes that NTMWD will divert and treat these flows with an expanded Main Stem Pump Station and new or expanded treatment wetland
NTMWD/Frisco	Collin County Direct Reuse, Expanded	Collin County Direct Reuse, Expanded	Revised quantities based on updated information provided by City of Frisco
TRA	Alliance Corridor Direct Reuse	Alliance Corridor Direct Reuse	Revised quantities based on information provided by Town of Flower Mound
TRA	Joe Pool Lake Indirect Reuse	Joe Pool Lake Indirect Reuse	Revised quantities based on updated return flow information.
TRWD	Trinity River Indirect Reuse - Cedar Creek	Trinity River Indirect Reuse- Cedar Creek	Revised quantities based on updated return flow information and additional reuse water purchased by TRWD from TRA

Sponsor	WMS/Project Name	WMS	Change from 2016 Plan
TRWD	TRA Central to TRWD	TRA Central to TRWD	New WMS- includes additional reuse water purchased by TRWD from TRA
UTRWD	Indirect Reuse of Lake Ralph Hall Water	Indirect Reuse of Lake Ralph Hall Water	Modified to begin in 2030 and based on updated return flow projections
UTRWD	Indirect Reuse of Sulphur River Basin Supplies	Indirect Reuse of Sulphur River Basin Supplies	New recommended WMS
Weatherford	Additional Lake Weatherford Indirect Reuse	Additional Lake Weatherford Indirect Reuse	New recommended WMS- includes additional supply that will be available with additional pumping capacity
TRWD, NTWMD, UTRWD	Marvin Nichols Reservoir, Wright Patman Flood Storage Reallocation	Sulphur Basin Supplies	Separated into two stand-alone strategies; changed elevation of Marvin Nichols from 313.5 to 328 msl; changed online date of Marvin Nichols to 2050; changed online date of Wright Patman to 2070
NTMWD, TRWD	Toledo Bend Phase I	Toledo Bend Phase I	Moved from recommended to alternative WMS
GTUA	GTUA Regional Water System	GTUA Regional Water System	Formerly named “Grayson County WSP” in 2016 Plan
Lake Kiowa SUD	GTUA Regional Water System	GTUA Regional Water System through Sherman	Strategy from 2016 Plan was Connect to Gainesville
Woodbine WSC	GTUA Regional Water System	GTUA Regional Water System through Sherman	Strategy from 2016 Plan was Connect to Gainesville
Runaway Bay	Treatment Plant & Infrastructure needed to treat and deliver	TRWD	Larger treatment plant (more expansions) and infrastructure to deliver because of new customer (Wise County Other)

Table 11.9: New and Removed WUGs Since the 2016 Plan

New WUGs	Removed WUGs
Arledge Ridge WSC	Annetta North
Avalon Water Supply and Sewer Service	Annetta South
B and B WSC	Argyle
B B S WSC	Aurora
B H P WSC	Bardwell
Becker Jiba WSC	Bartonville
Black Rock WSC	Blue Mound
Bois D Arc MUD	Bryson
Butler WSC	Combine
Callisburg WSC	Copper Canyon
Combine WSC	Cresson
Crescent Heights WSC	Cross Roads
Cross Timbers WSC	Double Oak
Delta County MUD	Ector
Desert WSC	Frost
Dogwood Estates Water	Garrett
Dorchester	Gun Barrel City
East Garrett WSC	Hickory Creek
Elmo WSC	Krugerville
Frognot WSC	Lake Dallas
Hilco United Services	Lakewood Village
Horseshoe Bend Water System	Lavon
Kaufman County Development District 1	Log Cabin
Kaufman County MUD 11	Lowry Crossing
Lake Cities MUA	Maypearl
Markout WSC	McLendon-Chisholm
Milligan WSC	Milford
Mustang SUD	New Fairview
Nevada WSC	New Hope
North Farmersville WSC	Oak Grove
North Kaufman WSC	Oak Leaf
North Rural WSC	Oak Point
Northwest Grayson County WCID 1	Oakwood
Oak Ridge South Gale WSC	Paloma Creek
Paloma Creek North CRU	Payne Springs
Paloma Creek South CRU	Pecan Hill
Pink Hill WSC	Post Oak Bend City
Pleasant Grove WSC	Rice
Poetry WSC	Savoy
Point Enterprise WSC	Scurry
Post Oak SUD	Seven Points
R C H WSC	Shady Shores
Red River Authority of Texas	St Paul
Santo SUD	Talty
South Ellis County WSC	Tool
South Freestone County WSC	Valley View
Starr WSC	Weston
Verona SUD	
West Leonard WSC	
Westminster WSC	
White Shed WSC	

New WUGs	Removed WUGs
Wolfe City	

Table 11.10: WUGs Renamed Since the 2016 Plan

2016 Region C Plan Name	2021 Region C Plan Name
Bethel-Ash WSC	Bethel Ash WSC
Brandon-Irene WSC	Brandon Irene WSC
Buena Vista - Bethel SUD	Buena Vista-Bethel SUD
De Soto	DeSoto
Denton County FWSD No. 10	Denton County FWSD 10
Denton County FWSD No. 1A	Denton County FWSD 1-A
Denton County FWSD No. 7	Denton County FWSD 7
Gastonia-Scurry SUD	Gastonia Scurry SUD
Kiowa Homeowners WSC	Lake Kiowa SUD
Lavon SUD	Bear Creek SUD
Luella WSC	Luella SUD
Mt Zion WSC	Mount Zion WSC
Nevada WSC	Nevada SUD
North Collin WSC	North Collin SUD
North Hunt WSC	North Hunt SUD
Rice WSC	Rice Water Supply and Sewer Service
Sardis-Lone Elm WSC	Sardis Lone Elm WSC
South Grayson WSC	South Grayson SUD

11.5 Chapter 11 List of References

(1) Freese and Nichols, Inc., Alan Plummer Associates, Inc., CP&Y, Inc., and Cooksey Communications, Inc.: *2016 Region C Water Plan, prepared for the Region C Water Planning Group*, Fort Worth, December 2015.

(2) Texas Water Development Board, *An Order Concerning the Interregional Conflict between the 2011 North Central Texas Regional Planning Area Regional Water Plan and the 2011 North East Texas Regional Planning Area Regional Water Plan in Accordance with Texas Water Code Section 16.053*, January 8, 2015.

(3) Freese and Nichols, Inc*. Sulphur River Basin: Socio-Economic Assessment.* Prepared for the Fort Worth U.S. Army Corps of Engineers, January 2014.